كليـــــــة الـطـب
والصيدلة - مراكش
FACULTÉ DE MÉDECINE
ET DE PHARMACIE - MARRAKECH

MARRAKECH
جامعة القاضي عياض
UNIVERSITÉ CADI AYYAD

Year 2024 Thesis N°194

The Effectiveness of Virtual Reality on Reducing Pain and Anxiety during Colonoscopy : A Randomized Controlled Trial

THESIS

PRESENTED AND DEFENDED PUBLICLY ON 10/06/2024

BY

Ms. Hafsa BELAMRABET

Born On 04th of January 1998 In Marrakesch

TO OBTAIN THE DEGREE OF DOCTOR OF MEDICINE

KEYWORDS

Virtual Reality – Colonoscopy – Anxiety – Pain – Comfort – Satisfaction – Unsedated colonoscopy

JURY

Mrs.	K.KRATI Professor of Gastroenterology	CHAIRWOMAN
Mr.	A.AIT ERRAMI Professor of Gastroenterology	SUPERVISOR
Mrs.	Z.SAMLANI Professor of Gastroenterology	JUDGES
Mrs.	S.OUBAHA Professor of Physiology	

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

قَالُوا۟ سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

صَدَقَ ٱللَّهُ ٱلْعَظِيمُ

Hippocratic Oath

I swear to fulfill, to the best of my ability and judgment, this covenant :
I will respect the hard-won scientific gains of those physicians in whose steps I walk, and gladly share such knowledge as is mine with those who are to follow.
I will apply, for the benefit of the sick, all measures [that] are required, avoiding those twin traps of overtreatment and therapeutic nihilism.
I will remember that there is art to medicine as well as science, and that warmth, sympathy, and understanding may outweigh the surgeon's knife or the chemist's drug.
I will not be ashamed to say "I know not," nor will I fail to call in my colleagues when the skills of another are needed for a patient's recovery.
I will respect the privacy of my patients, for their problems are not disclosed to me that the world may know. Most especially must I tread with care in matters of life and death. If it is given me to save a life, all thanks. But it may also be within my power to take a life ; this awesome responsibility must be faced with great humbleness and awareness of my own frailty. Above all, I must not play at God.
I will remember that I do not treat a fever chart, a cancerous growth, but a sick human being, whose illness may affect the person's family and economic stability. My responsibility includes these related problems, if I am to care adequately for the sick.
I will prevent disease whenever I can, for prevention is preferable to cure.
I will remember that I remain a member of society, with special obligations to all my fellow human beings, those sound of mind and body as well as the infirm.

LIST OF PROFESSORS

UNIVERSITE CADI AYYAD
FACULTE DE MEDECINE ET DE PHARMACIE
MARRAKECH

Doyens Honoraires : Pr. Badie Azzaman MEHADJI
: Pr. Abdelhaq ALAOUI YAZIDI

ADMINISTRATION

Doyen : Pr. Mohammed BOUSKRAOUI
Vice doyenne à la Recherche et la Coopératio : Pr. Hanane RAISS
Vice doyenne aux Affaires Pédagogiques : Pr. Ghizlane DRAISS
Vice doyen chargé de la Pharmacie : Pr. Said ZOUHAIR
Secrétaire Générale : Mr. Azzeddine EL HOUDAIGU

LISTE NOMINATIVE DU PERSONNEL ENSEIGNANTS CHERCHEURS PERMANANT

N°	Nom et Prénom	Cadre	Spécialité
01	BOUSKRAOUI Mohammed (Doyen)	P.E.S	Pédiatrie
02	CHOULLI Mohamed Khaled	P.E.S	Neuro pharmacologie
03	KHATOURI Ali	P.E.S	Cardiologie
04	NIAMANE Radouane	P.E.S	Rhumatologie
05	AIT BENALI Said	P.E.S	Neurochirurgie
06	KRATI Khadija	P.E.S	Gastro-entérologie
07	SOUMMANI Abderraouf	P.E.S	Gynécologie-obstétrique
08	RAJI Abdelaziz	P.E.S	Oto-rhino-laryngologie
09	KISSANI Najib	P.E.S	Neurologie
10	SARF Ismail	P.E.S	Urologie
11	MOUTAOUAKIL Abdeljalil	P.E.S	Ophtalmologie

12	AMAL Said	P.E.S	Dermatologie
13	ESSAADOUNI Lamiaa	P.E.S	Médecine interne
14	MANSOURI Nadia	P.E.S	Stomatologie et chirurgie maxillo faciale
15	MOUTAJ Redouane	P.E.S	Parasitologie
16	AMMAR Haddou	P.E.S	Oto-rhino-laryngologie
17	ZOUHAIR Said	P.E.S	Microbiologie
18	CHAKOUR Mohammed	P.E.S	Hématologie biologique
19	EL FEZZAZI Redouane	P.E.S	Chirurgie pédiatrique
20	YOUNOUS Said	P.E.S	Anesthésie-réanimation
21	BENELKHAIAT BENOMAR Ridouan	P.E.S	Chirurgie générale
22	ASMOUKI Hamid	P.E.S	Gynécologie-obstétrique
23	BOUMZEBRA Drissi	P.E.S	Chirurgie Cardio-vasculaire
24	CHELLAK Saliha	P.E.S	Biochimie-chimie
25	LOUZI Abdelouahed	P.E.S	Chirurgie-générale
26	AIT-SAB Imane	P.E.S	Pédiatrie
27	GHANNANE Houssine	P.E.S	Neurochirurgie
28	ABOULFALAH Abderrahim	P.E.S	Gynécologie-obstétrique
29	OULAD SAIAD Mohamed	P.E.S	Chirurgie pédiatrique
30	DAHAMI Zakaria	P.E.S	Urologie
31	EL HATTAOUI Mustapha	P.E.S	Cardiologie
32	ELFIKRI Abdelghani	P.E.S	Radiologie
33	KAMILI El Ouafi El Aouni	P.E.S	Chirurgie pédiatrique
34	MAOULAININE Fadl mrabih rabou	P.E.S	Pédiatrie (Néonatologie)

35	MATRANE Aboubakr	P.E.S	Médecine nucléaire
36	AIT AMEUR Mustapha	P.E.S	Hématologie biologique
37	AMINE Mohamed	P.E.S	Epidémiologie clinique
38	EL ADIB Ahmed Rhassane	P.E.S	Anesthésie-réanimation
39	ADMOU Brahim	P.E.S	Immunologie
40	CHERIF IDRISSI EL GANOUNI Najat	P.E.S	Radiologie
41	TASSI Noura	P.E.S	Maladies infectieuses
42	MANOUDI Fatiha	P.E.S	Psychiatrie
43	BOURROUS Monir	P.E.S	Pédiatrie
44	NEJMI Hicham	P.E.S	Anesthésie-réanimation
45	LAOUAD Inass	P.E.S	Néphrologie
46	EL HOUDZI Jamila	P.E.S	Pédiatrie
47	FOURAIJI Karima	P.E.S	Chirurgie pédiatrique
48	ARSALANE Lamiae	P.E.S	Microbiologie-virologie
49	BOUKHIRA Abderrahman	P.E.S	Biochimie-chimie
50	KHALLOUKI Mohammed	P.E.S	Anesthésie-réanimation
51	BSISS Mohammed Aziz	P.E.S	Biophysique
52	EL OMRANI Abdelhamid	P.E.S	Radiothérapie
53	SORAA Nabila	P.E.S	Microbiologie-virologie
54	KHOUCHANI Mouna	P.E.S	Radiothérapie
55	JALAL Hicham	P.E.S	Radiologie
56	OUALI IDRISSI Mariem	P.E.S	Radiologie
57	ZAHLANE Mouna	P.E.S	Médecine interne

58	BENJILALI Laila	P.E.S	Médecine interne
59	NARJIS Youssef	P.E.S	Chirurgie générale
60	RABBANI Khalid	P.E.S	Chirurgie générale
61	HAJJI Ibtissam	P.E.S	Ophtalmologie
62	EL ANSARI Nawal	P.E.S	Endocrinologie et maladies métabolique
63	ABOU EL HASSAN Taoufik	P.E.S	Anésthésie-réanimation
64	SAMLANI Zouhour	P.E.S	Gastro-entérologie
65	LAGHMARI Mehdi	P.E.S	Neurochirurgie
66	ABOUSSAIR Nisrine	P.E.S	Génétique
67	BENCHAMKHA Yassine	P.E.S	Chirurgie réparatrice et plastique
68	CHAFIK Rachid	P.E.S	Traumato-orthopédie
69	MADHAR Si Mohamed	P.E.S	Traumato-orthopédie
70	EL HAOURY Hanane	P.E.S	Traumato-orthopédie
71	ABKARI Imad	P.E.S	Traumato-orthopédie
72	EL BOUIHI Mohamed	P.E.S	Stomatologie et chirurgie maxillo faciale
73	LAKMICHI Mohamed Amine	P.E.S	Urologie
74	AGHOUTANE El Mouhtadi	P.E.S	Chirurgie pédiatrique
75	HOCAR Ouafa	P.E.S	Dermatologie
76	EL KARIMI Saloua	P.E.S	Cardiologie
77	EL BOUCHTI Imane	P.E.S	Rhumatologie
78	AMRO Lamyae	P.E.S	Pneumo-phtisiologie
79	ZYANI Mohammad	P.E.S	Médecine interne
80	GHOUNDALE Omar	P.E.S	Urologie

81	QACIF Hassan	P.E.S	Médecine interne
82	BEN DRISS Laila	P.E.S	Cardiologie
83	MOUFID Kamal	P.E.S	Urologie
84	QAMOUSS Youssef	P.E.S	Anésthésie réanimation
85	EL BARNI Rachid	P.E.S	Chirurgie générale
86	KRIET Mohamed	P.E.S	Ophtalmologie
87	BOUCHENTOUF Rachid	P.E.S	Pneumo-phtisiologie
88	ABOUCHADI Abdeljalil	P.E.S	Stomatologie et chirurgie maxillo faciale
89	BASRAOUI Dounia	P.E.S	Radiologie
90	RAIS Hanane	P.E.S	Anatomie Pathologique
91	BELKHOU Ahlam	P.E.S	Rhumatologie
92	ZAOUI Sanaa	P.E.S	Pharmacologie
93	MSOUGAR Yassine	P.E.S	Chirurgie thoracique
94	EL MGHARI TABIB Ghizlane	P.E.S	Endocrinologie et maladies métaboliques
95	DRAISS Ghizlane	P.E.S	Pédiatrie
96	EL IDRISSI SLITINE Nadia	P.E.S	Pédiatrie
97	RADA Noureddine	P.E.S	Pédiatrie
98	BOURRAHOUAT Aicha	P.E.S	Pédiatrie
99	MOUAFFAK Youssef	P.E.S	Anesthésie-réanimation
100	ZIADI Amra	P.E.S	Anesthésie-réanimation
101	ANIBA Khalid	P.E.S	Neurochirurgie
102	TAZI Mohamed Illias	P.E.S	Hématologie clinique
103	ROCHDI Youssef	P.E.S	Oto-rhino-laryngologie

104	FADILI Wafaa	P.E.S	Néphrologie
105	ADALI Imane	P.E.S	Psychiatrie
106	ZAHLANE Kawtar	P.E.S	Microbiologie- virologie
107	LOUHAB Nisrine	P.E.S	Neurologie
108	HAROU Karam	P.E.S	Gynécologie-obstétrique
109	BASSIR Ahlam	P.E.S	Gynécologie-obstétrique
110	BOUKHANNI Lahcen	P.E.S	Gynécologie-obstétrique
111	FAKHIR Bouchra	P.E.S	Gynécologie-obstétrique
112	BENHIMA Mohamed Amine	P.E.S	Traumatologie-orthopédie
113	HACHIMI Abdelhamid	P.E.S	Réanimation médicale
114	EL KHAYARI Mina	P.E.S	Réanimation médicale
115	AISSAOUI Younes	P.E.S	Anésthésie-réanimation
116	BAIZRI Hicham	P.E.S	Endocrinologie et maladies méta-boliques
117	ATMANE El Mehdi	P.E.S	Radiologie
118	EL AMRANI Moulay Driss	P.E.S	Anatomie
119	BELBARAKA Rhizlane	P.E.S	Oncologie médicale
120	ALJ Soumaya	P.E.S	Radiologie
121	OUBAHA Sofia	P.E.S	Physiologie
122	EL HAOUATI Rachid	P.E.S	Chirurgie Cardio-vasculaire
123	BENALI Abdeslam	P.E.S	Psychiatrie
124	MLIHA TOUATI Mohammed	P.E.S	Oto-rhino-laryngologie
125	MARGAD Omar	P.E.S	Traumatologie-orthopédie
126	KADDOURI Said	P.E.S	Médecine interne

127	ZEMRAOUI Nadir	P.E.S	Néphrologie
128	EL KHADER Ahmed	P.E.S	Chirurgie générale
129	LAKOUICHMI Mohammed	P.E.S	Stomatologie et chirurgie maxillo faciale
130	DAROUASSI Youssef	P.E.S	Oto-rhino-laryngologie
131	BENJELLOUN HARZIMI Amine	P.E.S	Pneumo-phtisiologie
132	FAKHRI Anass	P.E.S	Histologie-embyologie cytogénétique
133	SALAMA Tarik	P.E.S	Chirurgie pédiatrique
134	CHRAA Mohamed	P.E.S	Physiologie
135	ZARROUKI Youssef	P.E.S	Anesthésie-réanimation
136	AIT BATAHAR Salma	P.E.S	Pneumo-phtisiologie
137	ADARMOUCH Latifa	P.E.S	Médecine communautaire (médecine préventive, santé publique et hygiène)
138	BELBACHIR Anass	P.E.S	Anatomie pathologique
139	HAZMIRI Fatima Ezzahra	P.E.S	Histologie-embyologie cytogénétique
140	EL KAMOUNI Youssef	P.E.S	Microbiologie-virologie
141	SERGHINI Issam	P.E.S	Anesthésie-réanimation
142	EL MEZOUARI El Mostafa	P.E.S	Parasitologie mycologie
143	ABIR Badreddine	P.E.S	Stomatologie et chirurgie maxillo faciale
144	GHAZI Mirieme	P.E.S	Rhumatologie
145	ZIDANE Moulay Abdelfettah	P.E.S	Chirurgie thoracique
146	LAHKIM Mohammed	P.E.S	Chirurgie générale
147	MOUHSINE Abdelilah	P.E.S	Radiologie
148	TOURABI Khalid	P.E.S	Chirurgie réparatrice et plastique

149	BELHADJ Ayoub	Pr Ag	Anesthésie-réanimation
150	BOUZERDA Abdelmajid	Pr Ag	Cardiologie
151	ARABI Hafid	Pr Ag	Médecine physique et réadaptation fonctionnelle
152	ARSALANE Adil	Pr Ag	Chirurgie thoracique
153	NADER Youssef	Pr Ag	Traumatologie-orthopédie
154	SEDDIKI Rachid	Pr Ag	Anesthésie-réanimation
155	ABDELFETTAH Youness	Pr Ag	Rééducation et réhabilitation fonctionnelle
156	REBAHI Houssam	Pr Ag	Anesthésie-réanimation
157	BENNAOUI Fatiha	Pr Ag	Pédiatrie
158	ZOUIZRA Zahira	Pr Ag	Chirurgie Cardio-vasculaire
159	SEBBANI Majda	Pr Ag	Médecine Communautaire (Médecine préventive, santé publique et hygiene
160	ABDOU Abdessamad	Pr Ag	Chirurgie Cardio-vasculaire
161	HAMMOUNE Nabil	Pr Ag	Radiologie
162	ESSADI Ismail	Pr Ag	Oncologie médicale
163	MESSAOUDI Redouane	Pr Ag	Ophtalmologie
164	ALJALIL Abdelfattah	Pr Ag	Oto-rhino-laryngologie
165	LAFFINTI Mahmoud Amine	Pr Ag	Psychiatrie
166	RHARRASSI Issam	Pr Ag	Anatomie-patologique
167	ASSERRAJI Mohammed	Pr Ag	Néphrologie
168	JANAH Hicham	Pr Ag	Pneumo-phtisiologie
169	NASSIM SABAH Taoufik	Pr Ag	Chirurgie réparatrice et plastique
170	ELBAZ Meriem	Pr Ag	Pédiatrie

171	BELGHMAIDI Sarah	Pr Ag	Ophtalmologie
172	FENANE Hicham	Pr Ag	Chirurgie thoracique
173	GEBRATI Lhoucine	Pr Hab	Chimie
174	FDIL Naima	Pr Hab	Chimie de coordination bio-organique
175	LOQMAN Souad	Pr Hab	Microbiologie et toxicolgie environnementale
176	BAALLAL Hassan	Pr Ag	Neurochirurgie
177	BELFQUIH Hatim	Pr Ag	Neurochirurgie
178	MILOUDI Mouhcine	Pr Ag	Microbiologie-virologie
179	AKKA Rachid	Pr Ag	Gastro-entérologie
180	BABA Hicham	Pr Ag	Chirurgie générale
181	MAOUJOUD Omar	Pr Ag	Néphrologie
182	SIRBOU Rachid	Pr Ag	Médecine d'urgence et de catastrophe
183	EL FILALI Oualid	Pr Ag	Chirurgie Vasculaire périphérique
184	EL- AKHIRI Mohammed	Pr Ag	Oto-rhino-laryngologie
185	HAJJI Fouad	Pr Ag	Urologie
186	OUMERZOUK Jawad	Pr Ag	Neurologie
187	JALLAL Hamid	Pr Ag	Cardiologie
188	ZBITOU Mohamed Anas	Pr Ag	Cardiologie
189	RAISSI Abderrahim	Pr Ag	Hématologie clinique
190	BELLASRI Salah	Pr Ag	Radiologie
191	DAMI Abdallah	Pr Ag	Médecine Légale
192	AZIZ Zakaria	Pr Ag	Stomatologie et chirurgie maxillo faciale
193	ELOUARDI Youssef	Pr Ag	Anesthésie-réanimation

194	LAHLIMI Fatima Ezzahra	Pr Ag	Hématologie clinique
195	EL FAKIRI Karima	Pr Ag	Pédiatrie
196	NASSIH Houda	Pr Ag	Pédiatrie
197	LAHMINI Widad	Pr Ag	Pédiatrie
198	BENANTAR Lamia	Pr Ag	Neurochirurgie
199	EL FADLI Mohammed	Pr Ag	Oncologie mé0dicale
200	AIT ERRAMI Adil	Pr Ag	Gastro-entérologie
201	CHETTATI Mariam	Pr Ag	Néphrologie
202	SAYAGH Sanae	Pr Ag	Hématologie
203	BOUTAKIOUTE Badr	Pr Ag	Radiologie
204	CHAHBI Zakaria	Pr Ass	Maladies infectieuses
205	ACHKOUN Abdessalam	Pr Ass	Anatomie
206	DARFAOUI Mouna	Pr Ass	Radiothérapie
207	EL-QADIRY Rabiy	Pr Ass	Pédiatrie
208	ELJAMILI Mohammed	Pr Ass	Cardiologie
209	HAMRI Asma	Pr Ass	Chirurgie Générale
210	EL HAKKOUNI Awatif	Pr Ass	Parasitologie mycologie
211	ELATIQI Oumkeltoum	Pr Ass	Chirurgie réparatrice et plastique
212	BENZALIM Meriam	Pr Ass	Radiologie
213	ABOULMAKARIM Siham	Pr Ass	Biochimie
214	LAMRANI HANCHI Asmae	Pr Ass	Microbiologie-virologie
215	HAJHOUJI Farouk	Pr Ass	Neurochirurgie
216	EL KHASSOUI Amine	Pr Ass	Chirurgie pédiatrique

217	MEFTAH Azzelarab	Pr Ass	Endocrinologie et maladies métaboliques
218	DOUIREK Fouzia	Pr Ass	Anesthésie-réanimation
219	BELARBI Marouane	Pr Ass	Néphrologie
220	AMINE Abdellah	Pr Ass	Cardiologie
221	CHETOUI Abdelkhalek	Pr Ass	Cardiologie
222	WARDA Karima	Pr Ass	Microbiologie
223	EL AMIRI My Ahmed	Pr Ass	Chimie de Coordination bio-organnique
224	ROUKHSI Redouane	Pr Ass	Radiologie
225	EL GAMRANI Younes	Pr Ass	Gastro-entérologie
226	ARROB Adil	Pr Ass	Chirurgie réparatrice et plastique
227	SALLAHI Hicham	Pr Ass	Traumatologie-orthopédie
228	SBAAI Mohammed	Pr Ass	Parasitologie-mycologie
229	FASSI FIHRI Mohamed jawad	Pr Ass	Chirurgie générale
230	BENCHAFAI Ilias	Pr Ass	Oto-rhino-laryngologie
231	EL JADI Hamza	Pr Ass	Endocrinologie et maladies métaboliques
232	SLIOUI Badr	Pr Ass	Radiologie
233	AZAMI Mohamed Amine	Pr Ass	Anatomie pathologique
234	YAHYAOUI Hicham	Pr Ass	Hématologie
235	ABALLA Najoua	Pr Ass	Chirurgie pédiatrique
236	MOUGUI Ahmed	Pr Ass	Rhumatologie
237	SAHRAOUI Houssam Eddine	Pr Ass	Anesthésie-réanimation
238	AABBASSI Bouchra	Pr Ass	Pédopsychiatrie
239	SBAI Asma	Pr Ass	Informatique

240	HAZIME Raja	Pr Ass	Immunologie
241	CHEGGOUR Mouna	Pr Ass	Biochimie
242	RHEZALI Manal	Pr Ass	Anesthésie-réanimation
243	ZOUITA Btissam	Pr Ass	Radiologie
244	MOULINE Souhail	Pr Ass	Microbiologie-virologie
245	AZIZI Mounia	Pr Ass	Néphrologie
246	BENYASS Youssef	Pr Ass	Traumato-orthopédie
247	BOUHAMIDI Ahmed	Pr Ass	Dermatologie
248	YANISSE Siham	Pr Ass	Pharmacie galénique
249	DOULHOUSNE Hassan	Pr Ass	Radiologie
250	KHALLIKANE Said	Pr Ass	Anesthésie-réanimation
251	BENAMEUR Yassir	Pr Ass	Médecine nucléaire
252	ZIRAOUI Oualid	Pr Ass	Chimie thérapeutique
253	IDALENE Malika	Pr Ass	Maladies infectieuses
254	LACHHAB Zineb	Pr Ass	Pharmacognosie
255	ABOUDOURIB Maryem	Pr Ass	Dermatologie
256	AHBALA Tariq	Pr Ass	Chirurgie générale
257	LALAOUI Abdessamad	Pr Ass	Pédiatrie
258	ESSAFTI Meryem	Pr Ass	Anesthésie-réanimation
259	RACHIDI Hind	Pr Ass	Anatomie pathologique
260	FIKRI Oussama	Pr Ass	Pneumo-phtisiologie
261	EL HAMDAOUI Omar	Pr Ass	Toxicologie
262	EL HAJJAMI Ayoub	Pr Ass	Radiologie

263	BOUMEDIANE El Mehdi	Pr Ass	Traumato-orthopédie
264	RAFI Sana	Pr Ass	Endocrinologie et maladies méta-boliques
265	JEBRANE Ilham	Pr Ass	Pharmacologie
266	LAKHDAR Youssef	Pr Ass	Oto-rhino-laryngologie
267	LGHABI Majida	Pr Ass	Médecine du Travail
268	AIT LHAJ El Houssaine	Pr Ass	Ophtalmologie
269	RAMRAOUI Mohammed-Es-said	Pr Ass	Chirurgie générale
270	EL MOUHAFID Faisal	Pr Ass	Chirurgie générale
271	AHMANNA Hussein-choukri	Pr Ass	Radiologie
272	AIT M'BAREK Yassine	Pr Ass	Neurochirurgie
273	ELMASRIOUI Joumana	Pr Ass	Physiologie
274	FOURA Salma	Pr Ass	Chirurgie pédiatrique
275	LASRI Najat	Pr Ass	Hématologie clinique
276	BOUKTIB Youssef	Pr Ass	Radiologie
277	MOUROUTH Hanane	Pr Ass	Anesthésie-réanimation
278	BOUZID Fatima zahrae	Pr Ass	Génétique
279	MRHAR Soumia	Pr Ass	Pédiatrie
280	QUIDDI Wafa	Pr Ass	Hématologie
281	BEN HOUMICH Taoufik	Pr Ass	Microbiologie-virologie
282	FETOUI Imane	Pr Ass	Pédiatrie
283	FATH EL KHIR Yassine	Pr Ass	Traumato-orthopédie
284	NASSIRI Mohamed	Pr Ass	Traumato-orthopédie
285	AIT-DRISS Wiam	Pr Ass	Maladies infectieuses

286	AIT YAHYA Abdelkarim	Pr Ass	Cardiologie
287	DIANI Abdelwahed	Pr Ass	Radiologie
288	AIT BELAID Wafae	Pr Ass	Chirurgie générale
289	ZTATI Mohamed	Pr Ass	Cardiologie
290	HAMOUCHE Nabil	Pr Ass	Néphrologie
291	ELMARDOULI Mouhcine	Pr Ass	Chirurgie Cardio-vasculaire
292	BENNIS Lamiae	Pr Ass	Anesthésie-réanimation
293	BENDAOUD Layla	Pr Ass	Dermatologie
294	HABBAB Adil	Pr Ass	Chirurgie générale
295	CHATAR Achraf	Pr Ass	Urologie
296	OUMGHAR Nezha	Pr Ass	Biophysique
297	HOUMAID Hanane	Pr Ass	Gynécologie-obstétrique
298	YOUSFI Jaouad	Pr Ass	Gériatrie
299	NACIR Oussama	Pr Ass	Gastro-entérologie
300	BABACHEIKH Safia	Pr Ass	Gynécologie-obstétrique
301	ABDOURAFIQ Hasna	Pr Ass	Anatomie
302	TAMOUR Hicham	Pr Ass	Anatomie
303	IRAQI HOUSSAINI Kawtar	Pr Ass	Gynécologie-obstétrique
304	EL FAHIRI Fatima Zahrae	Pr Ass	Psychiatrie
305	BOUKIND Samira	Pr Ass	Anatomie
306	LOUKHNATI Mehdi	Pr Ass	Hématologie clinique
307	ZAHROU Farid	Pr Ass	Neurochirugie
308	MAAROUFI Fathillah Elkarim	Pr Ass	Chirurgie générale

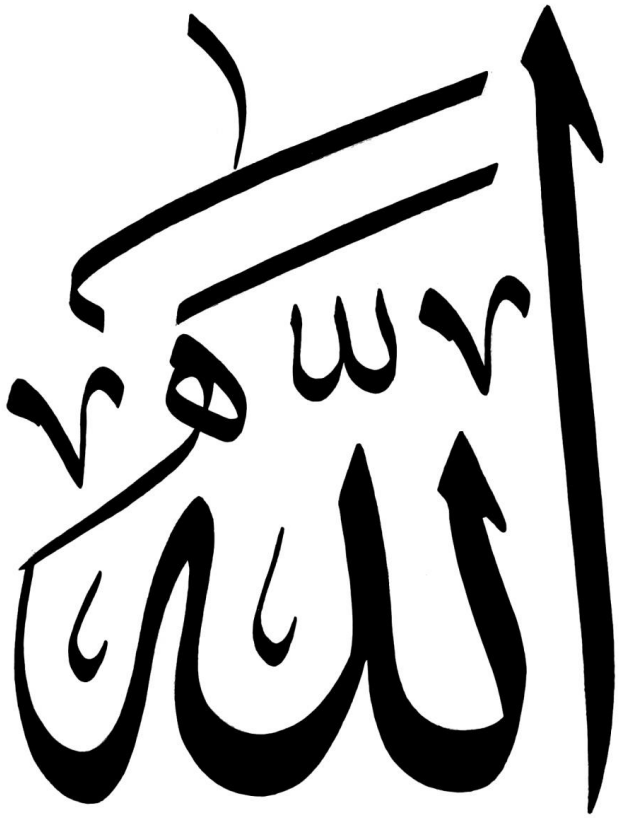
309	EL MOUSSAOUI Soufiane	Pr Ass	Pédiatrie
310	BARKICHE Samir	Pr Ass	Radiothérapie
311	ABI EL AALA Khalid	Pr Ass	Pédiatrie
312	AFANI Leila	Pr Ass	Oncologie médicale
313	EL MOULOUA Ahmed	Pr Ass	Chirurgie pédiatrique
314	LAGRINE Mariam	Pr Ass	Pédiatrie
315	OULGHOUL Omar	Pr Ass	Oto-rhino-laryngologie
316	AMOCH Abdelaziz	Pr Ass	Urologie
317	ZAHLAN Safaa	Pr Ass	Neurologie
318	EL MAHFOUDI Aziz	Pr Ass	Gynécologie-obstétrique
319	CHEHBOUNI Mohamed	Pr Ass	Oto-rhino-laryngologie
320	LAIRANI Fatima ezzahra	Pr Ass	Gastro-entérologie
321	SAADI Khadija	Pr Ass	Pédiatrie
322	DAFIR Kenza	Pr Ass	Génétique
323	CHERKAOUI RHAZOUANI Oussama	Pr Ass	Neurologie
324	ABAINOU Lahoussaine	Pr Ass	Endocrinologie et maladies méta-boliques
325	BENCHANNA Rachid	Pr Ass	Pneumo-phtisiologie
326	TITOU Hicham	Pr Ass	Dermatologie
327	EL GHOUL Naoufal	Pr Ass	Traumato-orthopédie
328	BAHI Mohammed	Pr Ass	Anesthésie-réanimation
329	RAITEB Mohammed	Pr Ass	Maladies infectieuses
330	DREF Maria	Pr Ass	Anatomie pathologique
331	ENNACIRI Zainab	Pr Ass	Psychiatrie

332	BOUSSAIDANE Mohammed	Pr Ass	Traumato-orthopédie
333	JENDOUZI Omar	Pr Ass	Urologie
334	MANSOURI Maria	Pr Ass	Génétique
335	ERRIFAIY Hayate	Pr Ass	Anesthésie-réanimation
336	BOUKOUB Naila	Pr Ass	Anesthésie-réanimation
337	OUACHAOU Jamal	Pr Ass	Anesthésie-réanimation
338	EL FARGANI Rania	Pr Ass	Maladies infectieuses
339	IJIM Mohamed	Pr Ass	Pneumo-phtisiologie
340	AKANOUR Adil	Pr Ass	Psychiatrie
341	ELHANAFI Fatima Ezzohra	Pr Ass	Pédiatrie
342	MERBOUH Manal	Pr Ass	Anesthésie-réanimation
343	BOUROUMANE Mohamed Rida	Pr Ass	Anatomie
344	IJDDA Sara	Pr Ass	Endocrinologie et maladies métaboliques

LISTE ARRETEE LE 09/01/2024

DEDICATIONS

To everyone who supported me throughout this journey, to those who took my hand when the path became unclear, and to the good hearts and brilliant minds I have encountered I say, Thank you. I am grateful to have crossed your path.



.

First and foremost, I thank Allah Almighty for blessing me with the opportunity to be here today and for granting me the honor of influencing people's lives. I am grateful for His answered prayers and for His mercy throughout this hard and rocky journey. Alhamdulillah, now and forever.

To my Dear Mother
Fatima Alouane

Loving and tender mother, I am lacking words to express my love and appreciation for you, as no words would be enough to portray how much you mean to me.
I thank Allah for blessing me with you as my mom, for granting me an everlasting source of love and support.
I love how your face lights when you tell me stories about my childhood, I love the pride in your eyes when you talk about me, I love the healing words you bestow on my heart when life brings me down.
Sweet and wise mother, I will forever be grateful for all the lessons I learned from you. Through you I leanred how a good mother should be. From the little mother daughter moments we had when I was a child, showing me the beautiful details of the word, introducing me to flowers, leaves and blue skies.
This journey wouldn't have been the same without your support. The worries you hid behind the heartfelt prayers and the love you showed through unlimited care and unconditional love did not go unnoticed.
Mother, my window to the world, this work is dedicated to you, to the parts of you that secretly shaped some parts of me, to your beautiful soul.
Thank you for being my MOM.
I love you.

To my Dear Father
Abdelghani Belamrabet

To the good father, the good man, the good teacher. To every part of you that I cherish and appreciate.
I just want to say: thank you.
Thank you for being the best dad to me and the best example to follow in dedication and discipline. Thank you for giving me the world. Thank you for your kind heart and wise soul.
You always know what to say and do. You never lose heart and always have room for jokes, no matter how tough situations get.
The bond we have built through our long walks and talks about everything and anything goes way back to when I was a blank page. The memories of those good old days are the roots of who I am today.
I pray for a life as rich in adventure as yours, a heart as grateful as yours, and a spirit as free as yours.
Father, thank you for introducing me to car brands and soccer teams, for teaching me how to drive, and for encouraging me to handle my paperwork by myself. Thank you for introducing me to the real world in the gentlest way possible.
Thank you for sharing your knowledge of physics with me and giving me a glimpse into the great teacher you were to your students.
Thank you for being the greatest father Allah could have blessed me with.
Dad, if I am here today, it is because of you. Because of who you are and what you have provided for me. This work is dedicated to you and your love for medicine.
I Love you.

To my Dear Aunt ***Zahra Alouane*** *and uncle* ***Hassan***

Boumchammer

To my dear aunt, the everloving heart and unlimited source of prayers. Your beautiful heart and your joyful essence have the power to brighten even the darkest of rooms..
Thank you for all the love you bestowed on me through the years. You have always considered me as a daughter to you, you have always had my best interest at heart and for that I will forever be grateful.
Dear aunt, thank you for being present through every step of this journey, cheering on me and blessing me with the most geniune support.
Thank you for my favourite prayer 'May Allah give you the power of 10 men'.
I love you.
To my dear uncle Hassan, thank you for your prayers and your support. I highly appreciate your calm demeanous and your wise words. Thank you for being a good husband to my aunt and good father to our Sara.
Grateful for you.
This work is dedicated to you.

To my Dear soul-sister
Sara Boumchammer

Where do I start?
As kids, we were tied at the hips. As teenagers, we were partners in crime, and as adults, we've become telepathic. You always guess my next word and know how to read my mind; as we say, 'one brain split into two.' The memories of us playing with little books and magazines, taking turns playing computer games, going on crazy adventures, crafting doll costumes and laughing our hearts out all day everyday are the definition of my childhood.
I have always appreciated your sensitive heart and strong character, your wise mind and childlike spirit. You give love without limits and you never let go of a hand in need.You have been a wonderful sister to me, and I am sure you will be the best mom to little Hero. I can't wait to witness you beautifully blooming into this new version of yourself.
Childhood wouldn't have been the same without you; consequently, I wouldn't be the same, today, without you.
I am grateful to have you in my life and grateful to call you a sister that Allah have blessed me with.
Dear Sara, your unlimited support and unconditional love made this journey possible, so thank you. Thank you for the laughs, the adventures, the inside jokes, and for making life fun and keeping me young at heart. Thank you for taking my hand through life and guiding me through the paths you walked before me.
Beautiful and sweet Sara, I dedicate this work to you soul sister.
Love you, partner in crime.
I would also love to thank your husband ***Alaaddin Durlanik*** *for his genuine support and care. He might be new to the family, but he has already become a brother to me. I am grateful to have crossed your path, big brother. Thank you.*

To my ride or die
Asma Quiouch

Who would have thought that a highschool classmate will become family ?
I remember the first day we stepped foot in university. 2 highschool classemates reunited after summer vacation. I recall recognizing a familiar face among the chaos of a full amphitheater and feeling the security and ease of having someone to experience firsts with.
t all started with belly laughs in the cafeteria and study sessions in the library, only to grow deeper and deeper, morphing into a unique connection. A connection where heart, mind, and soul collide.
From amphitheaters to night shifts, to discovering hidden corners of the south together. From young students to confused adults, you have been present through the thick and thin, seen the good and broken parts of who I am. You gave me the courage to be more, to grow more. Through your friendship, I realized that love goes beyond perceived limits and that family has more than one definition.
Thank you for reshaping the bent parts of me, for loving me when I was hard to love, and for sticking around through the rough patches. I am grateful for this journey that led me to you, my friend.
I dedicate this work, of which you have been behind the scenes every step of the way, to you best friend..
To many more firsts together, to years of unconditional love, to decades of unlimited support. Excited to go through the upcoming chapter with you.
Love you, roomie.

To my friend
Youssef Ramzi

I have always known that you were a good person. There has always been an inexplicable goodness about you, but this past year has shown me that there is even more kindness in your heart, beyond what I used to perceive. Always calm and wise, with the biggest smile on your face.
I didn't think that moving to another city would gift me a lifelong friend.One who is respectful, who feels for others and gives without limits.
Thank you for all your help and support, thank you for making the journey as easy as it can be, and thank you for handling even the smallest of details with so much care.
Thank you for your guidance through the making of this thesis.
This work is dedicated to you, brother.

To all my friends old friends that have blessed me with their support every step of the way.

This work is dedicated to you.
Thank you for everything.

To the good souls that I had the honor to meet in my journey through FMPM : ***Chaima, Nouhaila, Imane, Youssra, Hamza, Salma bellakziz, Wissal, Amal, Nouama, Houda,Tarik, Samia, Kaoutar zakzi, Kaoutar El fehmi, Noureddine, salma ahadri, Hajar outcoumit*** *and everyone I forgot to mention*
This work is dedicated to you,
Thank you for making the journey fun and easy.

To all my beloved family and friends who have blessed me with their unwavering love and support,
To all my professors from university who generously shared their knowledge with us,
To all my professors throughout my academic journey, especially those who believed in me,
I wouldn't be here without you. Thank you.

ACKNOWLEDGMENTS

I would like to thank

To Professor K. KRATI,

Thesis Chairwoman

Head of the Gastroenterology Department – CHU MED VI

Thank you for granting me a great honor by accepting the presidency of this honorable committee. I thank you for your presence despite all your commitments. Please accept, though this work, the expression of my appreciation, gratitude and my deepest respect

Professor A. AIT ERRAMI,

Thesis Supervisor

Professor of Gastroenterology – CHU MED VI

My chief tutor, who welcomed me from the very first day and introduced me to this subject: I have always appreciated your humility and enthusiasm. I deeply value all the work you do for the gastroenterology department and the immense effort and passion you dedicate to research. Thank you for your guidance and advice, your unwavering enthusiasm, encouragement , and support whenever needed. You have made this work less stressful. Please accept this modest work as a sincere expression of my gratitude and deepest respect.

Professor Z. SAMLANI,

Thesis Jury member

Professor of Gastroenterology – CHU MED VI

Thank you for the great honor you bestow upon us by accepting to be part of this esteemed committee. Your willingness to contribute your time, expertise, and valuable insights is truly appreciated. Please accept my sincerest expression of high esteem, utmost consideration, and deep respect.

Professor S.OUBAHA,

Thesis Jury member

Professor of Gastroenterology – CHU MED VI

We are grateful for your presence and interest in our thesis topic. We hold you in high regard for your expertise, dedication, energy, and kindness. I have the best memories of your brilliant and invaluable teaching, as your classes were both enjoyable and highly enriching. I hope you will see my genuine gratitude and respectful admiration expressed in this humble work.

Special thanks to ***Professor Oussama Nacir,***

It was such an honor to follow the path you have already paved. Thank you for your support and guidance, for your availability, humility and generosity. I immensely appreciate your enthusiasm for science and teaching. Thank you for all the effort you put into making the gastroenterology department a good place for learning.

Special thanks to the staff of the gastroenterology unit of endoscopy.
I would like to express my gratitude to ***Dr. Haida, Dr. Rajih****,* ***Dr. Jarti****,* ***Dr. El Marmouk****, and* ***Dr. Azzam*** *for their warm welcome and guidance. I also deeply appreciate* ***Dr. Zouaki*** *for her immense help,availability and kindness.*

Thank you to everyone who contributed, even in the slightest, to the making of this work.

ABREVIATIONS

LIST OF ABBREVIATIONS

AE	: Adverse events
AA	: Anesthesia assisted
ASA	: American Society of Anesthesiologists
BBPS	: Boston Bowel Preparation Scale
CCD	: Charge-coupled device
CTO	: Chronic total occlusion
CRC	: Colorectal Cancer
CBPS	: Chicago Bowel Preparation Scale
ESGE	: European Society of Gastrointestinal Endoscopy
EP	: Emotional processing
GCS	: Gloucester Comfort Scale
GI	: Gastro-intestinal
HCS	: Harefield Cleansing Scale
NPS	: Net promoter score
NRS	: Numeric rating scale
OBPS	: Ottawa Bowel Preparation Scale
PEG	: Polyethylene glycol
STAI	: State-Trait Anxiety Inventory
STAI-S	: State-Trait Anxiety Inventory - State
STAI-T	: State-Trait Anxiety Inventory - Trait
VR	: Virtual Reality

LIST OF FIGURES

LIST OF FIGURES

`

LIST OF TABLES

IIST OF TABLES

OUTLINE

INTRODUCTION

Endoscopy stands as an essential and indispensable instrument within the arsenal of every gastroenterologist, and ensuring quality and safety remains a primary concern despite the complexity of the procedure.

Colonoscopy, for instance, stands as the gold standard screening tool due to its exceptional sensitivity and specificity. It provides a chance to identify and remove neoplasia and precancerous lesions throughout the entire large bowel, as well as the diagnosis and follow up of various colonic diseases.

Despite the significance of the procedure and the gravity of certain conditions affecting the large bowel (such as colorectal cancer), patients have trouble accepting colonoscopy, describing it to be stressful, painful, and uncomfortable.

Although sedatives and analgestic drugs have been largely used to alleviate pain and anxiety during the procedure, colonoscopy continues to be reported as an experience marked by high anxiety and discomfort. Some studies have indicated that around 50% of patients experience moderate to severe anxiety.

Anxiety-related areas of concern included aspects such as bowel preparation, procedural difficulties (embarrassment, pain, and potential complications), as well as apprehensions regarding diagnosis, including the fear of being diagnosed with cancer.[1]

The pain experienced during colonoscopy primarily stems from the stretching of the colonic wall and mesenteric attachments caused by looping of the instrument shaft, excessive insufflation, and the pressure exerted on the colonoscope shaft. However, it is also influenced by the individual's pain tolerance and closely linked to their inherent anxiety levels, both trait and state-related.[2] Studies have shown that the perception of pain can be significantly impacted by emotional states and where one's attention is focused. Various brain regions responsible for processing pain also play crucial roles in managing emotions and directing attention.[3]

Returning to the use of sedatives and anesthesia, it is worth noting that numerous side effects as well as a great resource consumption goes into it.

On one hand, studies have shown that anesthesia assistance is associated with higher risk of complications compared to unsedated colonoscopy[4] such as perforation, spleen injury, hemorrhage and anesthesia related adverse effects like: aspiration, prolonged apnea, dysrhythmia, myocardial infraction and even death. On the other hand, the use of sedatives

requires recovery rooms, monitoring instruments and more medical staff which increases the cost of colonoscopy and decreases the efficiency of endoscopy services [5]. Furthermore, the impact of sedation and analgesics on patients' quality of daily activities (trouble driving back home, nausea and vomiting, headache, dizziness) has been demonstrated to reduce adherence to screening colonoscopy. [6]

Recently, studies have emerged that assess the possibility of reducing sedation doses during colonoscopy or achieving high-quality colonoscopies without the need for sedation, aiming for less adverse effects, less resource consumption, good management of pain and anxiety and a better co-operation of the patient during the procedure when necessary.

Bearing everything in mind, it is safe to say that the most straightforward approach to addressing this issue is by targeting the psychological aspects of the intervention. Great efforts have been going into finding alternative, low cost, accepted pain and anxiety management methods, providing a good experience for the patient while ensuring quality and safety.

It's fascinating how various methods of distraction and cognitive engagement have been explored for their potential in pain management and emotional regulation. Meditation, music, visual distraction, and games [7], [8], [9], [10], [11] have long been recognized for their effectiveness in shifting focus and altering emotional states. With the advancements in technology, particularly virtual reality (VR), there's been a surge of interest in its potential therapeutic applications.

Numerous studies have proven its efficacy in alleviating procedural pain and anxiety across a spectrum of medical scenarios including wound dressing, burn injuries, chronic pain management, pediatric procedures (venipuncture, cast removal, dentistry), psychiatric disorders treatment, support for breast cancer patients, endoscopy, peri-operative anxiety, and the list goes on. [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26]

VR offers an immersive experience that can transport individuals to entirely different environments, effectively diverting attention away from pain or distressing stimuli. The interactive nature of VR can also engage multiple senses, further enhancing its effectiveness as a distraction tool.

Moreover, VR has the flexibility to be tailored to individual preferences and needs, making it a versatile option for pain management and emotional control.

Studies exploring the use of virtual reality (VR) in colonoscopy patients receiving minimal sedation have been documented, although in limited numbers. However, there is a significant lack of research focusing on unsedated patients, especially with no published literature from Morocco.

To address this gap, we conducted a randomized, controlled trial to examine the effects of VR on patients undergoing unsedated colonoscopy.

The aim of the study was to assess the impact of virtual reality on five key areas of investigation:

- Anxiety
- Pain
- Comfort
- Satisfaction and wiligness to undergo further colonosocopies
- Procedural characteristics

METHODS

I. Patients and Methods

The study was conducted as an experimental, randomized, controlled research to evaluate the effect of VR on reducing pain and anxiety in non-sedated patients undergoing outpatient colonoscopy. A control group was designed to allow evaluation of procedural and patient-related outcomes. The sample size was set at 30 subjects per group. The study was conducted in the Endoscopy unit - Department of Gastroenterology, CHU Mohammed 6 in Marrakech.

1. Eligibility Criteria

We screened patients who were already scheduled for outpatient colonoscopy. Inclusion criteria of the study were:

- Aged over 18 years old.
- Elective indication for colonoscopy

2. Exclusion Criteria

- Vision or hearing impairment
- Cognitive impairment
- Seizure disorders
- Psychiatric disorders
- Psychoactive medications
- Limited Arabic language skills
- Patients who did not undergo bowel preparation

3. Informed Consent

All participants were required to provide informed consent. Patients scheduled for a colonoscopy appointment in the endoscopy unit were briefed on the research. Consent for study participation as well as for data collection was obtained by physicians of the Gastroenterology Department.

Following the assessment of the above criteria and the acquisition of informed consent from each participant, they were assigned to either the VR (intervention) or non-VR (control) group.

II. Intervention

For the intervention in the VR group, we used the Samsung gear VR headset: the VR. It is a three-dimensional VR headset, priced at 800 dh, compact in size and weighing a total of 345g. The headset provides distraction by projecting video into two independent optical lenses with 101-degree field of view and advanced distortion correction to minimize motion sickness. It is secured on the head using elastic straps.

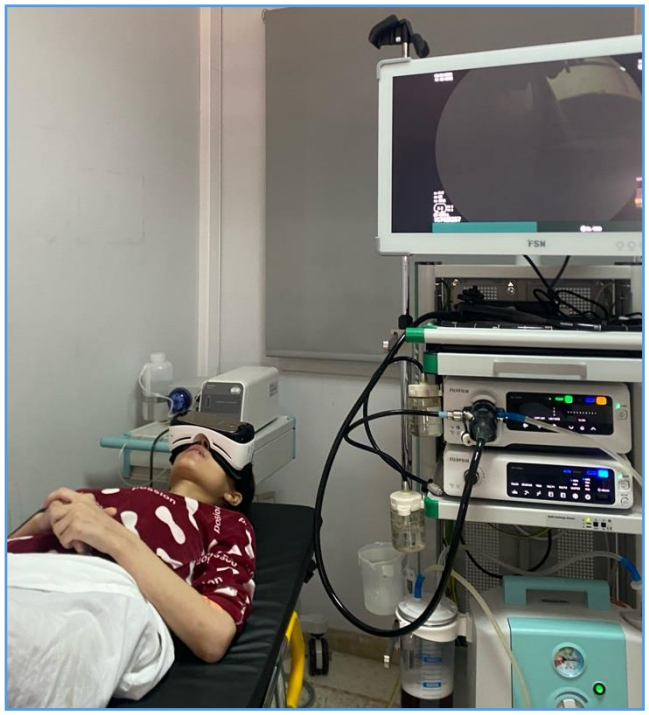


Figure 1 : Endoscopy unit - CHU MED VI. Patient wearing VR

Figure 2 : patient wearing VR headset.

We used a combination of video and audio on very low volume to allow proper communication with the patient while creating an immersing ambiance.

For the video content, we aimed for videos of a calming and moderately engaging nature. Therefore, we chose a series of relaxing nature videos. **(Annex 1)**

We chose relaxing piano melodies accompanied by natural sounds for the audio, aiming to calm the nervous system while ensuring the quality of communication with the patient remains undisturbed throughout the procedure.

III. Study Design

The study was conducted in **4 phases**:

- **T1**: Patients who gave consent where handed a Baseline Characteristics form collecting information about demographics as well as clinical information, previous colonoscopies, previous experience with VR and colonoscopy indication.
- **T2**: Immediately prior to the procedure, patients were administered a validated questionnaire concerning anxiety states and traits (STAI – short form). The objective was to assess pre-procedural anxiety levels in both groups by selecting the expressions that most accurately depicted their current emotions
- **T3**: During the procedure, we monitored the overall well-being of the patients while recording procedural characteristics to confirm the success of the procedure, including caecal intubation, completion of the colonoscopy, and total procedural time.
- **T4**: After the procedure, patients were requested to rate their pain levels using a scale from 0 to 10 and to qualify their comfort based on a validated questionnaire. We also reassessed the patients' anxiety levels using the same validated score. Furthermore, we evaluated their satisfaction levels as well as their willingness to undergo further colonoscopies.

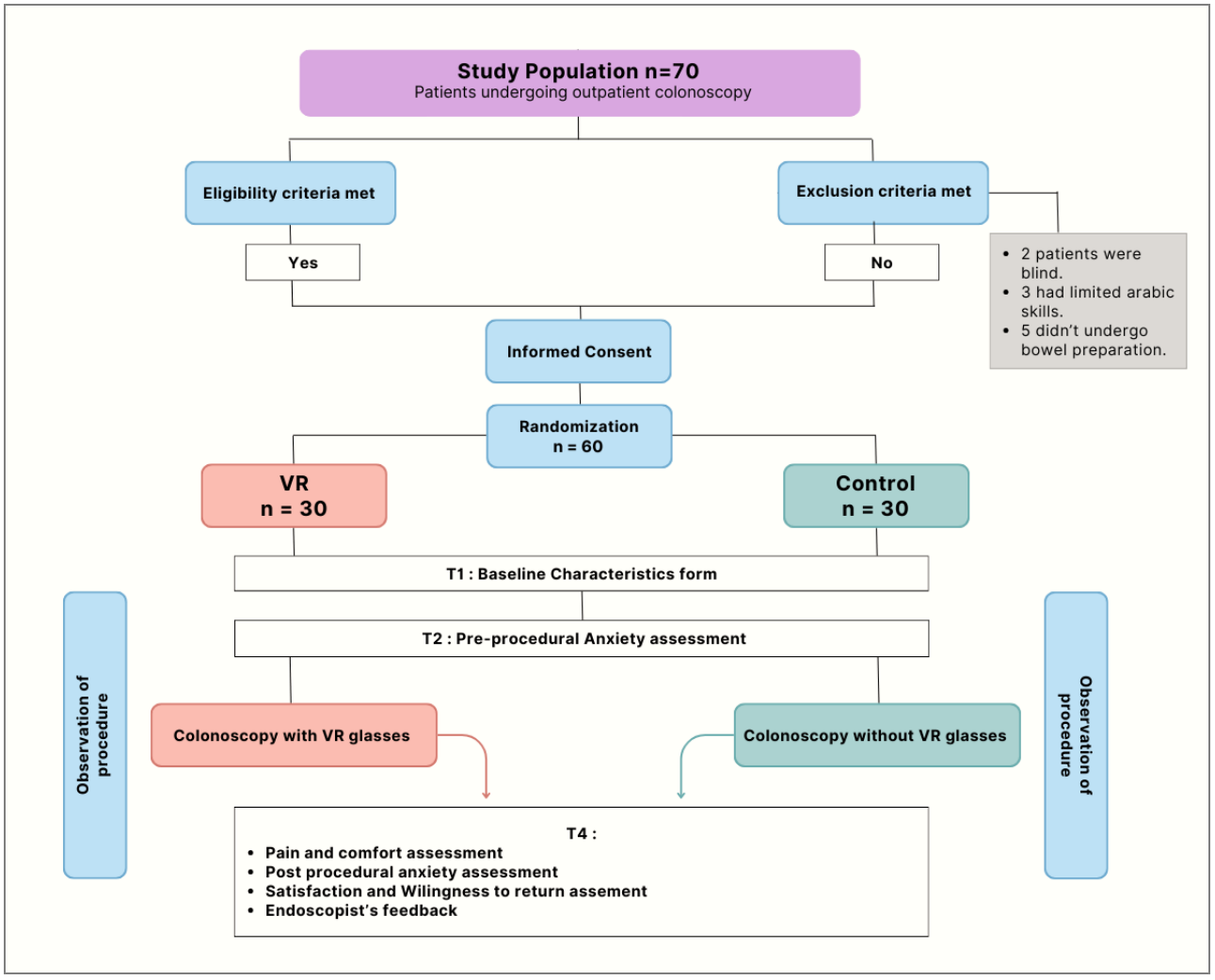


Figure 3 : study flowchart.

IV. Data collection tools

To collect data, we create a form based on similar studies consulted during the literature review **(Annex 2)** Initially created in English, the questionnaire was subsequently translated to Arabic, adapted to align with the Moroccan culture, aiming to mitigate potential information biases.

The Assessment Sheet started with an introductory presentation to the purpose of our study, and consisted of 5 data collecting tools:

1. Baseline Characteristics Form

We collected baseline characteristics of our patients including age, gender, level of education as well as their clinical information and previous experiences with colonoscopies and VR.

We also collected information about colonoscopy indication with a dedicated segment for the endoscopist to fill regarding the results of the procedure. Our aim from studying the characteristics of both groups, was making sure that they are statistically comparable.

2. The State-Trait Anxiety Inventory (STAI)

We used the STAI scale to evaluate state and trait anxiety levels perceived by the patients prior and after the procedure.

The STAI offers reliable and concise self-report assessments for both A-State and A-Trait. The STAI A-State scale comprises statements prompting individuals to express their current feelings. It evaluates the intensity of emotions such as tension, nervousness, worry, and apprehension. On the other hand, the STAI A-Trait scale asks respondents to indicate the frequency of experiencing particular anxiety symptoms on a four-point rating scale [27]

We chose a validated short version to help patients complete the form more easily and reduce response time to align with other arrangements of the procedure since it has narrowed the statements in both A-trait and A-state from 20 to 6 for the A- state and to 7 for A-trait. [28]

Before the colonoscopy, we evaluated the patient's trait and state anxiety, and subsequently reassessed their state anxiety after the procedure.

	Here's how you feel at the moment.	Not at all	Somewhat	Moderately so	Very much so
05	I feel at ease*	①	②	③	④
10	I feel comfortable*	①	②	③	④
15	I am relaxed*	①	②	③	④
16	I feel content*	①	②	③	④
19	I feel steady*	①	②	③	④
20	I feel pleasant*	①	②	③	④
	Here's how you feel often.	Not at all	Somewhat	Moderately so	Very much so
21	I feel pleasant*	①	②	③	④
23	I feel satisfied with myself*	①	②	③	④
26	I feel rested*	①	②	③	④
27	I am 'calm, cool and collected'*	①	②	③	④
30	I am happy*	①	②	③	④
33	I feel secure*	①	②	③	④
36	I am content*	①	②	③	④

Figure 4 : Short version of the State and Trait Anxiety Inventory. (28)

3. Numeric Rating Scale (NRS)

To assess pain, we chose the NRS for being practical and easier for the majority to comprehend [29]. Participants were required to rate pain perceived during the procedure on a scale from 0 et 10 ('no pain' to 'worst pain imaginable').

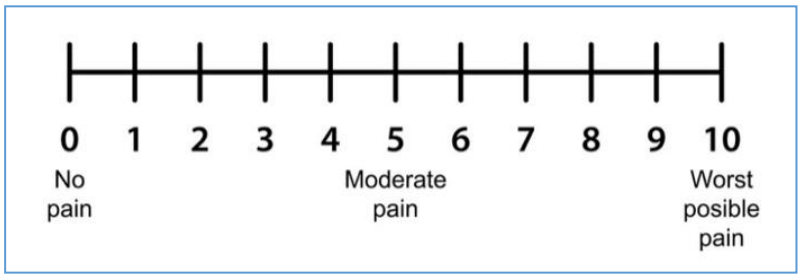


Figure 5 : Numeric Rating Scale (NRS)

4. Modified Gloucester Comfort Scale

Patients' comfort was evaluated based on the Modified GCS[30]. It is a 5 points Likert scale rating comfort from 1 being no discomfort to 5 being extreme discomfort.

Score	Scale	Description
1	No	No discomfort, talking/resting comfortably throughout
2	Minimal	One or two episodes of mild discomfort (without distress)
3	Mild	More than two episodes of mild discomfort (without distress)
4	Moderate	Significant discomfort experienced several times with some distress
5	Severe	Extreme discomfort frequently during the test

5. Net Promoter Score (NPS)

NPS is known for being a good complement to conventional patient-reported outcome measures by offering a comprehensive assessment of patient experiences[31].

Apart from employing two 4-point Likert scales to assess patient satisfaction and willingness to undergo future colonoscopies, we utilized the NPS to gain the most accurate understanding of participants' perceptions regarding the overall experience.

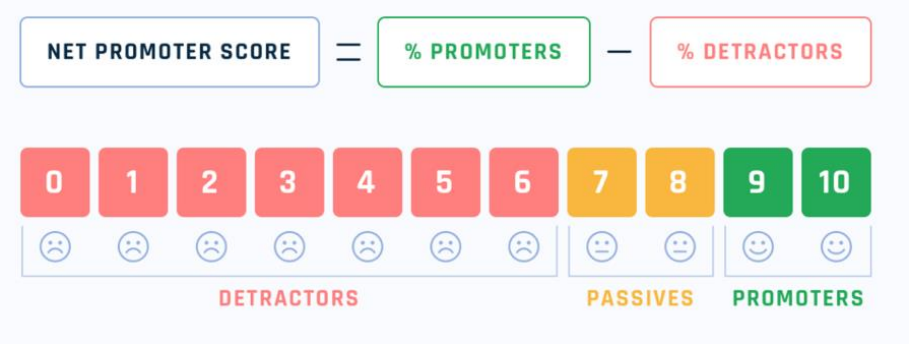


Figure 6: NPS Calculation - retently.com

V. Statistical data analysis

We used Microsoft Excel 2021 for the preparation of the database and for the elaboration of the graphs. The text entry was done on Microsoft Word 2021.

VI. Ethical considerations

To carry out the research, we obtained verbal and written consent from the participating patients, informing them about the study's details. Data collection adhered to global ethical standards concerning patient confidentiality and protection.

RESULTS

I. Demographic Data:

1. Age

The mean age of all patients was 50.68 years, ranging from 20 to 80 years old. There was no significant difference between the control group and the VR group in terms of age.

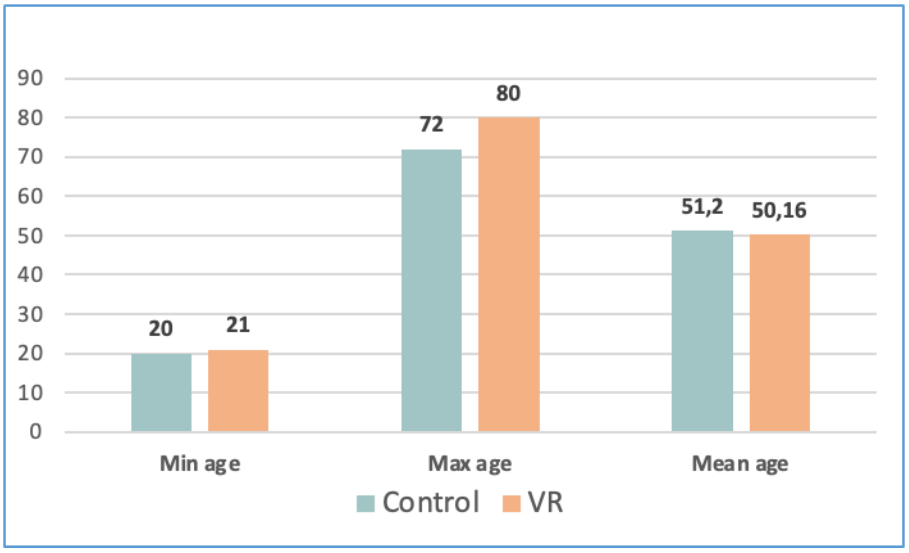


Figure 7 : Distribution of the studied population by age.

2. Gender

Analysis of distribution of our population based on gender shows a female-to-male ratio of 1.5:1. Both groups, control *(figure8)* and VR *(figure9)* were characterized by a female predominance with no signficant difference.

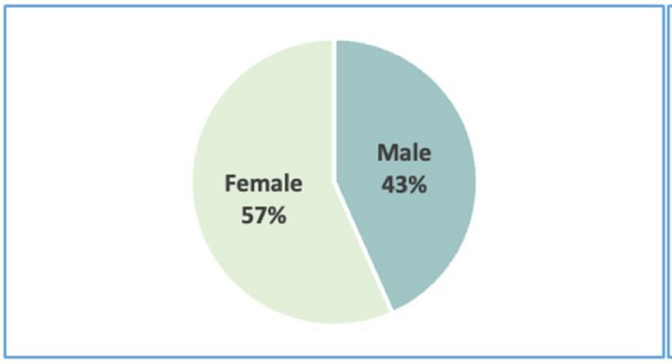


Figure 9 : Distribution by gender – Control group.

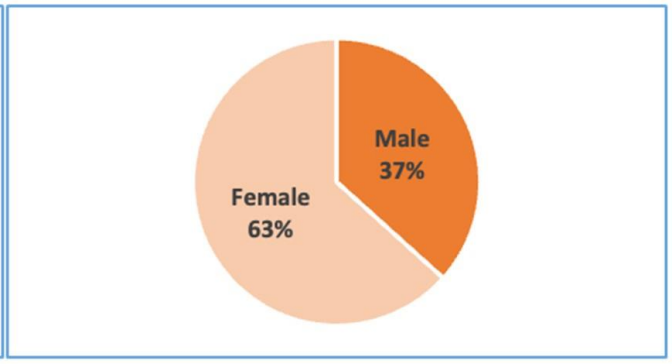


Figure 8 : Distribution by gender – VR group.

3. Level of education

A high prevalence of illiteracy was noted in both groups, with a total of 31 illeterate patients (52%). 22% (n=13) attended primary/secondary school, 15% (n=9) went to highschool and the remaining 12 % (n=7) received higher education. There was no significant difference in education levels between control and VR group according to the study of distribution.

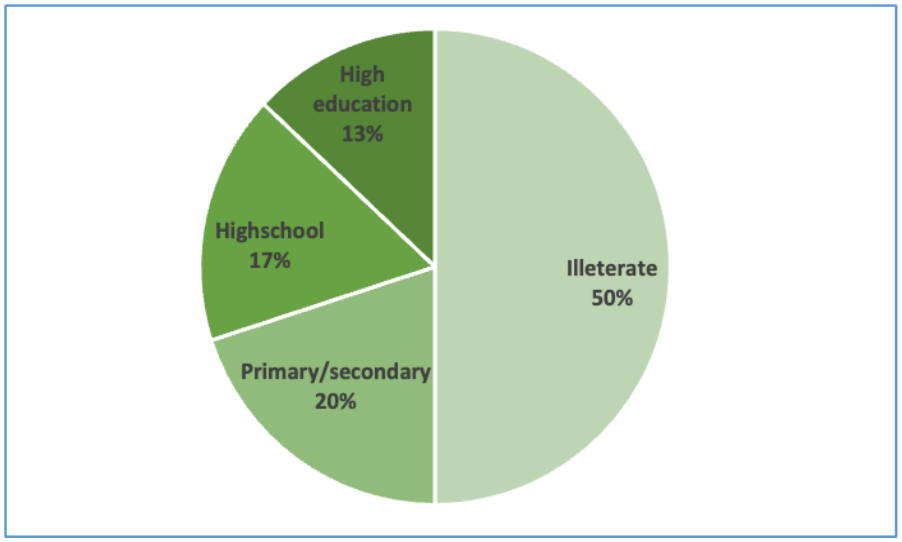


Figure 10 : distribution of patients by educational level – Control group.

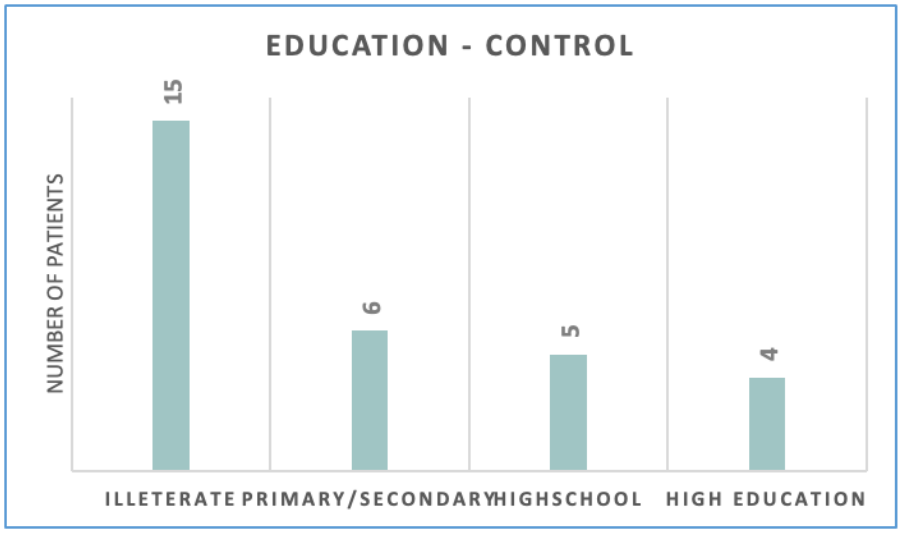


Figure 11 : distribution of educational levels among patients– Control group

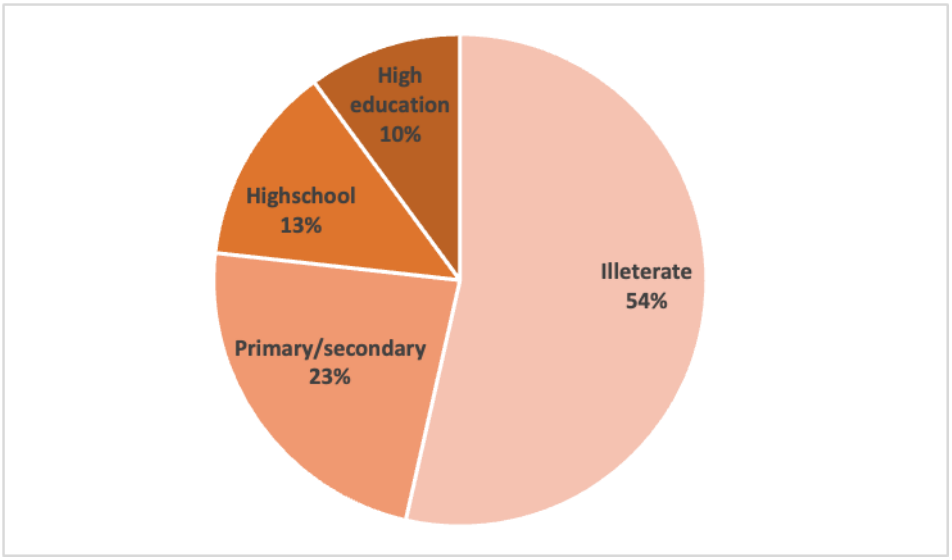


Figure 13 : Distribution by level of education – VR group.

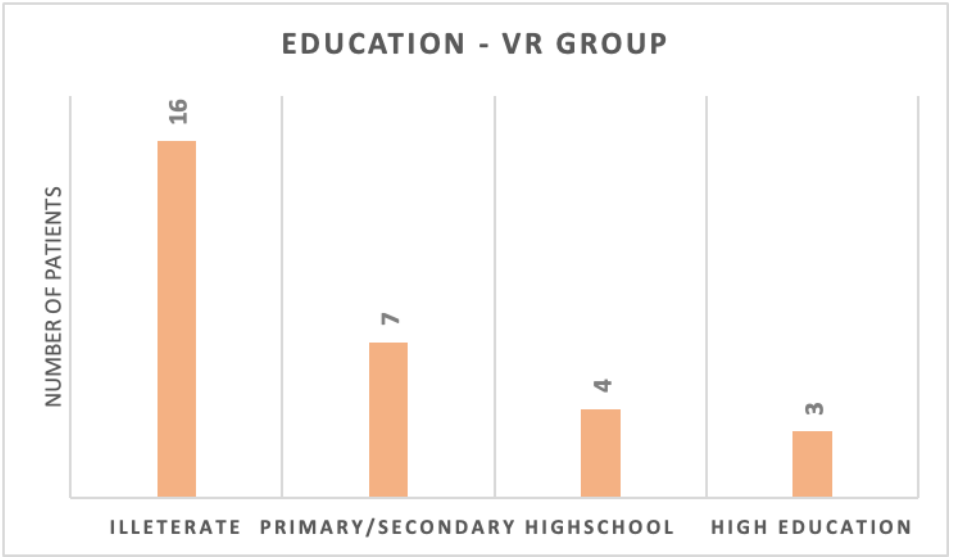


Figure 12 : Distribution of educational levels among patients – VR

4. Residency

Among our population, 60 % (n=36) were from urbain areas while 40% (n=24) lived in rural areas. No discernible difference was observed between the groups regarding residency, with 60% (n=17) from urbain areas in the control group versus 63% (n=19) in the VR group and 40% (n=13) of rural areas residents in the control group versus 37% (n=11) in the intervention group.

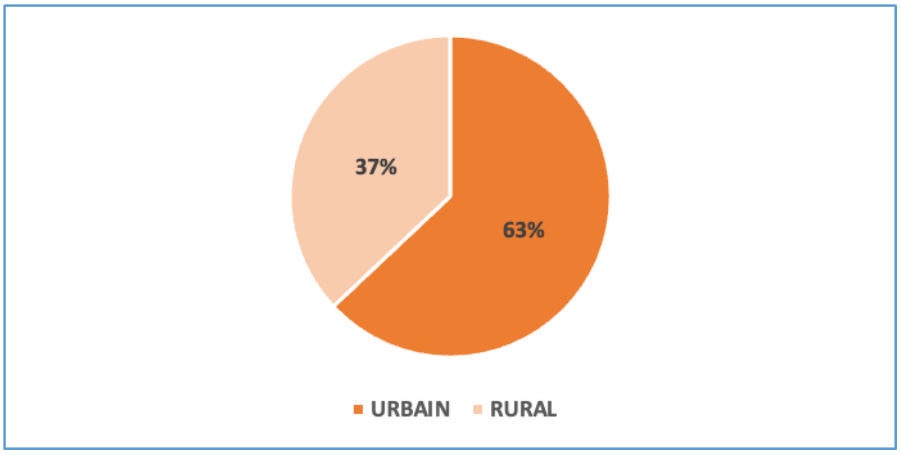


Figure 14 : Distribution of patients by residency – VR group.

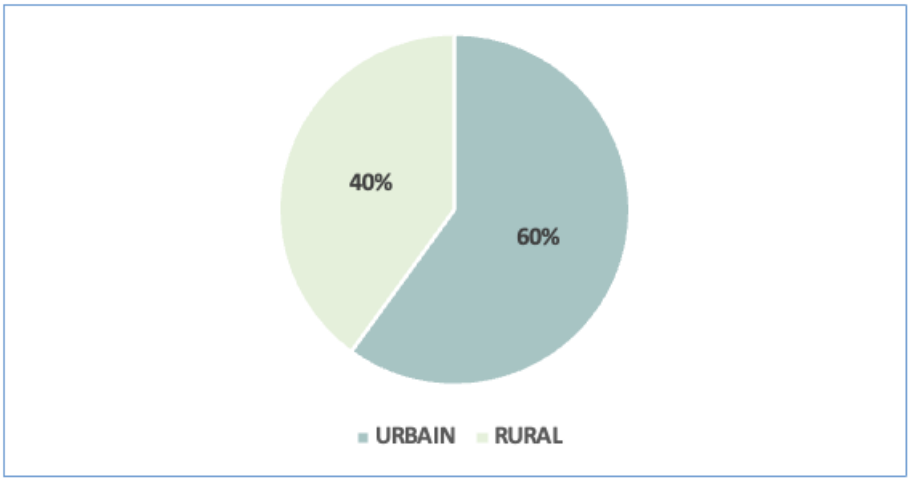


Figure 15 : distribution of patients by residency – Control group.

II. Medical Data:

1. Medical and surgical history

A medical history was reported by 67% (n= 40) of our studied population. In the control group, 70% (n=21) had a medical history, compared to 63% (n=19) in the intervention group. Once again, no substantial difference was observed between the two groups regarding their medical histories.

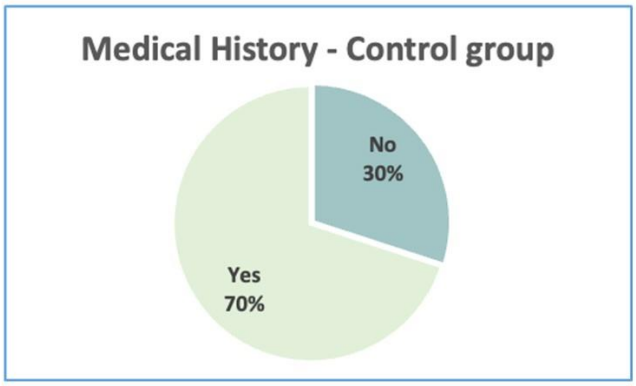


Figure 17 : distribution of control group patients by medical history presence.

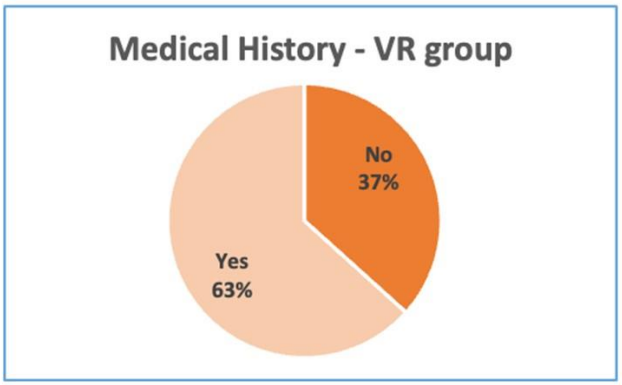


Figure 16 : distribution of VR group patients by medical history presence.

Listed below ***Table 1*** are the various medical conditions reported by both the control and intervention groups, along with the number of patients for each condition. Note that some patients had multiple conditions simultaneously.

Table 1 : Medical conditions reported by control group.

MEDICAL HISTORY – Control group	NUMBER OF PATIENTS
Diabetes	3
Hypertension	4
Cardiopathy	3
Nephropathy	0
Neoplasia	4
Hepatopathy	1
IBD	5
Proctology	2
Other*	2

Other* : one case of hypothyroidism and one case of ankylosing spondylitis.

The three cases of cardiopathy were ischemic cardiomyopathy. The four cases of neoplasia included one patient with rectal cancer, 2 patients with sigmoid cancer, and a case of cervical cancer under chemoradiotherapy. The one case of hepatopathy was cirrhosis. The IBD cases consisted of five patients with Crohn's disease. And lastly, 2 patients reported a history of hemorrhoids.

Table 2 : Medical conditions reported by VR group.

MEDICAL HISTORY – VR group	NUMBER OF PATIENTS
Diabetes	5
Hypertension	5
Cardiopathy	2
Nephropathy	1
Neoplasia	3
Hepatopathy	1
IBD	6
Proctology	3
Other*	3

Other* : Hypothyroidism – Sjogren's syndrome – Pleural tuberculosis.

In the VR group, our two cardiopathy conditions included ischemic cardiomyopathy and one undocumented case. The nephropathy case was urolithiasis. Three cases of neoplasia were recorded as 2 of sigmoid cancer and one of prostate cancer under radiotherapy, along with one case of cirrhosis, four cases of Crohn's disease and 2 cases of ulcerative colitis. Our three proctology cases were an anal fissure, complex perineal fistulas and a case of hemorrhoids.

Regarding **surgical history**, a total of 42% (n = 25) had undergone surgeries in both groups combined with a distribution of 37 % (n= 11) in control group and 47% (n= 14) in VR group. Most patients in both groups did not have a history of surgical procedures, with no significant difference between the groups.

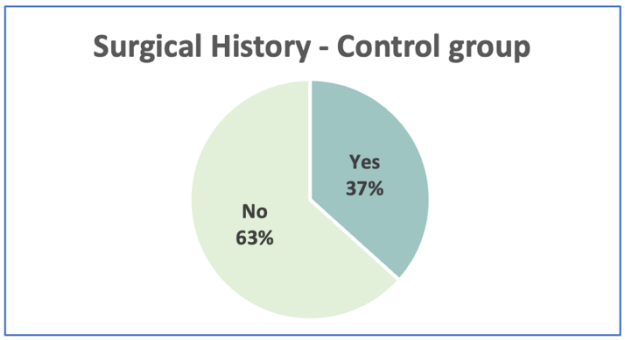


Figure 18 : distribution of control group patients by surgical history presence.

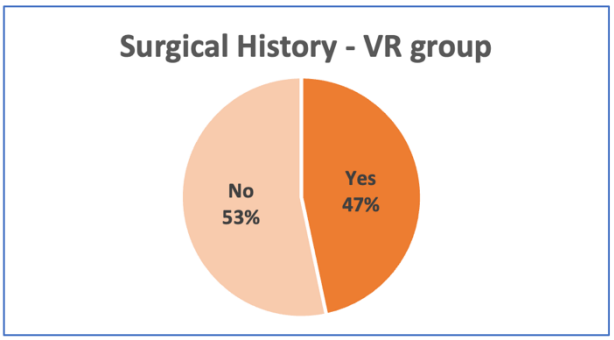


Figure 19 : distribution of VR group patients by surgical history presence.

Surgical procedures reported by patients are shown in the tables below :

Table 3 : Surgical procedures reported by control group.

SUREGICAL HISTORY – Control group	NUMBER OF PATIENTS
Colectomy	3
Cholecystecomy	4
Thyroidectomy	2
CABG	2

In the control group, three patients underwent colon surgeries consisting of one anus-preserving rectectomy and two sigmoidectomies.

Table 4 : surgical procedures reported by VR group.

SUREGICAL HISTORY – VR group	NUMBER OF PATIENTS
Cholecystectomy	6
Colectomy	3
Appendicectomy	1
Complexe perineal fistula	1
Thyroidectomy	1
Coronary stent	1
CABG	1

Meanwhile, in the VR group, one patient underwent a sigmoidectomy with cecectomy for intestinal stricture due to Crohn's disease, two patients had left hemicolectomies for sigmoid

cancer, and another patient had an appendectomy. Additionally, the patient with complex perineal fistulas underwent multiple surgeries (three) for recurrent fistulas.

2. Substance abuse

23% (n=14) of our patients had a history of smoking, 5% (n=3) had history of drinking, 2% (n=1) had a history of using cannabis while the remaining 70% (n=42) had no history of substance abuse. There was no significant difference regarding substance abuse between the 2 groups.

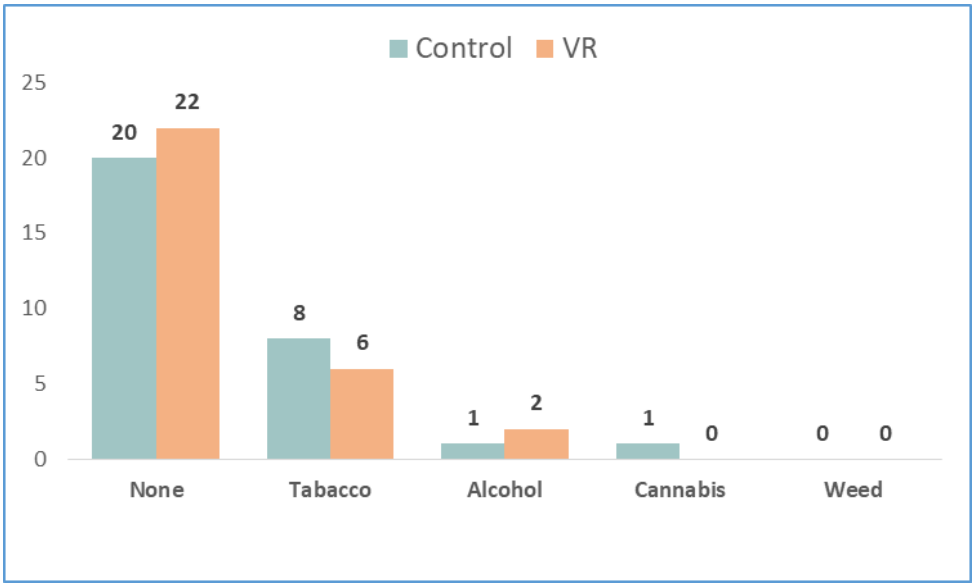


Figure 20 : distribution of substance use among patients in both groups.

3. Previous experience with colonoscopy and VR

In our studied population, 40% (n=24) had previously undergone colonoscopies. After studying the distribution in both groups, a predominance of patients who had never undergone colonoscopies was found, with 57% (n=17) in the control group and 63% (n=19) in the VR group . *(Figure 21)*

Regarding previous experience with VR, **only one patient** in the VR group reported having used it for entretaining purposes, leaving 59 patients in our population with no experience with VR.

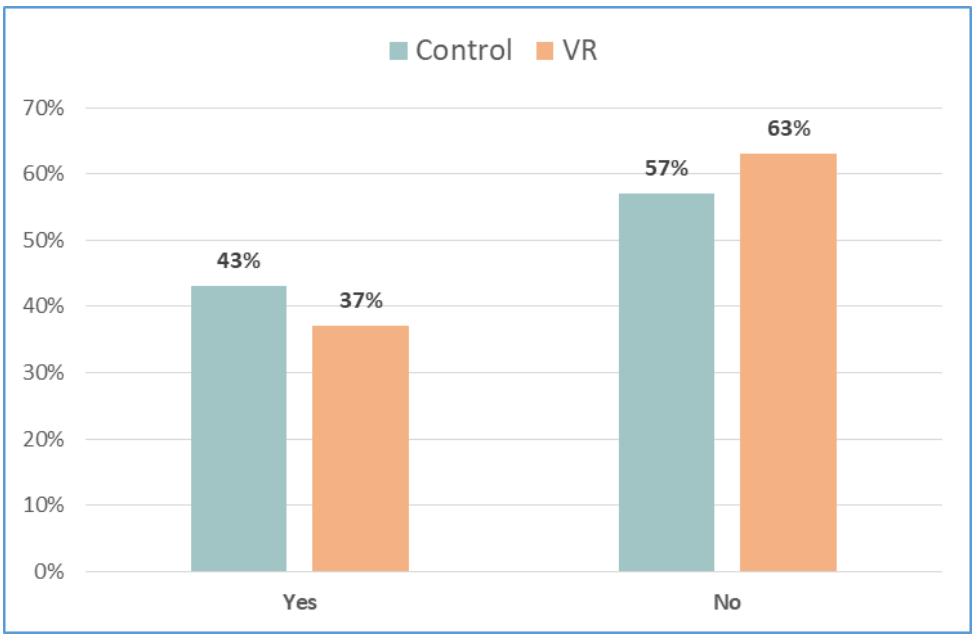


Figure 21 : distribution of studied population by previous colonoscopies.

4. Colonosocpy indications and results :

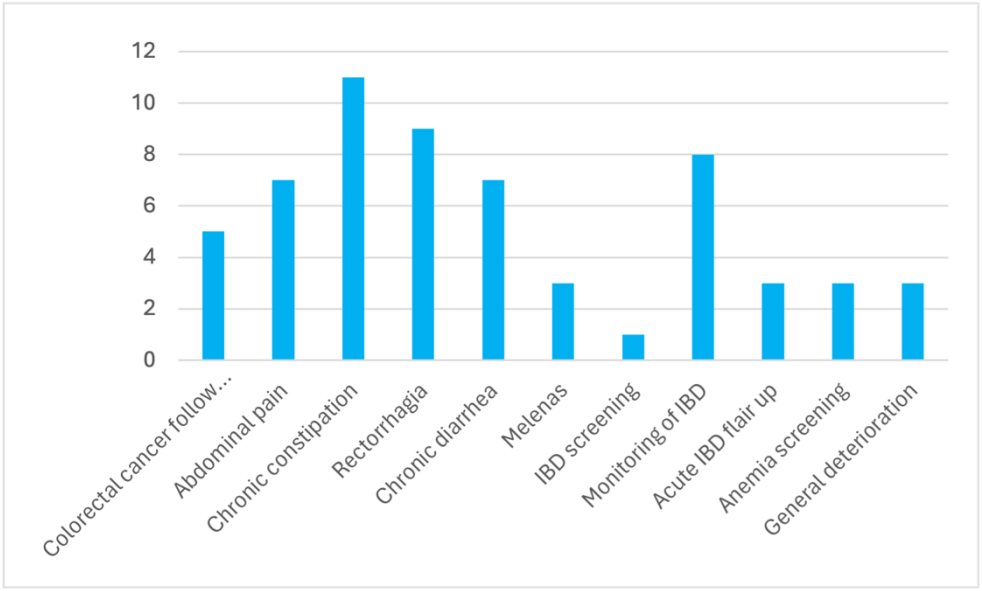


Figure 22 : Distribution of colonoscopy indications among the studied population.

As pictures in the graph above *(Figure 22),* the **most frequent indication** for colonoscopy in our studied population was **chronic constipation (18.3%, n=11**), followed by :

- Rectorrhagia 15%, (n=9)
- Monitoring of IBD 13.3% (n=8)
- Chronic diarrhea and abdominal pain each at 11.6% (n=7)
- CRC follow-up 8% (n=5)
- Melena, acute IBD flare-up, anemia screening, and general deterioration, each at 5% (n=3)
- IBD screening (2%, n=1)

Distribution of patients among each group by colonosocpy indication is shown in **Table 5.**

Table 5 : Distribution of colonoscopy indications among groups.

Colonoscopy Indication	CONTROL	VR
Colorectal cancer follow up	3	2
Abdominal pain	4	3
Chronic constipation	6	5
Rectorrhagia	4	5
Chronic diarrhea	3	4
Melenas	2	1
IBD screening	0	1
Monitoring of IBD	3	5
Acute IBD flair up	2	1
Anemia screening	2	1
General deterioration	1	2

No significant difference was seen between VR group and control group regarding indication distribution.

Regarding colonoscopy results, **most of our patients had a normal colonoscopy 57% (n=34).** The remaining results were as follows:

- 15% (n=9) showed signs of IBD
- 12% (n= 7) had angioplasia of the colon, with 2 being associated with radiation proctitis (cervical cancer and prostate cancer patients)
- 8% (n=5) had rectocolic tumors
- 7% (n=4) Rectocolic polyp
- 2% (n=1) had diverticulosis

These results may be attributed to the predominance of urgent colonoscopies in the endoscopy unit. Patients requiring immediate examination often undergo unsedated colonoscopy to avoid waiting for the sedation-assisted colonoscopy program, allowing for the prompt ruling out of emergent diagnoses.

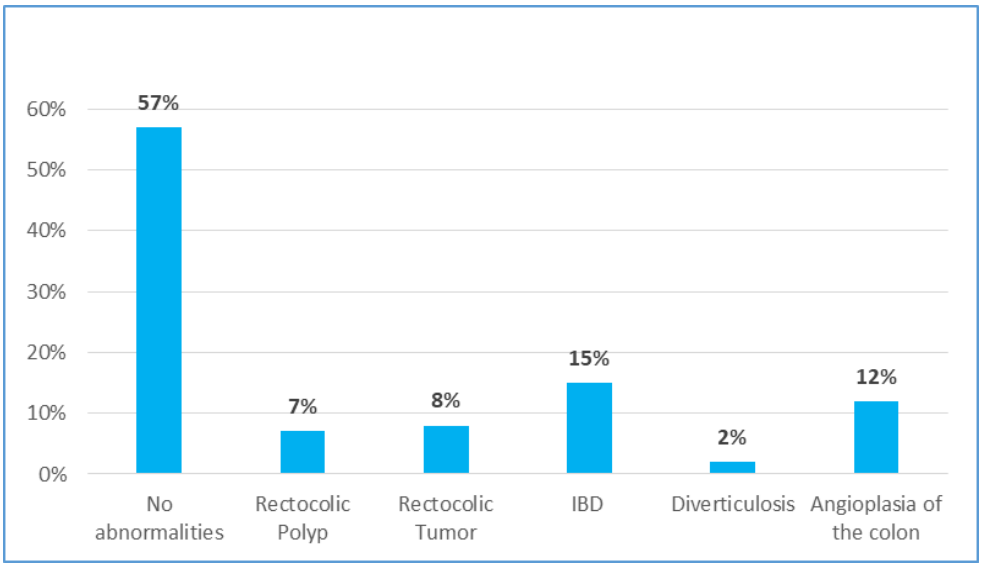


Figure 23 : distribution of colonoscopy results among the studied population.

No significant difference was found in terms of distribution between the control and intervention group, with a predominance of normal colonoscopies in both groups, as shown in the table below.

Table 6 : distribution of colonoscopy results by number of patients.

COLONOSCOPY RESULTS	CONTROL	VR
No abnormalities	16	18
Rectocolic Polyp	3	1
Rectocolic Tumor	3	2
IBD	4	5
Diverticulosis		1
Angioplasia of the colon	4	3

III. Procedure Characteristics:

Colonoscopies were performed by various specialized endoscopists (n=3) in the endoscopy unit of the gastroenterology department at CHU Med IV. Of these, 97% (n=58) were successfully completed. The time to reach the cecum and the total procedural time for each colonoscopy were recorded.

In the control group, 93% (n=28) of the colonoscopies were completed. The 2 uncompleted colonoscopies were due to poor bowel preparation. The mean time to reach the cecum was 24.48 minutes, and the mean time to complete the procedure was 35.17 minutes.

In the intervention group, 100% (n=30) of the colonoscopies were completed. The cecum was reached in a mean time of 20.87 minutes, and the procedure was completed in a mean time of 30.03 minutes.

Table 7 : Procedure characteristics

	Control group	VR group
Completed Colonoscopies %	93 (n=28)	100 (n=30)
Caecal Intubation in min	24.48 (10-35 min)	20.87 (10-33 min)
Total procedural time in min	35.17 (25-45 min)	30.03 (17-35)
Acceptance of VR %	-	100 (n=30)

IV. Preprocedural Anxiety Evaluation:

The mean anxiety trait (STAI-T) score and mean anxiety state (STAI-S) score were calculated for each group. In the control group, mean STAI-S and mean STAI-T were 17.33 and 14.53 , respectively. While in the VR group mean STAI-S was 17.4 and mean STAI-T was 14.36.

No significant difference was observed in mean anxiety score prior to the procedure as well as in mean baseline anxiety score (trait).

Table 8 : Pre-colonoscopy STAI-S and STAI-T for each group denoted as means.

	CONTROL	VR
PRE-COLONOSCOPY ANXIETY STATE	17.33	17.4
PRE-COLONOSCOPY ANXIETY TRAIT	14.53	14.36

V. Pain and comfort Evaluation:

Regarding comfort, most patients in both groups reported being 'mildly uncomfortable', 50% (n= 15) in the VR group versus 40% (n=12) in the control group. Followed by patients who reported being 'moderately uncomfortable' with 30% (n=9) in the VR group, compared to 33.3% (n=10) in the control group. Patients rarely reported being 'minimaly uncomfortable' in both groups with 6.6 % (n=2) in the intervention group and 3% (n=1) in the control group. Some difference was seen in patients who described the procedure as 'severely uncomfortable', with more patients in control group (23.3% n= 7) than in VR group (13.3% n=4).

Table 9 : Distribution level of comfort among the studied population.

	CONTROL	VR
No discomfort	0%	0%
Minimal	3%	6.6%
Mild	40%	50%
Moderate	33.3%	30%
Severe	23.3	13.3%

The mean comfort score was calculated for each group. The mean comfort score in the VR group was lower than in the control group. **Table 9**

Concerning pain, mean pain score was 4.53 in the VR group compared to 5.83 in the intervention group. Overall, patients in our studied population, regardless of the group, described the colonoscopy as painful, with better scores in the VR group.

Table 10 : comfort score and pain level for each group denoted as means

	CONTROL	VR
Comfort	3.76	3.43
Pain	5.83	4.53

VI. Post-procedural Anxiety Evaluation:

As mentioned before, only STAI-S was evaluated in this step of the study. Mean anxiety state in control group was 16.2 compared to 15.8 in the VR group.

Table 11 : Post colonoscopy STAI-S score for each group denoted as means

	CONTROL	VR
POST COLONOSCOPY STAI-S	16.2	15.8

Results indicated a difference between pre- and post-procedural anxiety (control group: 17.3 vs. 16.2; VR group: 17.4 vs. 15.8 respectively) within each group and between the VR and control groups

Table 12 : Anxiety, comfort and pain results.

	Control group (n=30)	VR group (n=30)
Anxiety*		
Anxiety TRAIT	14.53	14.36
Pre-procedural STATE	17.33	17.4
Post-procedural STATE	16.2	15.8
Gloucester comfort score*	3.76	3.43
Gloucester comfort scale % (n)		
Comfortable	0 (0)	0 (0)
Minimal	3 (1)	6.6 (2)
Mild	40 (12)	50 (15)
Moderate	33.3 (10)	30 (9)
Severe	23.3 (7)	13.3 (4)
Pain score*		
Before the procedure	0	0
During the procedure	5.83	4.53
*Variables are denoted as mean		

VII. Satisfaction and willingness to return assessment:

1. Satisfaction

The results indicate that the majority of the studied population, comprising 51% (n=31), were satisfied with the procedure. Additionally, 25% (n=15) expressed dissatisfaction, while 12% (n=7) reported being very satisfied, and an equal proportion of 12% (n=7) reported being very dissatisfied with the procedure.

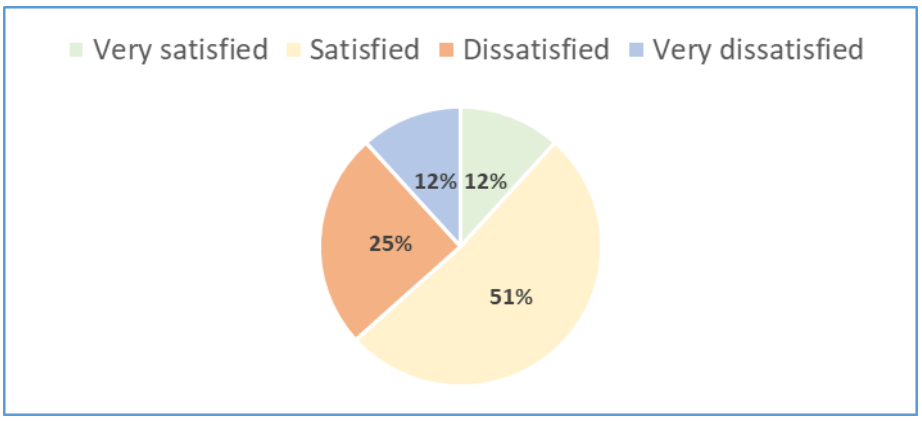


Figure 24 : satisfaction levels among the studied population – denoted in percentage.

Distribution of satisfaction levels among each group reveled that the majority of patients in both groups were satisfied with the procedure (Control group : 47% – VR group : 57%) with higher overall satisfaction (Satisfied + very satisfied) in the VR group : 74% versus 54% in the control group.

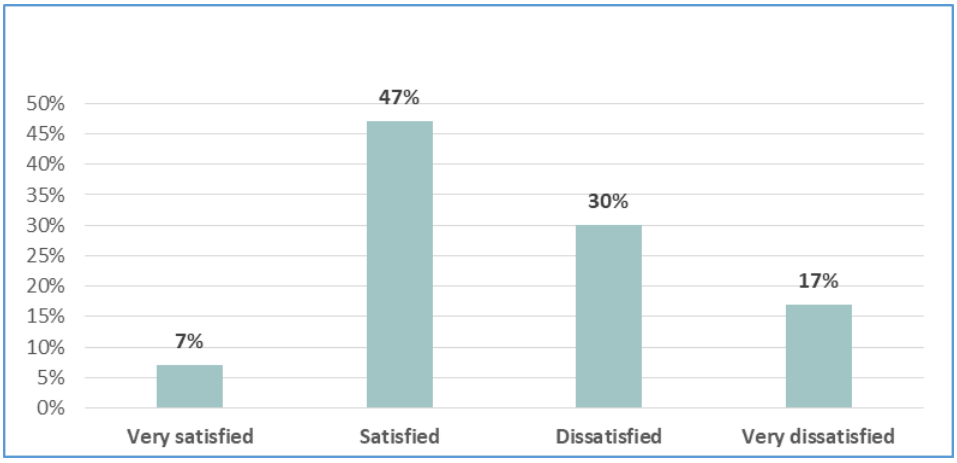


Figure 25 : Distribution of satisfaction levels among the control group.

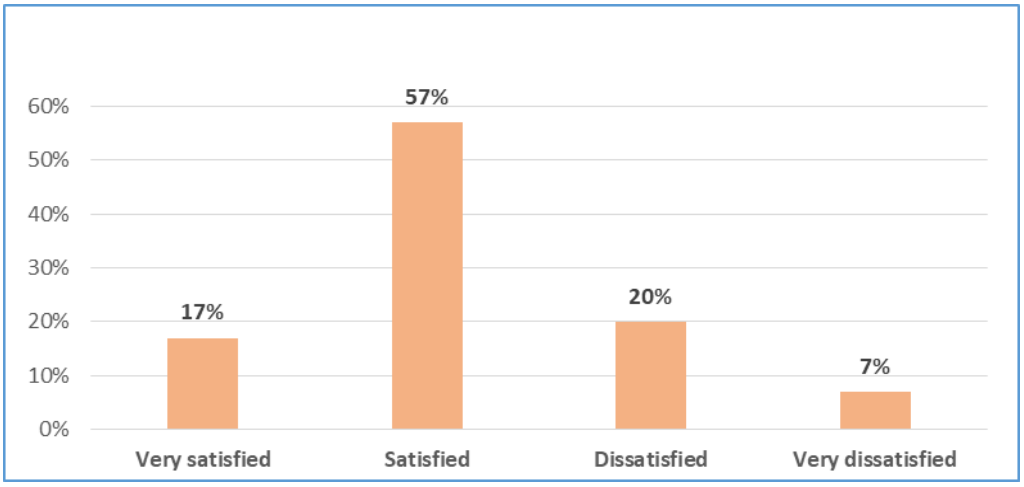


Figure 26 : Distribution of satisfaction levels among the VR group.

Promoter score was used in addition to the Linkert scale to assess patients' satisfaction.

Table 13 : Promoter score results.

	CONTROL	VR
Promoter Score	-16,66	-3,33

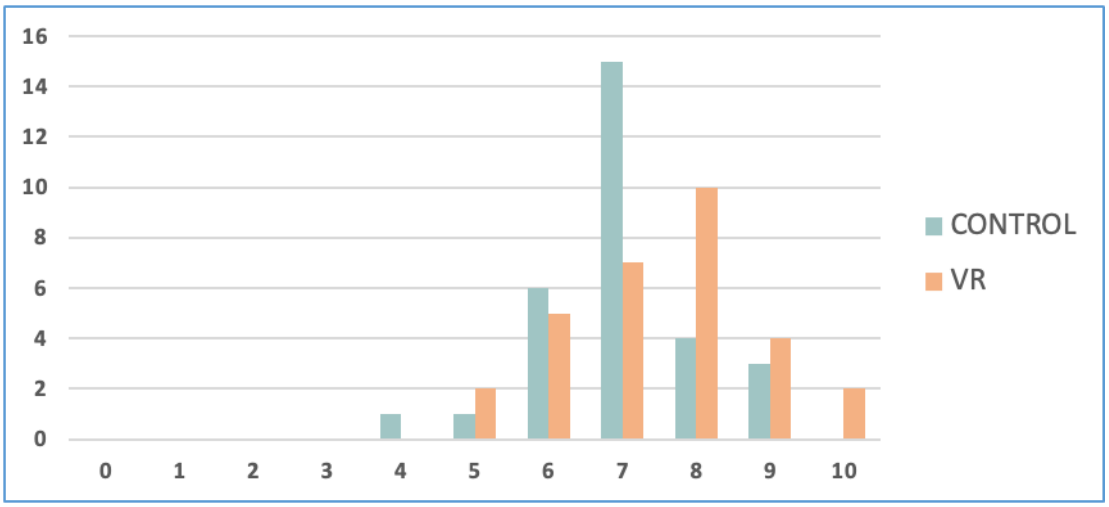


Figure 27 : distribution of promoter score ratings among each group.

The promoter score is negative for both groups, indicating that there are more detractors than promoters among the participants. In the VR group, the promoter score is -3.33, which is higher compared to the control group's score of -16.66. Although both groups have a negative score, the VR group has relatively fewer detractors and more promoters than the control group.

2. Willingness to return

The majority of patients in the studied population (60%, n=36) agreed with the statement, "I am willing to undergo further colonoscopies." Meanwhile, 26.6% (n=16) disagreed, and 8.3% (n=5) strongly disagreed with the statement. The least expressed response was "I strongly agree," with only 5% (n=3) of the patients selecting this option.

Table 14 : Willingness to return among the studied population.

WILLINGNESS TO RETURN	% in the studied population
Strongly agree	5% (n=3)
Agree	60% (n=36)
Disagree	26.6% (n=16)
Strongly disagree	8.3 (n=5)

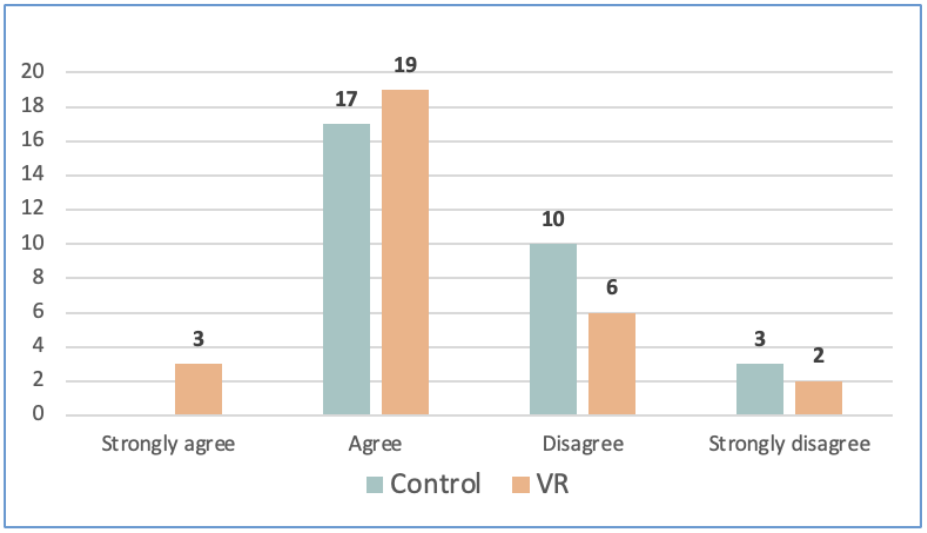


Figure 28 : Distribution of willingness to return statements by groups.

Distribution by groups *(figure 28)* revealed that most patients in both groups expressed agreement with the statement (control group: 56.6%, n=17; VR group: 63.33%, n=19). The 5% of patients who strongly agreed with the idea of returning for further colonoscopies were all in the VR group, representing 10% of its patients. No significant differences were observed in the distribution of other responses between the two groups.

Table 15 : Summary of satisfaction and willingness to return assessment results.

	Control group (n=30)	VR group (n=30)
Overall satisfaction % (n) 1*	54% (17)	74% (22)
Promoter score	-16.66	-3.33
Willingness to return		
I strongly agree % (n)		10 (5)
I agree % (n)	56.6 (17)	63.33 (19)
I disagree % (n)	33.3 (10)	20 (6)
I strongly disagree % (n)	10 (3)	6.6 (2)
Overall agreement to return % 2*	56.6	76.3

1* Was calculated by adding up percentage of patients who reported satisfied + very satisfied
2* Was calculated by adding up percentage of patients who reported I agree + I strongly agree

VIII. Endoscopists' Feedback:

Endoscopists in the VR group were asked to rate both their experience and comfort on a scale of 0 to 10.

All endoscopists (n=3) reported feeling comfortable incorporating VR into their practice, with a mean score of **8 (ranging from 7.5 to 9).** Additionally, they rated their experience with VR as good, with a mean score of **8.3 (ranging from 8 to 9).** Endoscopists commented that the procedure had a relaxing effect on them and they encountered no difficulties except when patients sometimes had to change positions.

DISCUSSION

PART I: Review of Literature

I. Colonoscopy:

1. Introduction

Colonoscopy has indeed revolutionized the field of gastrointestinal medicine since its inception in the late 1950s in Japan. Its ability to provide comprehensive visualization of the large intestine and distal terminal ileum has been instrumental in diagnosing and managing various gastrointestinal conditions.

One of the most significant contributions of colonoscopy is in the early detection and prevention of colorectal cancer (CRC). By allowing direct visualization of the colon and rectum, colonoscopy enables physicians to detect precancerous growths, such as polyps, and remove them before they have the chance to develop into cancer. This aspect of colonoscopy has led to its designation as the "gold standard" for CRC screening.

This procedure utilizes a handheld flexible instrument known as a colonoscope, featuring a high-definition camera positioned at its tip. The camera transmits visual data to a screen, aiding in the identification of abnormalities and assessing any thickening of the colonic wall. Consequently, this setup enables the evaluation, biopsy, and removal of mucosal lesions through various types of biopsy instruments.[34]

With such immense utility, colonoscopy offers the advantage of being not only diagnostic but also therapeutic. During the procedure, physicians can perform interventions such as polypectomy (removal of polyps) or dilatation of stenoses (narrowing of the intestinal lumen), thus addressing potential issues immediately and reducing the need for additional invasive procedures.

2. Colonoscope

The modern video colonoscope is a marvel of technology, blending cutting-edge electronic imaging and intricate mechanical design.

Encased within a watertight tube measuring 130–168 cm in length and only 9–13 mm in diameter, the modern video colonoscope houses delicate components such as glass illumination fibers, angulation cables, and suction and air/water channels. It must possess the strength to traverse the 1.8-meter-long colon, flexibility to navigate sharp bends, and elasticity to return to a straight configuration upon withdrawal.

Structured into distinct sections, the scope comprises a lengthy connector tube known as the "universal cord," linking the scope head to the light source, which also connects to the video processor, suction, and air/water supplies. The head of the instrument accommodates switches and valves operated by the endoscopist, regulating various scope functions.

The "insertion tube," a lengthy straight tube, is responsible for intubating the colon. Featuring a 10-cm bending section at its distal end, controlled by angulation wires and control wheels, it may include variable stiffness control if present.

The distal scope tip houses channel openings, an air-water nozzle for insufflation and lens cleaning, objective and light guide lenses, and a charge-coupled device (CCD) camera located just behind the objective lens. This camera electronically captures images, transmitting them through electrical wires to the video processor. *(Figure 37)*

The control section contains: the angulation dials and locks for up/down and right/left tip deflection, air-water and suction valves, and remote switches for photography, illumination light type, and zoom control.[36]

Figure 30 : Scope hung vertically after washing for drainage.

Figure 29 : Control head.

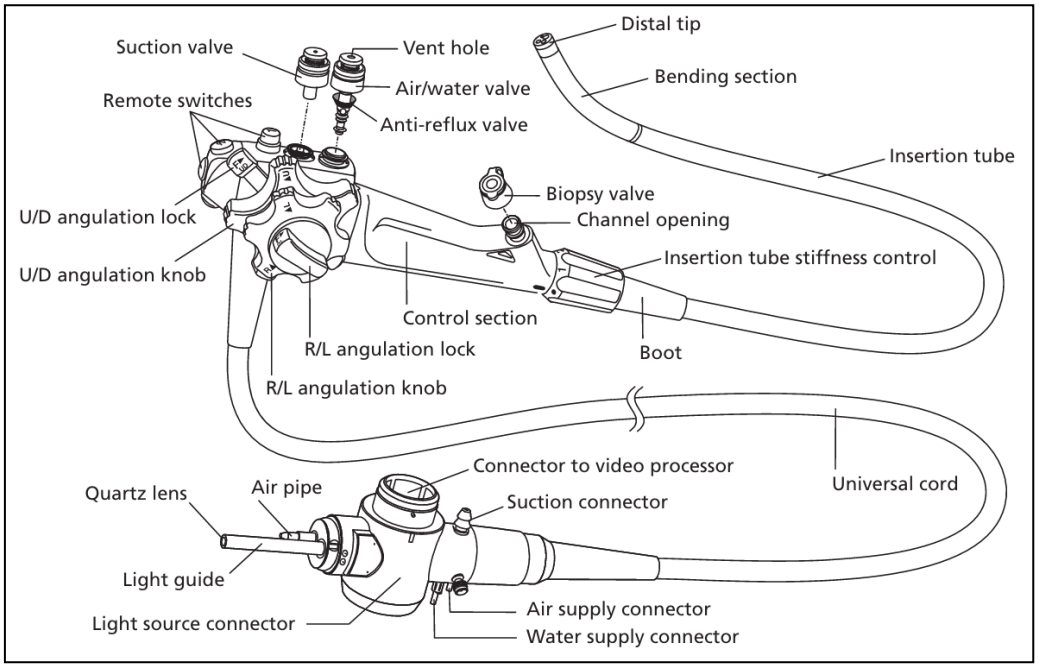


Figure 31 : The design and parts of a typical video colonoscope (36).

3. Indications and contraindications

Colonoscopy, being generally safe and offering both mucosal visualization and therapeutic procedures such as biopsy, resection, and cauterization, boasts numerous indications and few contraindications.[36]

a. Miscellaneous diagnostic indications

- Rectal bleeding (overt or occult)
- Iron-deficiency anemia.
- Chronic diarrhea
- New or worsening constipation
- Abnormality on CT scan, PET scan or barium enema
- Surveillance after removal of neoplasm
- Surveillance in chronic ulcerative or Crohn's colitis
- Unexplained abdominal/pelvic pain
- CRC screening
- Idiopathic colitis: determination of disease extent/ activity and/or response to therapy
- Intraoperative identification of a previously identified lesion not apparent at surgery

b. Miscellaneous therapeutic indications

- Removal of foreign body
- Excision of polyp
- Treatment of acute or chronic colonic bleeding
- Decompression of colonic pseudo-obstruction (Ogilvie syndrome)
- Decompression of volvulus
- Intramucosal injection of drug
- Dilation/stenting of symptomatic colonic stricture:
  - Benign
  - Malignant
- Marking (tattooing) site of lesion before surgical resection

c.Absolute contraindications to colonoscopy

- Toxic megacolon
- Fulminant colitis
- Free colonic perforation
- Patient refuses consent
- Patient cannot cooperate with the procedure.

d. Relative contraindications to colonoscopy

- Acute diverticulitis
- Inadequate colonic cleansing
- Recent myocardial infarction, pulmonary embolism, or clinical instability for any other cause
- Immediately post-colonic surgery (recent anastomosis)
- Severe coagulopathy

4. Bowel preparation

Examining the colon necessitates a clear colon devoid of any remaining stool or liquid that might obscure an area of concern. Insufficient bowel preparation correlates with lower adenoma detection rates, incomplete colonoscopies, and elevated expenses.

Research findings indicate that between 15% and 35% of colonoscopies suffer from insufficient bowel preparation, with disparities observed across different medical contexts and patient groups. [37], [38], [39] This inadequacy significantly undermines the detection rate of adenomas and various other benchmarks of colonoscopy efficacy. Moreover, it extends procedural durations due to heightened efforts in cleansing and removing debris, leading to prolonged withdrawal periods, and necessitating shorter surveillance intervals, consequently elevating associated expenses. [40], [41], [42]

Selecting the best bowel preparation regimen involves assessing its effectiveness, safety, and tolerability alongside individual patient needs. [43], [44] New formulations aim to enhance efficacy, tolerability, and safety. [45] Ideal preparations should efficiently remove stool residue without harming the colon's lining or disrupting plasma fluid and electrolyte homeostasis. They should also be affordable, easy to use, and well-tolerated. [46] Bowel cleansing agents vary in mechanism and volume requirements. [47] Polyethylene glycol (PEG) agents, isotonic, retain fluid in the colon, while hypertonic agents induce fluid shifts toward the colon.

Recent advancements in bowel preparation aim to enhance tolerability and effectiveness of colonoscopies. This includes introducing lower volume, flavored preparations, utilizing adjuncts, and implementing split-dose regimens to improve patient compliance and preparation quality. Preliminary studies on artificial intelligence for assessing preparation quality show promise. Moreover, smartphone technology for pre-procedure education has been found to enhance the adequacy of bowel preparations. [45], [48], [49]

a. Patient Information

Colonoscopy mandates that patients receive adequate information about the procedure to enable their participation in the decision-making process. The informed consent dialogue allows the colonoscopist to address patient concerns, strengthen the doctor-patient relationship, and provide some legal protection.

Multiple topics should be reviewed during this initial step including [36]:

- Colonoscopy Advantages
- Options Besides Colonoscopy
- Primary Dangers Associated with Colonoscopy
- Less Severe but Frequent Risks, like Intravenous Infiltration or Post-Colonoscopy Bloating
- Colonoscopy Limitations
- Sedation Risks, Advantages, and Alternatives
- Appropriate Post-Procedure Care (Including Escort Requirement)

Besides the informed consent, patients should be instructed about bowel preparation (diet, preparation, timing …) as well as the steps of the procedure. Addressing potential challenges encountered during preparation is crucial to enhance adherence to the process, which is often daunting for patients.

In a meta-analysis, it was discovered that enhanced instructions before colonoscopy, including visual aids and digital tools like smartphone apps and social media, improved bowel cleanliness and increased patient willingness to repeat the preparation. While the cecal intubation rate was higher, the polyp detection rate remained similar to those receiving regular instructions.[50]

In another randomized controlled study, patients using a web-based multimedia patient engagement program prior to colonoscopy experienced decreased anxiety, required less medication, and underwent shorter procedures compared to those who received standard pre-colonoscopy handouts [51].

b. Diet and Bowel Preparation

Controversies exist regarding the effectiveness of strict low residue and clear liquid diets recommended before colonoscopy. Despite these guidelines, there's a lack of standardized dietary instructions for patients, and limited research on the dietary factors impacting bowel preparation adequacy. Additionally, there is a concern that excessive dietary restriction might lead to decreased patient satisfaction but also to less compliance.[45]

In a meta-analysis, patients were categorized into groups either adhering to a low residue or regular diet, or following a clear liquid diet, for comparison. The low residue/regular diet group exhibited greater willingness to repeat the procedure, improved tolerability, and a higher frequency of consuming the recommended amount of bowel laxative compared to those on a clear liquid diet.[52]

In studies on low residue diets, many randomized controlled trials interchangeably used the terms "low residue" and "low fiber," with few specifying the fiber content of their regimen. Permitted foods in a low residue diet included certain peeled and pitted fruits, cooked

vegetables, cheese, meat, fish, and white bread, while wholegrain bread, muesli, brown rice, and certain fruits and vegetables were restricted. Some trials provided prepackaged low fiber or fiber-free food, while others instructed participants on food preparation.[47]

c. Types of Bowel Preparation

Numerous bowel preparation formulations have been developed , with the most prevalent being the isosmotic PEG containing electrolyte preparations (PEG-ELS) introduced to the market in the 1980s. These formulations primarily consist of key active ingredients, predominantly poly-ethylene glycol (PEG), sodium sulfate, sodium picosulfate, or sodium phosphate.[45]

Agent	Efficacy (split/same-day regimen)	Safety
High volume polyethylene glycol (PEG)	Noninferior or superior to low volume PEG or non-PEG regimens	Not recommended in: ▪ Patients with congestive cardiac failure (NYHA class III or IV).
Low volume PEG plus adjuvants		
▪ 2 L PEG + ascorbate	Noninferior to high volume PEG and non-PEG regimens	Not recommended in patients with: ▪ Severe renal insufficiency (creatinine clearance < 30 mL/min); ▪ Congestive heart failure (NYHA III or IV); ▪ Phenylketonuria; or ▪ Glucose-6-phosphate dehydrogenase deficiency.
▪ 2 L PEG + citrate	Noninferior to high volume PEG or 2 L PEG + ascorbate	Not recommended in patients with: ▪ Severe renal insufficiency (creatinine clearance < 30 mL/min): ▪ Congestive heart failure (NYHA III or IV) ▪ Unstable angina; or ▪ Acute myocardial infarction. No long-term data available. Limited post-marketing data available.
▪ 1 L PEG + ascorbate	Noninferior to 2 L PEG + ascorbate, oral sulfate solution (OSS), and magnesium citrate plus picosulphate (MCSP). No comparison with high volume PEG.	Not recommended in patients with: ▪ Severe renal insufficiency (creatinine clearance < 30 mL /min); ▪ Congestive heart failure (NYHA III or IV); ▪ Phenylketonuria; or ▪ Glucose-6-phosphate dehydrogenase deficiency. Adequate hydration must be maintained. Limited post-marketing data available.
▪ 2 L PEG + bisacodyl	Noninferior to high volume PEG or 2 L PEG + ascorbate	Occasional reports of ischemic colitis with high dose bisacodyl. Not recommended in: ▪ Patients with congestive cardiac failure (NYHA class III or IV).
Magnesium citrate plus picosulphate (MCSP)	Noninferior to high volume PEG or 2 L PEG + ascorbate	Not recommended in patients with: ▪ Congestive heart disease; ▪ Hypermagnesemia; or ▪ Severe kidney insufficiency. Not recommended in patients at risk for: ▪ Hypermagnesemia; or ▪ Rhabdomyolysis.
Trisulfate (magnesium sulfate, sodium sulfate, and potassium sulfate), also called oral sulfate solution (OSS)	Noninferior to high volume PEG, 2 L PEG as-corbate Superior to MCSP in a single RCT	Not recommended in patients with: ▪ Severe renal insufficiency (creatinine clearance < 30 mL/min); ▪ Congestive heart failure; or ▪ Ascites.

Figure 32 : Data on efficacy and safety of validated laxatives for routine bowel preparation – Picture from ESGE Guideline 2019. (45)

European Society of Gastrointestinal Endoscopy recommends [47]:

- The use of high volume or low volume PEG-based regimens as well as that of non-PEG-based agents that have been clinically validated for routine bowel preparation. In patients at risk for hydroelectrolyte disturbances, the choice of laxative should be individualized.
- ESGE does not suggest any specific bowel preparation in patients with constipation.
- ESGE recommends high volume or low volume PEG-based bowel preparation in patients with inflammatory bowel disease.
- ESGE recommends PEG regimens for bowel preparation if urgent colonoscopy is scheduled for lower gastrointestinal bleeding.

d. Timing Recommendations

Timing of bowel preparation is an important aspect to consider. There are two types of regiments:

- Split-dose bowel preparation: half of the bowel preparation solution is taken the night prior to, and half is provided on the day of the colonoscopy.
- Single dose regimen: the whole preparation is taken the day prior to the procedure.

European Society of Gastrointestinal Endoscopy recommends [47] :

- Split-dose bowel preparation for elective colonoscopy.
- For patients undergoing afternoon colonoscopy, a same-day bowel preparation as an acceptable alternative to split dosing.
- To start the last dose of bowel preparation within 5 hours of colonoscopy, and to complete it at least 2 hours before the beginning of the procedure.
- Observational studies have shown an inverse correlation between the degree of mucosal cleanliness and the interval between the last dose of bowel preparation and the start of colonoscopy. An interval of 3 – 5 hours resulted in the best preparation quality scores throughout the colon.

e. Contraindications to Bowel Preparation [36]

- Gastrointestinal tract obstruction
- Gastrointestinal tract perforation
- Severe gastroenteritis/diarrhea
- Dysphagia/pulmonary aspiration risk
- Inability to drink preparation.
- Hemodynamic instability

f. Bowel Preparation Scoring System

In order to establish a standardized measure of bowel preparation quality, various scales have been developed, with some being validated. Among the scales commonly utilized in clinical trials are the Aronchick Scale [53], [54], the Boston Bowel Preparation Scale (BBPS [55], [56], [56], [57]and the Ottawa Bowel Preparation Scale (OBPS) [53]. *(Figure 39)*

Other instruments that have been validated, but are less commonly used, include the Harefield Cleansing Scale (HCS) [58] and the Chicago Bowel Preparation Scale [59] (CBPS).

Despite having several limitations, the **Boston Bowel Preparation Scale** emerges as the most suitable choice and is consequently advised as the prevailing standard for clinical practice.[55],

Scale	Scale range	Segments which contribute to scoring	Timing of Scoring	Excellent preparation	Poor preparation	Limitations	Advantages
Aronchick Scale	Excellent to inadequate	Stool in entire Colon	Prior to washing and suctioning	Excellent 1	Inadequate 5	No score at which preparation is considered adequate, no validation	Ease of use
Ottawa Bowel Preparation Scale (OBPS)	0–14	Stool in different segments of colon (0–4 each segment), fluid in entire colon (0–2)	Prior to washing and suctioning	0	14	No score at which preparation is considered adequate	
Boston Bowel Preparation Scale (BBPS)	0–9	Stool in entire colon divided into 3 segments	After washing and suctioning	9	0	Ambiguity of intermediate scoring which results in mixed recommendations for repeat colonoscopy intervals	

[57], [60]

Figure 33 : Comparison of the most commonly used bowel preparation scales – picture from Springer Science+Business Media

Bowel prep name	Points	Description
Aronchick Scale*	5	Inadequate (repeat preparation needed)
	4	Poor (semisolid stool could not be suctioned and <90% of mucosa seen)
	3	Fair (semisolid stool could not be suctioned, but >90% of mucosa seen)
	2	Good (clear liquid covering up to 25% of mucosa, but >90% of mucosa seen)
	1	Excellent (>95% of mucosa seen)
Ottawa Bowel Prep Scale rating for each colon segment†	4	Inadequate (solid stool not cleared with washing and suctioning)
	3	Poor (necessary to wash and suction to obtain a reasonable view)
	2	Fair (necessary to suction liquid to adequately view segment)
	1	Good (minimal turbid fluid in segment)
	0	Excellent (mucosal detail clearly visible)
Ottawa Bowel Preparation Scale rating for the amount of fluid in the whole colon†	2	Large amount of fluid
	1	Moderate amount of fluid
	0	Small amount of fluid
Boston Bowel Preparation Scale rating for each colon segment‡	0	Unprepared colon segment with stool that cannot be cleared
	1	Portion of mucosa in segment seen after cleaning, but other areas not seen because of retained material
	2	Minor residual material after cleaning, but mucosa of segment generally well seen
	3	Entire mucosa of segment well seen after cleaning

Figure 34 : Bowel Preparation Scales – picture from American Society for Gastrointestinal Endoscopy. (44)

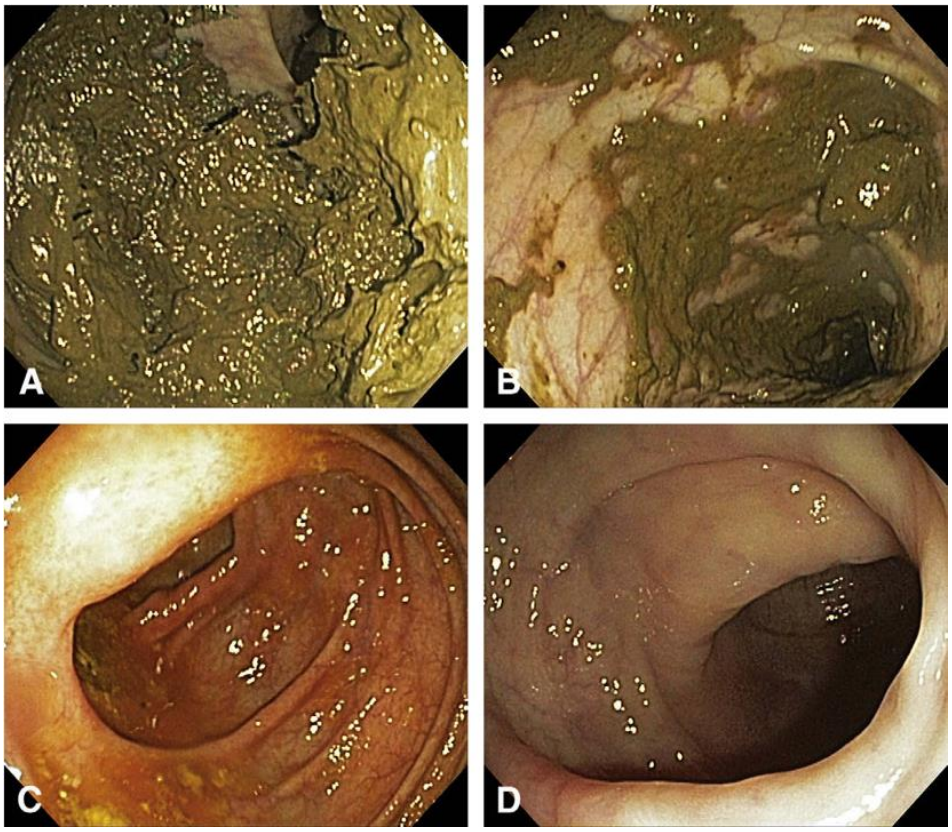


Figure 35 : Boston Scale – picture from GIE Journal (55)

A: segment score 0: unprepared colon segment with mucosa not seen due to solid stool that cannot be cleared.

B: segment score 1: portion of mucosa of the colon segment seen, but other areas of the colon segment not well seen due to staining, residual stool and/or opaque liquid.

C – segment score 2: minor amount of residual staining, small fragments of stool and/or opaque liquid, but mucosa of colon segment seen well.

D – segment score 3: entire mucosa of colon segment seen well with no residual staining, small fragments of stool and/or opaque liquid.

5. Procedure

The objectives during both scope insertion and withdrawal involve safely and efficiently navigating the winding colon and thoroughly examining the mucosa. While insertion primarily emphasizes the technical challenges of intubation, withdrawal shifts focus towards inspecting the colon lining.[36]

a. Preparation for Scope Insertion

- The patient is positioned comfortably in the left lateral decubitus position with the buttocks at the edge of the examining table.
- Typically, the knees are slightly flexed, and the right knee is positioned in front of the left knee.
- The colonoscopist confirms scope functionality before every examination.
- the digital rectal examination is performed, to evaluate anal pathology, the effectiveness of the cathartic preparation, sphincter tone, the prostate gland or gynecologic organs, and the wall of the distal rectum. In addition, it lubricates and relaxes the anal sphincter in preparation for scope entry.
- The tip of the colonoscope is lubricated and is gently passed through the anal canal.

b. Proper Technique for Holding the Scope

- The colonoscopist should remain cognizant of posture. Colonoscopy should proceed without a need for much force.
- The head of the scope is held in the left hand, gripped securely between the palm and the middle, ring, and little fingers. The large up/down dial is manipulated with the left thumb. *(figure 43)*
- The index finger is extended in front of the air/water and suction trumpet valves.
- Many endoscopists use the right hand to turn the right/left dial. *(Figure 42)*
- The shaft of the colonoscope is held between the thumb and fingers of the right hand, in a screwdriver grip. If the entire insertion tube is left on the examining table
- The scope is gripped with a small gauze pad about 30 cm from the anus.

Figure 37 : holding technique of the head.

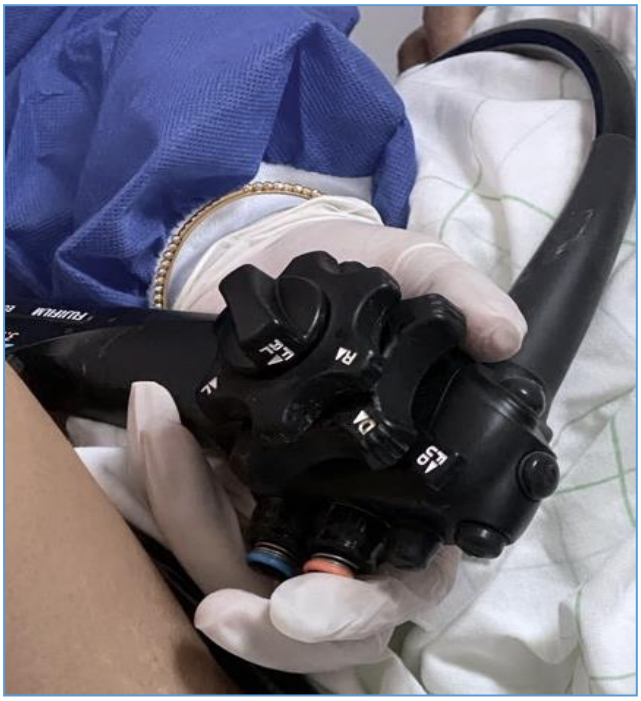


Figure 36 : Using the right/left dial.

c. Technique of Intubation

- Keep focused on the endoscopic image.
- Angulate the tip of the scope: angulating the tip of the scope allows the colonoscopist to navigate around turns.
- Always know the position of the lumen: the endoscopist should never push blindly.
- Insufflate and evacuate air strategically: air insufflation distends the colon and opens up the folds, improving visualization.
- Using water instillation: some endoscopists instill warm water when they encounter a difficult sigmoid colon. Several groups have reported success distending the entire colon with water instead of air. This "water method" is reported to decrease sedation requirements and may even permit unsedated colonoscopy.
- Be alerted to looping. An enlarging loop can pull on the mesenteric attachments, causing pain.
- Never push against fixed resistance.
- Know when to abort the case.
- Be aware how much scope you have inserted.
- Look for landmarks: during intubation, landmarks predict the approximate location of the tip of the scope.
- Wash and suction: debris is evacuated during intubation and withdrawal. Attempting to suction seeds can clog the channel and should be avoided.

d. Technique of Withdrawal

The withdrawal phase of a colonoscopy may be the only opportunity for a decade of the patient's life to detect malignant or premalignant lesions of the colon.

Cleaning the mucosa If there is a modest amount of debris or turbid fluid, the endoscopist must strive to remove it, repetitively washing and suctioning.

The colonoscope must be withdrawn **slowly, centimeter by centimeter**, while each segment of the colon is meticulously inspected.

6. Complications

In general, colonoscopy is regarded as a safe procedure, despite reports of several serious adverse events (AEs).

The definition of serious AEs varies among studies but typically encompasses events resulting in unplanned hospitalizations, procedures, interventions, prolonged hospital stays, or fatalities.[61]

AEs can be categorized as either procedure-related or non-procedure-related. Procedure-related AEs stem from issues with scope handling, while non-procedure-related AEs are attributed to other causes such as cardiovascular issues.

In a prospective cohort study, involving asymptomatic veterans, adverse events were documented in 105 out of 3,727 follow-up examinations, representing 2.8% of examinations in 93 participants. These events included 22 major and 87 minor occurrences.[62]

6.1 Procedure related adverse events

i. Perforation

Colonic perforation during colonoscopy can result from various factors, essentially : mechanical pressure on the bowel wall, barotrauma, or as a direct consequence of therapeutic procedures. Initial symptoms often include persistent abdominal pain and abdominal distention.

While plain radiographs of the chest and abdomen may reveal free air, abdominal CT scans offer superior diagnostic accuracy. Therefore, patients with abnormal plain film findings should undergo abdominal CT scanning.[63]

In a meta-analysis conducted by the American Society for Gastrointestinal Endoscopy, the combined rate of perforations among 10,328,360 colonoscopies was 5.8 per 10,000 procedures.[61]

A retrospective cohort study performed in North Denmark found that perforations during colonoscopy were attributed to polypectomy in 62% of cases, shearing force in 23%, therapeutic dilation in 8%, and biopsy in 6%.[64]

Last but not lesat, another meta-analysis of population-level studies revealed that colonoscopies involving polypectomy had a higher perforation rate (8 per 10,000) compared to those without polypectomy (4 per 10,000). It also suggested that a significant portion of the risks are linked to procedural factors independent of polypectomy, such as the torque or pressure applied to the bowel wall and barotrauma from colon insufflation.[65]

ii. Bleeding

Bleeding can occur during, immediately after, or be delayed following a colonoscopy. Early bleeding, due to inadequate cauterization of blood vessels, is typically treatable endoscopically. Late hemorrhage occurs when a clot dislodges or thermal necrosis erodes a vessel, presenting with rectal bleeding or symptoms of acute blood loss. This can happen from a few hours to 21 days post-polypectomy.[36]

According to the cohort study conducted in Denmark, bleeding was a relatively common adverse event (3.07‰). Most lower GI bleedings were associated with polypectomy (91%). [64]

Another meta-analysis reports that, Based on 15 population-level studies involving 5,544,454 patients, the bleeding rate was 2.4 per 1,000 colonoscopies and that unlike perforation, the risk of bleeding during colonoscopy is strongly linked to the performance of polypectomy.[61]

iii. Splenic Injury

Splenic injury is a rare but serious adverse event of colonoscopy. It can occur immediately or several days after the procedure, complicating diagnosis. The true incidence is unknown due to variability in reporting.[61]

In a retrospective observational study of 2,258,040 inpatient colonoscopies conducted between 2012 and 2018, the incidence of colonoscopy-associated splenic injury remained relatively stable, at 0.033% compared to 0.020%.[66]

The actual incidence of splenic injury may be higher than reported. Some patients may sustain splenic injuries during colonoscopy that go undiagnosed because they are asymptomatic or their symptoms are so mild that they do not seek medical attention.[67]

Suggested mechanisms for splenic injury during colonoscopy include : direct trauma as the colonoscope traverses the splenic flexure or rupture of the splenic capsule due to traction on the splenocolic ligament or adhesions.[61]

The most common clinical presentation of splenic injury is abdominal pain, either generalized or localized to the left hypochondrium. Other minor presentations include dizziness, syncope, back pain, chest pain, and symptoms of anemia.[61]

A systematic review published in 2014 found that 74.14% of patients with splenic injury presented with hypotension and cardiovascular instability.[67]

Suggested risk factors for splenic injury include deep sedation with propofol, difficullt colonosocpy, inexperienced operator, the supine position, some maneuvers like applying abdominal pressure to the left hypochondrium and hooking the splenic flexure, among others.[61]

iv. Abdominal discomfort and Bloating

The most commonly reported minor AEs of colonoscopy are bloating and abdominal pain and/or discomfort.[61], [68], [69]

Although abdominal pain can result from various serious adverse events, it is usually not very serious. However, this minor adverse event is still significant as it can impact patient compliance with future colonoscopies.[64], [70], [71], [72]

Multiple studies have investigated the causes of post-colonoscopy discomfort and bloating, reporting that it may stem from colonic spasms, gaseous distention of the colon, and mechanical or barotrauma.[73]

Many efforts have been made to find better ways to reduce pain during the procedure and prevent discomfort afterward; One one hand, using proper techniques, like avoiding and reducing endoscope looping and minimizing air insufflation, can help reduce these symptoms. [71], [74], [75] On the other hand, new techniques have been evaluated like using carbone diaoxide for insufflation and the technique of water intubation.

Studies have shown that using carbon dioxide for insufflation results in less post-procedure pain compared to standard air insufflation. Even better results in reducing pain and minimizing procedure time have been observed with water immersion and water exchange, particularly when minimal to no sedation is used.[5], [76], [77], [78], [79], [80]

v. Gas Explosion

Explosive complications from colonoscopy are rare but can have serious consequences. A gas explosion can occur if combustible levels of hydrogen or methane gas are present in the colonic lumen, oxygen is available, and electrosurgical energy is used.[81]

Suspected risk factors include the use of nonabsorbable or partially absorbable carbohydrate preparations, such as mannitol, lactulose, or sorbitol, as well as incomplete colonic cleansing, which can result from using a sigmoidoscopy preparation (enemas for example) or inadequate colonoscopic preparation.[82], [83]

However, a recent study found that high concentrations of methane and hydrogen in the colon are more closely related to insufficient washing and oxygen insufflation, regardless of the drug used for bowel cleansing. Consequently, the likelihood of CH4 and H2 concentrations exceeding the critical limit is very low and is more likely influenced by the colonoscopy technique rather than the preparation used.[84]

Some studies have aborded the efficacy of CO2 insufflation in reducing the concentrations of combustible gases and have advocated for the use of CO2 during colonoscopy, particularly when electrosurgical energy is employed.[84], [85]

vi. Infection

The incidence of bacteremia after colonoscopy ranges from 0% to 25%, regardless of whether a biopsy or polypectomy is performed. In immunocompetent patients, bacteremia developing during or after colonoscopy is generally temporary and asymptomatic. [61]

The risk factors for bacteremia after colonoscopy depend on patient-related factors (such as comorbidities, medications, and degree of bowel cleaning), the endoscopic device (including

sterilization practices), and the type of invasive intervention performed (such as polypectomy, dilation, and procedure duration).[86]

Although individual cases of infection after colonoscopy have been reported, there is no definitive causal link to the endoscopic procedure, and no proven benefit for antibiotic prophylaxis.[61], [87]

vii. Mortality

Death after colonoscopy has been rarely reported. In a 2010 review of adverse events based on prospective studies and retrospective analyses of large clinical or administrative databases, the pooled death rate was 0.03%. All-cause mortality within 30 days occurred in 0.07% of patients, while colonoscopy-specific mortality was 0.007%.[88]

viii. A rare case of Intramural hematoma

A recent study reported a rare case of intramural hematoma in a 50-year-old female who presented with abdominal pain and syncopal episode after a hard screening colonoscopy. Diagnosis was based on a CT scan. *(figure 44)*

Figure 38 : CT abdomen C+ showing ascending colon hematoma (89)

After trying conservative management exploratory laparotomy and right hemicolectomy was necessary *(figure 45)*. This study suggests that many complications of colonoscopy might be underreported and highlights the importance of being aware of these rare and potentially life-threatening complications for early diagnosis and management.[89]

Figure 39 : Intramural hematoma in ascending colon. (89)

6.2 Sedation related adverse events

Colonoscopy poses a "triple threat" to the cardiovascular and pulmonary systems: bowel preparation can cause fluid and electrolyte shifts, sedative drugs can affect cardiovascular tone and respiratory function, and instrumentation and distention of the colon can induce vagally mediated hypotension. The risk of death is higher with serious cardiovascular or respiratory adverse events than with hemorrhage or perforation.

Intraprocedural cardiopulmonary complications can range from events of unclear clinical significance, such as minor fluctuations in oxygen saturation or heart rate, to significant complications, including respiratory arrest, cardiac arrhythmias, myocardial infarction, and shock.[81]

A recent study reported that serious cardiopulmonary events were the most common major adverse events, occurring at a rate of 4.6 per 1,000 examinations. 2.7% of these examinations reported hypotension requiring intervention, 0.27% experienced peri-procedural apnea, 1.6% resulted in cardiac arrhythmia, 0.81% had bradycardia requiring atropine, and 0.27% reported a vasovagal event during follow-up.[62]

Furthermore, in a population-based study, the incidence of aspiration requiring hospitalization was 0.14% for patients undergoing colonoscopy under deep sedation with anesthesia assistance, compared to 0.10% for patients under moderate sedation without anesthesia assistance.[90]

When it comes to aspiration pneumonia, a population-based cohort study of 3,059,045 outpatient colonoscopies reported that the use of anesthesia assistance was associated with an increased risk of aspiration pneumonia, occurring in 1.63% of cases compared with colonoscopies performed without anesthesia assistance.[91]

Besides acute complication, authors have reported that colonoscopy is associated with an increased incidence of cardiovascular events within the 30-day postprocedure period. In a prospective study, the event rate for angina, myocardial infarction, stroke, or transient ischemic attack within 30 days was 1.4 per 1,000. [92]

Given the increased risk of cardiopulmonary events associated with colonoscopy in patients of advanced age and those with comorbidities, it is crucial to emphasize the importance of appropriate anesthesia risk assessment prior to the procedure. Ensuring that high-risk patients are co-managed with other specialists can help reduce cardiopulmonary complications.[93]

7. The Use of Anesthesia

Sedation and analgesia are widely used in GI endoscopy to reduce pain and anxiety, ultimately improving patient compliance with screenings and follow-ups. Sedation options range from minimal to moderate sedation, typically managed by endoscopists, to deep sedation or general anesthesia, which requires the intervention of professional anesthesiologists.

7.1 Precolonoscopy management

This part of the process focuses on evaluating the patient's overall well-being and their eligibility for anesthesia, as well as determining the most appropriate type of sedation for each individual.

A sedation-focused history should cover :

- Prior difficulties with anesthesia/sedation
- Major medical issues
- Airway abnormalities (such as excessive snoring and sleep apnea)
- Significant alcohol or drug use
- Diabetes or hypoglycemia
- Medication and food allergies
- Last food intake
- Current medications
- Potential pregnancy.

The physical exam should assess :

- Patient's overall health (e.g., signs of dehydration or lethargy, weight)
- Physical build (e.g., obesity)
- Anxiety level
- Vital signs
- Mouth, head, and neck anatomy

The American Society of Anesthesiologists (ASA) classification system was developed to stratify patients by their risk for sedation. (*figure 46)*

Benefits, risks as well as alternatives of sedation during colonoscopy should be discussed with the patient during this phase of the process to get their pre-procedure informed consent.[36]

Class	Description
I	The patient is normal and healthy.
II	The patient has mild systemic disease that does not limit activities (eg, controlled hypertension or controlled diabetes without systemic sequelae).
III	The patient has moderate or severe systemic disease that does not limit activities (eg, stable angina or diabetes with systemic sequelae).
IV	The patient has severe systemic disease that is a constant threat to life (eg, severe congestive heart failure, end stage renal failure).
V	The patient is morbid and is at a substantial risk of death within 24 hours (with or without a procedure).
E	Emergency status: in addition to indicating the underlying ASA status (I-V), any patient undergoing an emergency procedure is indicated by suffix "E."

Figure 40 : ASA Classification (95)

7.2 Approaches to sedation for colonosocpy

i. Unsedated Colonoscopy

Patients who may be able to undergo endoscopic procedures without sedation should be identified. Predictors of successful unsedated colonoscopy include male gender, college education, and low pre-procedural anxiety.[36]

The key to successful technical performance of unsedated colonoscopy lies in effective communication with patients. Patients should be thoroughly informed about each step of the procedure so they can anticipate what they will feel and experience.[94]

Standard pre-procedural preparation for sedation and monitoring, should be followed in case the patient does not tolerate the procedure.[95]

ii. Minimal and Moderate Sedation

Minimal and moderate sedation (*figure 47)* are routinely used to enhance patient tolerance during colonoscopy and can be safely administered by endoscopists to patients classified as ASA Class I, II, or III. *(figure 46)*

	Minimal sedation (anxiolysis)	Moderate sedation (conscious sedation)	Deep sedation	General anesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response after repeated or painful stimulation	Unarousable even with painful stimulus
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

Figure 41 : Levels of sedation and anesthesia (95)

Minimal and moderate sedation regimens typically combine a **benzodiazepine** to address anxiety and a **narcotic analgesic** to reduce pain and discomfort. Benzodiazepines can also be used alone for minimal sedation. The most commonly used benzodiazepines are **midazolam** and **diazepam**, both of which have comparable efficacy. However, midazolam is often preferred by endoscopists due to its rapid onset, short duration of action, lower risk of thrombophlebitis, and strong amnestic properties.

The opiates commonly used for sedation during colonoscopy are meperidine and fentanyl. Fentanyl is often preferred due to its more rapid onset of action and clearance, as well as a lower incidence of nausea compared to meperidine.[95]

However, a recent study conducted in Italy examined the efficacy of sedation using midazolam in combination with either meperidine or fentanyl during elective colonoscopy. The study reported that the midazolam plus meperidine regimen resulted in less pain, distress, anxiety, and depression compared to the midazolam plus fentanyl regimen, with equal recovery times and no significant differences in the duration of the procedure.[96]

Although benzodiazepine/opioid combinations are generally safe, adverse or fatal cardiopulmonary events have occurred with respiratory depression being the greatest risk. thus ,extra caution is required in the elderly, patients with preexisting neurological disease, and those with highrisk airways.[36]

iii. Propofol mediated sedation

In contrast to benzodiazepine/opioid combinations, the use of propofol during colonoscopy is linked with enhanced satisfaction among both patients and physicians, as well as quicker onset and recovery times.

Propofol can be administered alone or in conjunction with a narcotic and a benzodiazepine. Due to its propensity to depress breathing, propofol administration is preferably managed by personnel experienced in airway maintenance and require routine capnography[97]. *(figure 48)*

The most common and severe complications are dose-dependent hypotension, particularly notable in hypovolemic patients, and transient apnea following induction doses.

However, when propofol is used in combination with other sedative agents, the adverse cardiovascular effects can be mitigated by reducing the propofol dosage. [98] A prospective study conducted in Egypt, studying the association of propofol with ketamine and fentanyl, reported high hemodynamic stability in propofol ketamine group, with less nausea, vominiting and hypoxia. In contrast, hallucinations where more common in the group, with a slightly longer recovery time.[99]

Propofol's potent amnestic properties and mitigation of the emetogenic effects associated with colonoscopy insufflation are among its most beneficial attributes for sedation during the procedure. [98]

Propofol sedation for generally healthy individuals results in faster recovery and discharge times. However, despite these advantages, patients should still be discharged only in the presence of a responsible companion and should refrain from driving or engaging in vigorous exercise for the rest of the day.[97]

A sedation team with appropriate education and training. At least 1 person who is qualified in advanced life support skills (ie, airway management, defibrillation, and the use of resuscitative medications).
Trained personnel dedicated to the uninterrupted monitoring of the patient's clinical and physiologic parameters throughout the procedure should be available.
Physiologic monitoring must include pulse oximetry, electrocardiography, and intermittent blood pressure measurement. Monitoring oxygenation by pulse oximetry is not a substitute for monitoring ventilatory function. Capnography should be considered because it may decrease the risks during deep sedation. Continuous monitoring will allow recognition of patients who have progressed to a deeper level of sedation.
Personnel should have the ability to rescue a patient who becomes unresponsive or unable to protect his or her airway or who loses spontaneous respiratory or cardiovascular function.
Age-appropriate equipment for airway management and resuscitation must be immediately available.
A physician should be present throughout propofol sedation and must remain immediately available until the patient meets discharge criteria.

Figure 42 : Recommendations for propofol use during endoscopy – Picture from the ASGE Guidelines – GIE JOURNAL (95)

7.3 Post colonoscopy management

The effects of sedative drugs persist, and therefore careful monitoring of the patient during recovery is essential. Every patient who undergoes anesthesia should be monitored afterward in the post-anesthesia care unit.

Diagnosis and treatment of nausea/vomiting, and pain control should be covered as well as the assessment of criteria for ambulation, liquid intake, and urine volume.

Since serious side effects typically occur within the first 30 minutes in sedated patients, they should be monitored in the recovery room for at least this duration. Before getting discharged, respiration, oxygen saturation, blood pressure,consciousness, and activity should be evaluated.

Patients may encounter extended periods of amnesia and cognitive impairment following the procedure. Consequently, it is advisable for them to depart accompanied by a companion and provided with written directives concerning post-procedure precautions, such as refraining from driving, operating machinery, or making legal commitments until they have completely regained their faculties.[98]

II. Unsedated Colonoscopy

Over the past decade, sedation has increasingly been employed to assist colonoscopy due to its proven efficacy in reducing anxiety, inducing amnesia for most or all discomfort, and subsequently improving patient satisfaction and willingness to undergo further procedures.[94], [100]

However, upon reviewing the literature, we encounter some controversy surrounding this innovative technique.

1. Colonoscopy quality

Given the established benefits of sedation and anesthesia in enhancing patients' experiences, some authors have sought to determine whether these interventions have similar efficacy in improving the technical performance of colonoscopy.

Sedation has been shown to increase the cecal intubation rate, but **no benefits were observed regarding adenoma and polyp detection**. Some studies suggest that using anesthesia assistance is **unnecessary for improving colonoscopy quality**.[101], [102] Which puts the spotlight on the necessity of weighting the benefits/risks before making the decision of using anesthesia.

2. Adverse event

A lot of studies have been done on the subject of adverse effects encountered during and after colonosocopy with many reporting that overall **complications were more common** in cases with anesthesia assistance. [4], [90]

In addition to anesthesia-related adverse effects, which constitute the majority of major complications as discussed in the previous chapter, the use of anesthesia has also been associated with an **increase in certain procedure-related adverse effects** such as post-procedure pain, perforation, and splenic injury.[4]

These complications are mainly attributed to the fact that colonic wall tension from colonoscopy **pressure is not detected by the endoscopits in the absence of patient feedback** due to sedation. [90], [103]

3. Recovery and cost

Sedation for colonoscopy procedure increases the cost and post-procedure recovery time for patients.

Sedation and anesthesia require escort and interruption of several daily activities post-procedure to ensure patient safety. With the widespread adoption of colorectal cancer screening programs among healthy, young, and working adults, the impact of sedation and analgesia on patients' daily activities and work has been shown to reduce adherence to screening colonoscopy.[6]

When it comes to the cost, administration of moderate sedation demands considerable time and resources. This includes pre-procedure evaluation, establishing intravenous access,

delivering fluids, administering medications, monitoring the patient during and after the procedure, conducting recovery assessments, and managing patient discharge.

On a broader scale, it also involves documentation, maintaining emergency equipment, and managing medication inventory. It is estimated that these activities, along with the associated sedation expenses, account for up to 40% of the total overhead cost of an endoscopic examination.[104]

Moreover, despite society guidelines clearly stating that the use of anesthesia assistance (AA) in low-risk patients was **not cost-effective**, studies revealed that AA was predominantly used in patients without clear medical necessity or increased comorbidity. This underscores the need to refine evidence-based clinical criteria to identify patients who are most likely to benefit from AA, thereby assisting gastroenterologists in better showcasing the value of the services they offer.[105]

4. Unsedated colonoscopy In Literature

Unsedated colonoscopy is a topic that arises frequently in the literature review. Many studies support the concept, while others view it as an outdated practice.

Arguments in favor of unsedated colonoscopy include:

- Reducing costs and consequently **increasing the profit margin** for the colonoscopist who practices in the office or the facility owner in the ambulatory surgery center or hospital.
- The **absence of restrictions** on driving or decision making after the colonoscopy and is ability to return to work on the same day.
- **Saving up time and increasing the efficiency of endoscopy services**. A study have shown that unsedated colonoscopy can save up to 62min per patient while preserving patient's willingness to undergo the same procedure.[100]
- **Less adverse events** [106]
- **Increasing patients' co-operation** during the procedure.

In contrast to the proven benefits of unsedated colonoscopy, enhancing patients' awareness of their surrounding environment and happenings increases their risk of experiencing autonomic distress.[5]

Unsedated patients who undergo colonoscopy are at risk of experiencing vagal reactions, which can be severe. Severe bradycardia, which can occur in these cases, may be treated with atropine, but this treatment can be associated with significant hypotension and even fainting spells.

However, the most significant argument against unsedated colonoscopy is its potential impact on the reputation of the procedure within the community. Patients who undergo colonoscopy without sedation often make negative comments about their experience to family and friends, which may discourage others from seeking screening.[94]

Therefore, the **introduction of pain management techniques was essential** to maintain patient comfort, reduce anxiety, and divert attention from pain. **Numerous efforts, including our study**, have been mad in this regard, aiming to enhance the patient experience while ensuring quality and safety.

III. Psychological Aspect of Colonoscopy:

Colonosocpy is often described as painful, uncomfortable and anxiety inducing. The vulnerability of the procedure as well as the fear of diagnosis are some of the main reasons behind these feelings.

Invasive procedures often cause pain, which is typically accompanied by feelings of embarrassment, anxiety, and fear. Morrison referred to this combination of physical and emotional distress as **"discomfort**."[107] **Physical discomfort** can arise from the **length of the procedure**, the need to maintain an **uncomfortable position**, or the necessity to remain **motionless for extended periods**. **Emotional discomfort** may stem from the **embarrassment** of exposing one's body, the **anxiety and fear** of experiencing pain, or the apprehension about receiving an unfavorable diagnosis. The **intensity of pain** experienced during an invasive

procedure varies based on patient compliance and is influenced by numerous factors. These include previous experiences, pre-existing or chronic pain, the presence of fear or anxiety, the type and duration of the procedure, and the patient's expectations of pain.[108]

1. Emotional barriers to Colonoscopy

Studies on emotional barriers to colonoscopy have identified **fear**, **embarrassment**, and **disgust** as key factors influencing people's attitudes towards screening and cancer.

These emotions are significant contributors to the **avoidance behaviors** observed in relation to colonosocpy [109]. Fear often stems from concerns about potential pain, the discovery of cancer, and the procedure itself. Embarrassment is frequently related to the invasive nature of the colonoscopy and the exposure of private body parts. Disgust can be triggered by the preparation process and the thought of the procedure. Together, these emotional responses create a significant barrier to CRC screening, leading many individuals to avoid undergoing this potentially life-saving procedure.[108]

Another frequently reported feeling among patients is **anxiety**. Many patients express moderate to extreme levels of pre-procedural anxiety, mainly related to the anticipation of pain, the nature of the results, potential complications, sedation and being a burden to friends or family. Poorly controlled pain, as well as discomfort during a previous colonoscopy, are also reasons for avoiding further examinations.[1], [110], [111]

Investigations were also conducted on **disgust** due to its complexity as an emotion and its role as a predictor of screening avoidance.[112]

Disgust, a negative emotion signaling withdrawal from potential contaminants to protect the body, is triggered by colonoscopy preparation and testing. The process involves **handling fecal matter** and **bodily invasions**. The need to **empty the bowels** with laxatives or enemas and the **insertion of an endoscope** into the rectum act as significant barriers to screening due to their association with disgust. There was concern that trait disgust, a difficult-to-modify personal characteristic, might influence adherence to screening. However, studies have shown that **disgust**

related to colonoscopy is more about the procedure itself than personal traits. This is promising, as affective associations with a behavior are easier to modify than personality traits.[113]

Last but not least, a study investigating the **relationship between behavior and affective associations** demonstrated that **behavior is influenced by these affective associations**, which encompass the emotional states or specific feelings connected with a particular behavior. The study found that affective associations fully mediated the relationship between perceived benefits and barriers to screening uptake.[114]

2. Cognitive and emotional control

There is a complex and interdependent relationship among pain, pain perception, and the mind, involving intricate interactions among the brain, mind, body, and behavior. Pain is not merely a physical sensation but a multifaceted experience influenced by various psychological and physiological factors.[108]

The brain plays a central role in processing pain signals from the body. When the body experiences injury or discomfort, nerve signals are sent to the brain, where they are interpreted as pain. However, this process **is not purely mechanical**; the mind's state can significantly influence how pain is perceived. For instance, **emotional states such as stress, anxiety, and depression can amplify pain perception**, making a given stimulus feel more intense than it might otherwise. **Even simpler cognitive manipulations, such as imagining or anticipating a painful experience, can activate pain pathways.**

Several studies have demonstrated that when an individual anticipates the onset of pain, brain regions associated with pain sensation, pain affect, and pain modulation become activated.[3]

As an example, according to a prospective study done in Korea, patient **stress can lead to increased sympathetic outflow, heightened bowel sensitivity, and decreased procedure tolerance**, which explains why first-time colonoscopy patients and those with high levels of pre-procedural anxiety often experience more pain during the procedure.[115]

a. Pain Catastrophizing

Behavioral responses to pain, such as avoidance of certain activities, seeking medical help, or using pain relief strategies, are also shaped by the brain and mind. These behaviors can further influence **how pain is experienced and managed**. For instance, **catastrophizing thoughts** can lead to increased attention to pain and heightened suffering, while active coping strategies can mitigate the impact of pain on daily life.

Several studies have found that high levels of catastrophizing can **cause dysregulation or dysfunction in endogenous opioid pain-control systems**. Endogenous opioids are key neurochemicals in various **pain-inhibitory systems**, acting both in the periphery and in the central nervous system to modulate noxious stimuli. Elevated catastrophizing h**as been linked to a greater need for postoperative opioid analgesics to manage post-surgical pain**.[116]

The amplification of pain and fear of its negative consequences by pain catastrophizing not only triggers ruminative thoughts about pain but also impairs the patient's ability to cope with painful situations. This phenomenon is not only associated with perceived pain intensity and disability but also with the severity of depression and anxiety states.[117], [118]

b. Emotional Processing

Emotional processing (EP) is a psychological concept employed to comprehend the subjective experience of fear in emotional disorders. EP theory elucidates how individuals naturally adjust to emotional events in order to mitigate their psychological and physiological effects.

A lack of emotional awareness can lead to generalized negative emotional states, **heightened arousal**, and **increased vigilance toward physical sensations**. Consequently, bodily sensations, including **pain, may be intensified** and perceived as more unpleasant.

Likewise, colonoscopy patients who cognitively avoid the idea of undergoing the procedure in order to dismiss their fears may **struggle to incorporate information** aimed at reassessing the situation, such as the **benefits of cancer screening and the safety of the procedure**. Patients who have difficulty controlling their emotions may experience **more severe and unpleasant**

sensations, potentially **leading to voluntary or involuntary movements that disrupt the endoscopist's procedures.**

This indicates that an **inability to manage emotions**, experiencing negative emotional states, and avoiding emotional triggers prior to the procedure were all **linked to unfavorable pain outcomes during and after colonoscopy, as well as heightened procedure-related worry and** anxiety.[111]

c. Mind-Body Techniques

Conversely, **positive mental states and coping mechanisms** can modulate the perception of pain. Techniques such as mindfulness, meditation, and cognitive-behavioral therapy can help alter the brain's response to pain signals, reducing the overall experience of pain.

These techniques encompass a range of interventions that are multifaceted, often involving both **cognitive and emotional components**. For instance, they may incorporate strategies like **redirecting attention** or altering thought patterns (cognitive component) alongside techniques aimed at managing emotional responses such as **relaxation or mindfulness** (emotional component).

Both attentional and emotional factors play roles in modulating pain perception. Directing attention towards pain tends to amplify the perceived intensity of the sensation, while experiencing negative emotions tends to increase the perceived unpleasantness of the pain without necessarily changing its intensity.[3]

In a particular study, it was observed that the emotional tone affected pain ratings and a spinal nociceptive reflex similarly, whereas **distraction reduced pain perception** while simultaneously enhancing the reflex. Hence, it seems that distinct systems might be engaged in the modulation of pain by attention and emotions[119]

Alongside the impact of positive emotional states on pain reduction, there exists a phenomenon known as the **anticipation of pain relief**, which is a significant **contributor to placebo analgesia.** This process targets the same brain regions as positive emotional states

regarding pain. Brain imaging studies have demonstrated that following the administration of placebo analgesia, pathways are activated that diminish the intensity of noxious stimuli.[3]

The understanding of **these findings puts the spotlight once again on the importance of creating mind-body techniques** that would target the different modulatory systems in a synergic way.

Overall, the relationship among pain, pain perception, and the mind is a dynamic interplay that underscores the holistic nature of pain management, requiring an integrated approach that considers the **biological, psychological, and behavioral dimensions of pain**.

IV. Virtual Reality:

1. What is VR ?

Virtual reality (VR) is a powerful technology that promises to change our lives unlike any other. By artificially stimulating our senses, our bodies become tricked into accepting another version of reality. VR is like a waking dream that could take place in a magical cartoon-like world or could transport us to another part of the Earth or universe.

Definition of VR: Inducing targeted behavior in an organism by using artificial sensory stimulation, while the organism has little or no awareness of the interference.

The hardware produces stimuli that override the senses of the user in the head-mounted display. Tracking is needed to adjust the stimulus based on human motions. It is also important to consider the surrounding physical world as part of the VR system. In spite of stimulation provided by the VR hardware, the user will always have other senses that respond to stimuli from the real world.[120]

Indeed, virtual reality (VR) has become a popular tool for studying human behavior and brain functions. This rise in popularity has sparked questions about the nature of VR: **How real is it? Does VR represent a true form of reality, or is it more accurately described as an advanced simulation?** A recent study aimed to determine the extent to which virtual reality can be considered has shown that today's VR setups using photorealistic 3D-360° experiences fulfill the

essential prerequisites for the emergence of a feeling of reality and paves the way for a more in-depth examination of the relevant cognitive and emotional processes as well as the technological features of VR giving rise to them. Furthermore, the study provides a scientific framework for developing **recreational, educational, and therapeutic VR application**.[121]

2. The use of VR in Health care

Although health and safety concerns present challenges for VR, the technology holds significant potential for improving our health. VR has found numerous applications in the medical field, both in training and therapy.

a. In Medical Training

There is a growing trend towards distributed medicine, where doctors train individuals in remote communities to perform routine medical procedures. This training is facilitated through telepresence and VR technology. For example, VR allows doctors to immerse themselves in 3D organ models generated from medical scan data. This enables them to better plan and prepare for surgeries by studying a patient's body in detail before an operation.

VR has the **potential to significantly reduce training costs** and increase the number of available training scenarios across various domains. Delivered online, these scenarios are convenient and inexpensive to access. While VR training may not always be cheaper, its benefits can justify the investment costs.[122]

Researchers have thoroughly explored using virtual reality for medical training, and VR has proved it's **efficacy in reducing errors** among healthcare workers and consequently **inhance patient** safety with well-designed simulation-based training.[123]

For instance, numerous authors have examined the performance differences between surgeons who underwent traditional training and those who received VR-based training. The results indicated that the VR-trained groups performed significantly better than the traditionally trained groups[124], [125], [126], [127]

Educators in gastroenterology have also extensively used simulation-based training in endoscopy. Although it has not been proven that VR can replace traditional training, it has been shown to **enhance trainee performance without compromising patient safety**. Studies suggest that VR could be a valuable addition to endoscopy training with the condition of making simulation programs more engaging and mimicking to real life.(128,129)

b. In Therapy

VR has vast potential to revolutionize healthcare and patient well-being with its diverse therapeutic applications.

It can help patients overcome **phobias and stress disorders** such as generalized anxiety disorder, social anxiety disorder post traumatic stress disorder, obssessive compulsive disorder, schizophrenia, **addcition** and the list goes on, through **exposure therapy and distraction**.[14], [18], [19]

VR has also been utilized to address **preprocedural anxiety and procedural pain**. It has been tested in dental care and venipuncture, particularly in the pediatric population [15], [17], as well as in preoperative anxiety in both children and adults. Studies have explored various surgical settings, including colorectal cancer surgery, cardiac surgery, pulmonary nodules, and CTO revascularization [24], [25], [26], [28], [128], [129]. VR has demonstrated positive effects in reducing preprocedural anxiety, thereby decreasing the need for excessive sedation and boosting morale in patients.

Another area of application is relieving **pain and anxiety in patients undergoing special treatments** like breat cancer patients, patients with Inflammatory bowel disease and burn victims. VR proved to be a good tool to support these patients through their painful and stress inducing experience. Thereby, increasinf adherence to tratment and follow ups as well as painting an optimisitic view about their diseases. [13], [20], [130]

Furthermore, virtual reality have been an accessible and inexpensive tool to assist in some **outpatient care interventions** going from simple wound care and cast removal to endoscopy and minor surgeries. [12], [131], [132], [133]

VR has been employed not only for endoscopy training, as discussed in the preceding chapter, but also to aid **patients undergoing endoscopic procedures**. Various studies have reported positive results regarding its **effectiveness in reducing anxiety and distracting from pain.** Several medical specialties, including gastroenterology for upper gastrointestinal exploration, as well as colonoscopy, and pneumology for bronchoscopy, have investigated the efficacy of this tool.[21], [22], [23], [134], [135], [136], [137], [138]. Additionally, doctors can use VR to explain medical options to patients and their families, helping them make more informed decisions.[139], [140], [141]

Last but not least VR can also improve or **maintain cognitive skills in aging individuals** and enhance motor skills to help those with balance, muscular, or nervous system disorders, with a potential to improve longevity and quality of life for older adults by allowing them to virtually travel, engage in enjoyable physical therapy, and overcome loneliness by connecting with family and friends in a way that feels present and inclusive.

The list of applications of VR in the medical field and the aspirations that science has for this tool are extensive. Virtual reality has demonstrated its efficacy on multiple levels, paving the way for further advancements in programs to enhance engagement and realism for better outcomes, all while maintaining safety, affordability, and accessibility.

PART II: General Discussion and Conclusions

The aim of this study was to investigate the impact of virtual reality (VR) exposure on patients scheduled to undergo colonoscopy. While numerous studies have examined the effects of auditory and visual stimuli, as well as VR, on patient experiences in different medical fields (as discussed in the previous chapter) there is a notable gap in the research concerning the influence of VR exposure during colonoscopy. This study seeks to address this gap by evaluating how VR exposure affects patients' procedural experiences, comparing the results to the few available studies in the literature, and potentially offering insights into new methods for enhancing patient comfort and reducing anxiety during colonoscopy.

I. Procedure characteristics:

The characteristics of the procedure were not only evaluated to ensure the groups were comparable but also to examine the impact of VR on the procedure, determining if it had a positive or negative effect on its progression.

In our study, the caecum was intubated in 97% of procedures, with an average time of **20.87 minutes** in the control group compared to **24.48 minutes** in the VR group. Additionally, the overall time to complete the procedure was **5.14 minutes shorter** in the VR group **(30.03 min in VR group vs 35.17 min).**

There is a notable improvement in caecal intubation time as well as in total procedural time. Moreover, the use of VR did not negatively affect the progression of the procedure.

Our results are in concordance with studies in the literature that have evaluated the use of VR in patients undergoing colonoscopies like the pilot study of **Veldhuijzen et al, 2020 [138]** conducted in the Netherlands. Despite the use of conscious sedation in their study, the VR group showed positive effects on procedure characteristics, although there was no significant difference in total procedure time, there was a significant decrease in caecal intubation time.

Other studies, such as **Çakır and Evirgen,2021[135]** in Turkey and **Qizhi Liu et al.,2022 [142]** in China, which were conducted on unsedated patients, focused on evaluating total procedural time and the completion of the procedure. These studies also reported no significant difference in total procedural time but observed a positive effect of VR, with no adverse impacts on the procedure or patient communication.

Table 16 : Characteristics of the mentioned studies.

Authors	Year	Country	Sedation	Hardware
Veldhuijzen et al.	2020	Netherlands	Conscious sedation	Samsung gear VR
Çakır and Evirgen	2021	Turkey	Unsedated	VR cardboard by google
Qizhi Liu et al	2022	China	Unsedated	Nibiru 3.50.005

Table 17 : Procedure characteristics in literature review.

Procedural Characteristics	Veldhuijzen et al.	Çakır and Evirgen	Qizhi Liu et al	Our study
Completed colonoscopies %				
Control	100	100	100	93
VR	90	100	100	100
Time to reach caecum				
Control	10.48	-	-	24.47
VR	6.83	-	-	20.87
Total procedural time				
Control	21.20	7.36	16	35.17
VR	22.60	7.30	15	30.03
Note: **In our study, the time to reach the caecum and the total procedural time are presented as means, whereas in the other studies, these metrics are reported as medians.**				

II. Analysis of Procedural Anxiety:

Colonoscopy is often depicted as an anxiety-**inducing** procedure in the literature, characterized by high levels of pre-procedural anxiety [143].

The increased recognition of high levels of pre-procedural anxiety associated with colonoscopy has prompted the use of anxiolytics for sedation. However, it has also underscored the importance of addressing the psychological aspect of colonoscopy, particularly given the adverse effects associated with sedation and anesthesia.

Among the various studied techniques aimed at alleviating colonoscopy-induced anxiety, which include meditation, music therapy, and visual distraction [7], [8], [9], [10], [11], [144], [145], [146] , virtual reality (VR) has emerged as a notable intervention.

Our study suggests a beneficial effect of VR on procedural anxiety, as evidenced by a greater reduction in anxiety levels from pre- to post-colonoscopy in the VR group compared to the control group (control group: **17.3 to** 16.2 versus VR group: **17.4 to** 15.8).

Our findings corroborate other studies that point to VR as an effective anxiolytic. For instance a cohort study conducted in the USA by **Friedman et al [136]** in 2021, on unsedated patients who had previously undergone colonoscopy under conscious sedation, aimed to assess patients' attitude towards VR as a potential alternative to sedation. Among the patients surveyed, 42.3% reported feeling less anxious, 30.8% reported experiencing similar levels of anxiety, and only 11.5% reported feeling more anxious compared to their last colonoscopy under conscious sedation.

The **Turkish study as well as the Dutch study** [135], [138] found no significant difference between the pre and post operative anxiety. **Veldhuijzen et al.** has even reported an increase in median anxiety score after the procedure in both groups. This could be explained by various psychological factors that influence anxiety, such as pain catastrophizing and impaired emotional processing, as outlined in the chapter on emotional and cognitive processing.

The **Chinese study** [142] employed a unique approach to assess patients' anxiety, utilizing skin conductance measurements in conjunction with monitoring heart rate and blood pressure.

They observed a notable decrease in heart rate five minutes after colonoscope insertion, as well as a reduction in skin conductance values, indicating that VR technology might alleviate patients' nervousness.

Table 18 : Psychometric evaluation of Anxiety in literature review.

<table>
<tr><th>Author</th><th>Country</th><th>Psychometric Evaluation of Anxiety</th></tr>
<tr><td>Friedman et al 2021</td><td>USA</td><td>Anxiety vs. past sedation colonoscopy
Less anxiety- 11 (42.3)
Similar anxiety – 8(30.8)
More anxiety – 3 (11.5)
Do not remember – 1 (3.8)</td></tr>
<tr><td>Çakır and Evirgen 2021</td><td>Turkey</td><td>Trait and state anxiety expressed in median<table><tr><th></th><th>VR</th><th>CONTROL</th><th>P</th></tr><tr><td>TRAIT ANXIETY</td><td>39.73 ± 3.14</td><td>46.70 ± 5.97</td><td>.000</td></tr><tr><td>PRE-PROCEDURAL STATE ANXIETY</td><td>47.70 ± 3.55</td><td>48.28 ± 5.26</td><td>.647</td></tr><tr><td>POST-PROCEDURAL STATE ANXIETY</td><td>46.83 ± 10.94</td><td>49.66 ± 2.83</td><td>.175</td></tr></table></td></tr>
<tr><td>Veldhuijzen et al. 2020</td><td>Netherlands</td><td>Trait and state Anxiety expressed in median.<table><tr><th></th><th>VR</th><th>CONTROL</th><th>P</th></tr><tr><td>TRAIT ANXIETY</td><td>35 [28; 41.5]</td><td>29 [21; 36.5]</td><td>0.1562</td></tr><tr><td>PRE-PROCEDURAL</td><td>48.5 [45.75; 50.25]</td><td>49 [48, 50]</td><td>0.4972</td></tr><tr><td>POST-PROCEDURAL</td><td>50 [47.75; 51.25]</td><td>50 [48; 52.5]</td><td>0.5492</td></tr></table></td></tr>
<tr><td>Qizhi Liu et al 2022</td><td>China</td><td><table><tr><th></th><th>CONTROL</th><th>VR</th></tr><tr><td>SKIN CONDUCTION</td><td>0.66</td><td>0.390</td></tr><tr><td>HEART RATE</td><td colspan="2">lower in VR group with p<0.001)</td></tr></table></td></tr>
<tr><td>Our study 2024</td><td>Morocco</td><td>Trait and state anxiety expressed in mean.<table><tr><th></th><th>CONTROL</th><th>VR</th></tr><tr><td>TRAIT ANXIETY</td><td>14.53</td><td>14.36</td></tr><tr><td>PRE-PROCEDURAL</td><td>17.33</td><td>17.4</td></tr><tr><td>POST-PROCEDURAL</td><td>16.2</td><td>15.8</td></tr></table></td></tr>
</table>

Various authors have explored the anxiolytic potential of VR across diverse medical contexts. For instance, **Kim et al.[147]** found that VR exposure prior to endoscopic procedures reduced anxiety levels and increased satisfaction with sedation. **Nguyen et al.[22]** demonstrated VR's safety and effectiveness in reducing anxiety and costs in children and young adults undergoing unsedated transnasal endoscopy for eosinophilic esophagitis. Pre-operative anxiety has also been addressed, as evidenced by **Turrado et al.[24]**'s randomized trial on colorectal cancer patients, which showed decreased anxiety and depression levels with VR simulation. These findings, along with others discussed in the chapter on the use of VR in the medical field, support the anxiolytic effects of VR observed in our study.

III. Pain and Comfort Evaluation:

Effective pain management is paramount for colonoscopy patients due to its significant impact on procedural outcomes. High levels of pain not only hinder the completion of colonoscopies but also diminish patients' willingness to undergo repeat procedures in the future. Therefore, implementing strategies to mitigate pain during colonoscopies is essential to ensure patient comfort, procedural success, and encourage continued participation in colonoscopy screenings for the prevention and early detection of colorectal conditions.

VR has been investigated as a method to reduce pain through distraction, capitalizing on the principle of redirecting attention. Research has shown that focusing attention on pain tends to amplify the perceived intensity of the sensation.[3]

Multiples studies have reported VR's efficacy on reducing pain. For instance, the study of **Mosso Vázquez et al, 2014 [26]** about the use of VR to manage Pain in cardiac surgery suggests that Virtual reality (VR) provides a noninvasive and safe method for easing postsurgical distress in intensive care units (ICUs). By allowing patients to interact with virtual environments (VE) using various senses, VR encourages immersion in an alternate reality, thereby improving the distractive aspects of pain management.

Another study conducted by **Genç et al, 2022** [132] examined the impact of combining virtual reality (VR) with a stress ball during transrectal prostate biopsy. The findings revealed that using

VR glasses and squeezing stress balls during the procedure significantly reduced pain and had a positive influence on vital signs.

The findings of **our study,** coupled with those from various other investigations, further reinforce the efficacy of virtual reality (VR) in pain reduction. Our research specifically highlights a decrease in pain within the VR group (5.83 in control group versus 4.53 in the VR group), affirming the potential of VR technology to alleviate discomfort during medical procedures.

The same findings were reported by **Qizhi Liu et al.**[142] and **Çakır and Evirgen** [135], indicating that pain reduction can be achieved through VR technology. Compared with the control group, patients in the VR group experienced significantly higher satisfaction levels with pain control and reported lower pain scores.

In the **American study** [136], 96.3% of participants completed their colonoscopies using VR without any sedative or narcotic medications, reporting minimal pain (mean procedural pain: 3.5). Although an equal proportion of patients (42%) described the procedure as similarly or more painful, it is evident that VR had a notable effect on pain reduction. Conversely, the **Dutch study** [138] revealed similar median pain scores before and during the procedure in both groups. However, patient comments described the impact of VR as positive.

The examination of various studies **Table 18** elucidates the multifaceted role of virtual reality (VR) technology in pain management across medical procedures. VR's ability to distract patients from pain through immersive virtual environments underscores its potential as a noninvasive and safe adjunct to traditional pain management strategies.

Regarding comfort, our study found that most patients rated their comfort as mild in both groups. However, the VR group had slightly more patients experiencing minimal discomfort and fewer patients reporting severe discomfort. Thus, although the difference was not very significant, VR had a positive effect on improving comfort levels. These findings are consistent with those of **Veldhuijzen et al.** and **Friedman et al.[136], [138]**

Table 19 : Pain Evaluation in Literature review.

<table>
<tr><th>Author</th><th>Country</th><th>Evaluation of Pain</th></tr>
<tr><td>Friedman et al
2021</td><td>USA</td><td>Pain vs. past sedation colonoscopy
Less pain- 1 (3.8)
Similar pain – 11 (42.3)
More pain – 11 (42.3)</td></tr>
<tr><td>Çakır and Evirgen
2021</td><td>Turkey</td><td><table><tr><th></th><th>VR</th><th>CONTROL</th><th>P</th></tr><tr><td>DURING PROCEDURE</td><td>2.76 ± 1.25</td><td>3.76 ± 2.11</td><td>.03</td></tr><tr><td>POST PROCEDURAL</td><td>0.83 ± 1.44</td><td>1.36 ± 1.51</td><td>.175</td></tr></table></td></tr>
<tr><td>Veldhuijzen et al.
2020</td><td>Netherlands</td><td><table><tr><th></th><th>VR</th><th>CONTROL</th><th>P</th></tr><tr><td>PRE-PROCEDURAL</td><td>0[0,3]</td><td>0 [0; 1.75]</td><td>0.968</td></tr><tr><td>POST-PROCEDURAL</td><td>3 [1,4]</td><td>3 [1.5; 5.5]</td><td>0.661</td></tr></table></td></tr>
<tr><td>Qizhi Liu et al
2022</td><td>China</td><td><table><tr><th></th><th>VR</th><th>CONTROL</th></tr><tr><td>DURIN THE PROCEDURE</td><td>5 (4–6)</td><td>7 (6–8)</td></tr></table></td></tr>
<tr><td>Our study
2024</td><td>Morocco</td><td><table><tr><th></th><th>VR</th><th>CONTROL</th></tr><tr><td>BEFORE</td><td>0</td><td>0</td></tr><tr><td>DURING THE PROCEDURE</td><td>4.53</td><td>5.83</td></tr></table></td></tr>
</table>

IV. Satisfaction and Willingness to return:

As discussed in detail in the previous literature review chapter, several barriers compromise patient satisfaction with colonoscopy and their willingness to undergo future procedures. These barriers include:

- **Pain and Discomfort:** The physical discomfort and pain associated with the procedure can deter patients from wanting to repeat the experience. Even with sedation, the anticipation of pain can cause anxiety and reluctance.
- **Emotional Factors:** Fear and embarrassment play significant roles. Fear of potential pain, the possibility of discovering cancer, and the overall procedure can cause significant anxiety. Embarrassment about the invasive nature of the procedure and the exposure of private body parts further discourages participation.
- **Sedation and Recovery:** The need for sedation requires patients to arrange for an escort and disrupts their daily activities. This inconvenience, along with the recovery time needed post-procedure, can be a substantial deterrent, especially for working adults.
- **Cost and Resources:** The administration of moderate sedation is resource-intensive, requiring pre-procedure evaluations, IV access, medication administration, patient monitoring, and post-procedure recovery management. These factors can contribute to the overall cost, which might be a financial burden for some patients.
- **Preparation Requirements:** The bowel preparation required before a colonoscopy is often cited as uncomfortable and unpleasant. The need to follow a restrictive diet and use laxatives can be off-putting for many individuals.
- **Previous Negative Experiences:** Patients who have had previous negative experiences with colonoscopies, whether due to pain, discomfort, or other issues, are less likely to want to undergo the procedure again.

Addressing these barriers through improved pain management, reducing emotional stress, minimizing the impact of sedation, and streamlining the preparation process can enhance patient satisfaction and willingness to adhere to recommended colonoscopy schedules.

Following the heightened interest in studying the psychological and socio-economic barriers to colonoscopy, VR has re-emerged as a tool to address these issues. It aims to enhance the psychological experience and mitigate socio-economic challenges, ultimately increasing patient adherence to colonoscopy by improving their overall experience and facilitating access to the procedure.

A study conducted in the Netherlands by the university of Groningen, by **Blokzijl et al.,2018 [134]** evaluated patients willingness to undergo colonoscopy with virtual reality instead of procedural sedation. All adults referred for a non-emergent colonoscopy were eligible to participate. They were requested to complete a survey before the actual colonoscopy procedure. Participation in the survey did not affect the subsequent colonoscopy process, which proceeded as usual. In total, 25.7% of participants expressed their willingness to begin with VR instead of sedation. Studies like these paved the way for further evaluations of practical VR applications.

Based on this, **our study** focused on assessing patient satisfaction and willingness to return. Our results indicate that the VR group had higher overall satisfaction, with 74% of patients being satisfied or very satisfied compared to 54% in the control group. To better evaluate this, we also calculated the Net Promoter Score (NPS) in addition to the Likert scale, and found that the NPS was higher in the VR group, further emphasizing the positive impact of VR on the overall experience.

Regarding willingness to return, the majority of the studied population agreed to undergo further colonoscopies, favoring unsedated procedures. Distribution by groups revealed that overall willingness to return was higher in the VR group, with more patients strongly agreeing and fewer patients disagreeing with the statement.

Our findings align with the conclusions of both the **American and Chinese studies** [136], [142], which also reported increased overall satisfaction with the use of VR and willingness to return. In the American study, the majority of patients who had previously undergone colonoscopy with conscious sedation indicated they would prefer VR for future procedures. **Friedman et al**. further explored the reasons behind this preference, identifying several key motivators. The strongest motivator was the ability to drive and perform normal activities post-

procedure, followed by the desire to avoid narcotics. Moderate motivators included the perception that the procedure was not uncomfortable and the lack of need for an escort for pick-up.

The Dutch study [138] reported that no differences were observed between the two groups in terms of patient satisfaction. Both groups exhibited high satisfaction rates, and the majority of patients in both groups expressed a willingness to return for future procedures. The absence of significant differences may be attributed to the use of conscious sedation for both groups during the study. These findings further underscore the positive effect of VR, as they eliminate the possibility of VR hindering a positive patient experience.

V. Endoscopists' Feedback:

As quality and safety are paramount considerations, endoscopists' feedback is vital for evaluating the effectiveness of VR. They can observe its impact on the procedure's progression and determine whether VR enhances or compromises quality.

All of our endoscopists expressed comfort in incorporating VR into their practice and reported having a positive experience with it. No difficulties were encountered during the procedure as well, except for minor adjustments needed when patients had to change positions.

According to **Friedman et al.** [136] and **Qizhi Liu et al**. [142] , who also assessed endoscopists' feedback, there were no reported difficulties, and endoscopists expressed comfort in using VR as a pain management strategy. **Liu et al.** even noted a decrease in difficulty with VR compared to traditional unsedated colonoscopy.

Based on our findings and the literature review, it is safe to conclude that VR not only impacts patients' experiences but also those of endoscopists. Thus, it effectively addresses two key aspects: enhancing patients' adherence to colonoscopy by reducing pain, anxiety, and discomfort, while also ensuring quality and safety.

CONCLUSION

Our study demonstrates the promising potential of virtual reality (VR) as an effective tool for enhancing patient experience during colonoscopy. By conducting the study in a real-life setting with a representative sample of patients, we have ensured the external validity of our findings. Utilizing the Samsung Gear VR, a widely available and relatively inexpensive device, further enhances the generalizability of our results, making VR a feasible option for broader clinical application.

Study Strengths:

Real-Life Setting: Conducting the study in a real-world environment increases the applicability of our findings to everyday clinical practice.

Representative Sample: The diverse patient sample adds robustness to our conclusions, ensuring that the results are relevant to a wide range of individuals undergoing colonoscopy.

Accessibility of VR Technology: Using an affordable and accessible VR device like the Samsung Gear VR supports the practicality of implementing VR in various healthcare settings.

Study Limitations:

Variability in Endoscopist Experience: The involvement of multiple endoscopists with varying levels of experience could influence the results, as less experienced endoscopists might affect the procedure and patient experience differently.

Busy Endoscopy Unit: The high activity level of the endoscopy unit could increase patient anxiety and rush the assessment process, potentially impacting the study's outcomes.

High Illiteracy Rates: The significant level of illiteracy among the patient population made the assessment process challenging, possibly affecting the accuracy and completeness of the data collected.

In summary, while our study underscores the beneficial impact of VR in reducing anxiety, pain, and discomfort during colonoscopy, it also highlights areas that need further refinement. Future research should aim to address these limitations, possibly through more standardized training for endoscopists and ensuring a calmer assessment environment. Nonetheless, VR presents a viable, non-invasive, and cost-effective method to improve patient satisfaction and adherence to colonoscopy, suggesting its broader implementation in clinical practice.

ABSTRACT

Abstract

Introduction

Colonoscopy is the gold standard for screening due to its high sensitivity and specificity, enabling the identification and removal of neoplasia and precancerous lesions, as well as the diagnosis and follow-up of various colonic diseases. Despite its importance, patients often find colonoscopy stressful, painful, and uncomfortable. While sedatives and analgesics are commonly used to alleviate pain and anxiety, the procedure is still frequently reported as distressing. Additionally, anesthesia assistance increases the risk of complications and requires more resources, which raises costs and reduces efficiency. Recent studies have explored reducing sedation or performing high-quality colonoscopies without it to minimize adverse effects, reduce resource use, and improve patient cooperation. Various distraction and cognitive engagement methods, such as meditation, music, and games, have been recognized for their pain management and emotional regulation benefits. With technological advancements, virtual reality (VR) has gained interest for its therapeutic applications. VR offers an immersive experience that diverts attention from pain and engages multiple senses, enhancing its effectiveness as a distraction tool.

Study Aim

The aim of the study was to assess the impact of virtual reality on five key areas of investigation: Anxiety, Pain, Comfort, Satisfaction and willingness to undergo further colonoscopies and Procedural characteristics.

Patients and methods

- We conducted an experimental, randomized, controlled research to evaluate the effect of VR on reducing pain and anxiety in non-sedated patients undergoing outpatient colonoscopy. A control group was designed to allow evaluation of procedural and patient-related outcomes. The sample size was set at 30 subjects per group. All patients above 18 years of age with elective indication for colonoscopy were eligible. Collection of data was by a questionnaire based on validated scales and scores for anxiety, pain, comfort and satisfaction. The study was conducted in the Endoscopy unit - Department of Gastroenterology, CHU Mohammed 6 in Marrakech.

Results

Our study demonstrates that VR has a positive impact on various aspects of the colonoscopy procedure. Firstly, VR reduced the time to caecum intubation by 3.61 minutes (20.87 vs 24.48 min) and total procedure by 5.14 minutes (30.03 vs 35.1min) . Additionally, VR showed beneficial effects on procedural anxiety, with a greater reduction in anxiety levels from pre- to post-colonoscopy in the VR group compared to the control group (VR group: 17.4 to 15.8; control group: 17.3 to 16.2).

In terms of pain reduction and comfort improvement, our research highlights a significant decrease in pain for the VR group (5.83 in the control group versus 4.53 in the VR group). Most patients rated their comfort as mild in both groups, but the VR group had slightly more patients reporting minimal discomfort and fewer patients reporting severe discomfort.

Overall satisfaction was notably higher in the VR group, with 74% of patients being satisfied or very satisfied, compared to 54% in the control group. The Net Promoter Score (NPS) was also higher in the VR group (-0.33) compared to the control group (-16.66), further emphasizing the positive impact of VR on the overall patient experience.

Regarding willingness to return for another colonoscopy, the VR group showed higher overall willingness, with more patients strongly agreeing and fewer disagreeing with the statement compared to the control group (Strongly agree: 3, Agree: 19, Disagree: 6, Strongly disagree: 2 in the VR group versus 0, 17, 10, and 3 in the control group).

Endoscopists' feedback was also positive, with all reporting comfort in incorporating VR into their practice, giving it a mean score of 8 (ranging from 7.5 to 9). They rated their overall experience with VR as good, with a mean score of 8.3 (ranging from 8 to 9). Endoscopists noted that VR had a relaxing effect on them, with no significant difficulties encountered except occasional adjustments when patients needed to change positions.

Conclusion

In conclusion, patients accepted VR distraction during colonoscopy without compromising the procedure's technical success. The study found that VR exposure reduces patients' anxiety, pain, and discomfort during colonoscopy, with no adverse effects reported. It also improves patient satisfaction and consequently adherence to screenings and follow-ups.

VR, being easily available, non-invasive, and inexpensive with minimal implementation time, can be widely recommended for routine use in endoscopy units as a promising tool for alleviating pain and improving patient experiences.

Résumé

Introduction

La coloscopie est la référence en matière de dépistage grâce à sa haute sensibilité et spécificité, permettant l'identification et l'élimination des néoplasies et des lésions précancéreuses, ainsi que le diagnostic et le suivi de diverses maladies coliques. Malgré son importance, les patients trouvent souvent la coloscopie stressante, douloureuse et inconfortable. Bien que des sédatifs et des analgésiques soient couramment utilisés pour atténuer la douleur et l'anxiété, la procédure est souvent perçue comme éprouvante. De plus, l'assistance anesthésique augmente le risque de complications et nécessite plus de ressources, ce qui augmente les coûts et réduit l'efficacité. Des études récentes ont exploré la réduction de la sédation ou la réalisation de coloscopies de haute qualité sans sédation afin de minimiser les effets indésirables, de réduire l'utilisation des ressources et d'améliorer la coopération des patients. Diverses méthodes de distraction et d'engagement cognitif, telles que la méditation, la musique et les jeux, ont été reconnues pour leurs bienfaits en gestion de la douleur et régulation émotionnelle. Avec les avancées technologiques, la réalité virtuelle (RV) suscite un intérêt croissant pour ses applications thérapeutiques. La RV offre une expérience immersive qui détourne l'attention de la douleur et engage plusieurs sens, améliorant ainsi son efficacité en tant qu'outil de distraction.

Objectif de l'étude

L'objectif de l'étude était d'évaluer l'impact de la réalité virtuelle sur cinq domaines clés d'investigation : l'anxiété, la douleur, le confort, la satisfaction et la volonté de subir d'autres coloscopies, ainsi que les caractéristiques procédurales.

Patients et Méthodes

Nous avons mené une recherche expérimentale, randomisée et contrôlée pour évaluer l'effet de la RV sur la réduction de la douleur et de l'anxiété chez des patients non sédatés subissant une coloscopie en ambulatoire. Un groupe de contrôle a été conçu pour permettre l'évaluation des résultats procéduraux et liés aux patients. La taille de l'échantillon était de 30 sujets par groupe. Tous les patients âgés de plus de 18 ans avec une indication élective pour une coloscopie étaient éligibles.

La collecte de données s'est faite par un questionnaire basé sur des échelles et des scores validés pour l'anxiété, la douleur, le confort et la satisfaction. L'étude a été menée dans l'unité d'endoscopie du Département de gastro-entérologie, CHU Mohammed 6 à Marrakech.

Résultats

Notre étude démontre que la RV a un impact positif sur divers aspects de la coloscopie. Premièrement, la RV a réduit le temps d'intubation du cæcum de 3.61 minutes (20.87 vs 24.48 min) et du temps totale de l'intervention de 4,29 min (30.03 vs 35.17 min). De plus, la RV a montré des effets bénéfiques sur l'anxiété procédurale, avec une réduction plus importante des niveaux d'anxiété avant et après la coloscopie dans le groupe RV par rapport au groupe de contrôle (groupe RV : 17,4 à 15,8 ; groupe de contrôle : 17,3 à 16,2). En termes de réduction de la douleur et d'amélioration du confort, notre recherche souligne une diminution significative de la douleur pour le groupe RV (5,83 dans le groupe de contrôle contre 4,53 dans le groupe RV). La plupart des patients ont évalué leur confort comme étant modéré dans les deux groupes, mais le groupe RV comptait légèrement plus de patients rapportant un inconfort minimal et moins de patients rapportant un inconfort sévère. La satisfaction globale était notablement plus élevée dans le groupe RV, avec 74 % des patients étant satisfaits ou très satisfaits, contre 54 % dans le groupe de contrôle. Le Net Promoter Score (NPS) était également plus élevé dans le groupe RV (-0,33) par rapport au groupe de contrôle (-16,66), soulignant encore davantage l'impact positif de la RV sur l'expérience globale du patient. Concernant la volonté de revenir pour une autre coloscopie, le groupe RV a montré une volonté globale plus élevée, avec plus de patients fortement d'accord et moins de patients en désaccord avec l'affirmation par rapport au groupe de contrôle (fortement d'accord : 3, d'accord : 19, en désaccord : 6, fortement en désaccord : 2 dans le groupe RV contre 0, 17, 10 et 3 dans le groupe de contrôle). Les retours des endoscopistes étaient également positifs, tous rapportant se sentir à l'aise d'incorporer la RV dans leur pratique, avec une note moyenne de 8 (allant de 7,5 à 9). Ils ont évalué leur expérience globale avec la RV comme étant bonne, avec une note moyenne de 8,3 (allant de 8 à 9). Les endoscopistes ont noté que la RV avait un effet relaxant sur eux, sans difficultés majeures rencontrées sauf des ajustements occasionnels lorsque les patients devaient changer de position.

Conclusion

En conclusion, les patients ont accepté la distraction par RV pendant la coloscopie sans compromettre le succès technique de la procédure. L'étude a montré que l'exposition à la RV

réduit l'anxiété, la douleur et l'inconfort des patients pendant la coloscopie, sans effets indésirables rapportés.

Elle améliore également la satisfaction des patients et par conséquent leur adhésion aux dépistages et suivis. La RV, étant facilement disponible, non invasive et peu coûteuse avec un temps de mise en œuvre minimal, peut être largement recommandée pour une utilisation routinière dans les unités d'endoscopie comme un outil prometteur pour soulager la douleur et améliorer l'expérience des patients.

ملخص

مقدمة

تُعتبر عملية تنظير القولون المعيار الذهبي للفحص بسبب حساسيتها ونوعيتها العالية، مما يُمكن من تحديد وإزالة الأورام والآفات ما قبل السرطانية، وكذلك تشخيص ومتابعة مختلف أمراض القولون. على الرغم من أهميتها، غالبًا ما يجد المرضى أن تنظير القولون مُجهد ومؤلم وغير مريح. في حين تُستخدم المُهدئات والمسكنات بشكل شائع لتخفيف الألم والقلق، إلا أن الإجراء لا يزال يُعتبر مزعجًا بشكل متكرر. بالإضافة إلى ذلك، يزيد استخدام المساعدة التخديرية من مخاطر المضاعفات ويتطلب موارد أكثر، مما يرفع التكاليف ويقلل من الكفاءة. استكشفت الدراسات الحديثة تقليل التخدير أو إجراء تنظير عالي الجودة بدونه لتقليل الآثار السلبية وتقليل استخدام الموارد وتحسين تعاون المرضى. وقد تم الاعتراف بطرق الإلهاء والتفاعل المعرفي المختلفة، مثل التأمل والموسيقى والألعاب، لفوائدها في إدارة الألم وتنظيم العواطف. ومع التقدم التكنولوجي، اكتسبت الواقع الافتراضي (VR) اهتمامًا لتطبيقاته العلاجية. يوفر الواقع الافتراضي تجربة غامرة تُبعد الانتباه عن الألم وتشرك الحواس المتعددة، مما يعزز فعاليته كأداة إلهاء.

هدف الدراسة

كان هدف الدراسة تقييم تأثير الواقع الافتراضي على خمسة مجالات رئيسية للتحقيق: القلق، الألم، الراحة، الرضا، والاستعداد للخضوع لمزيد من إجراءات تنظير القولون، والخصائص الإجرائية.

المرضى والأساليب • أجرينا بحثًا تجريبيًا، عشوائيًا، مُراقبًا لتقييم تأثير الواقع الافتراضي على تقليل الألم والقلق لدى المرضى غير المخدرين الذين يخضعون لتنظير القولون في العيادات الخارجية. تم تصميم مجموعة ضابطة للسماح بتقييم النتائج الإجرائية والمتعلقة بالمرضى. تم تحديد حجم العينة عند 30 مريضًا لكل مجموعة. كان جميع المرضى فوق سن 18 عامًا ولديهم مؤشر اختياري لتنظير القولون مؤهلين. تم جمع البيانات باستخدام استبيان يعتمد على مقاييس معتمدة لتقييم القلق والألم والراحة والرضا. أجريت الدراسة في وحدة التنظير - قسم أمراض الجهاز الهضمي في CHU محمد السادس في مراكش.

النتائج

تُظهر دراستنا أن الواقع الافتراضي له تأثير إيجابي على مختلف جوانب إجراء تنظير القولون. أولاً، قلل الواقع الافتراضي من وقت دخول الأعور بمقدار 3.61 دقيقة (20.87 دقيقة مقابل 24.48 دقيقة) والإجراء الكلي بمقدار 5.14 دقيقة (30.03 دقيقة مقابل 35.1 دقيقة). بالإضافة إلى ذلك، أظهر الواقع الافتراضي تأثيرات مفيدة على القلق الإجرائي، مع تقليل أكبر في مستويات القلق من قبل إلى بعد التنظير في مجموعة الواقع الافتراضي مقارنةً بالمجموعة الضابطة (مجموعة الواقع الافتراضي: 17.4 إلى 15.8؛ المجموعة الضابطة: 17.3 إلى 16.2.(

فيما يتعلق بتقليل الألم وتحسين الراحة، تُبرز أبحاثنا انخفاضًا كبيرًا في الألم لمجموعة الواقع الافتراضي (5.83 في المجموعة الضابطة مقابل 4.53 في مجموعة الواقع الافتراضي). قيَّم معظم المرضى راحتهم على أنها خفيفة في كلا المجموعتين، لكن مجموعة الواقع الافتراضي كان لديها عدد قليل من المرضى الذين أبلغوا عن عدم ارتياح شديد وعدد أقل من المرضى الذين أبلغوا عن عدم ارتياح شديد.

كان الرضا العام أعلى بشكل ملحوظ في مجموعة الواقع الافتراضي، حيث كان 74٪ من المرضى راضين أو راضين جدًا، مقارنة بـ 54٪ في المجموعة الضابطة. كان صافي نقاط الترويج (NPS) أيضًا أعلى في مجموعة الواقع الافتراضي (-0.33) مقارنةً بالمجموعة الضابطة (-16.66)، مما يؤكد التأثير الإيجابي للواقع الافتراضي على تجربة المريض بشكل عام.

فيما يتعلق بالاستعداد للعودة لإجراء تنظير قولون آخر، أظهرت مجموعة الواقع الافتراضي استعدادًا أعلى بشكل عام، حيث وافق عدد أكبر من المرضى بشدة ورفض عدد أقل منهم البيان مقارنة بالمجموعة الضابطة (الموافقة الشديدة: 3، الموافقة: 19، الرفض: 6، الرفض الشديد: 2 في مجموعة الواقع الافتراضي مقابل 0، 17، 10، و 3 في المجموعة الضابطة.(

كان تغذية الاسترجاع من أطباء التنظير أيضًا إيجابيًا، حيث أفاد جميعهم براحة في دمج الواقع الافتراضي في ممارساتهم، حيث أعطوه درجة متوسطة تبلغ 8 (تتراوح بين 7.5 و 9). قيَّموا تجربتهم العامة مع الواقع الافتراضي على أنها جيدة، بمتوسط درجة 8.3 (تتراوح بين 8 و 9). لاحظ أطباء التنظير أن الواقع الافتراضي كان له تأثير مريح عليهم، دون صعوبات كبيرة إلا التعديلات العرضية عندما يحتاج المرضى إلى تغيير أوضاعهم.

الخلاصة

في الختام، قَبِلَ المرضى إلهاء الواقع الافتراضي خلال تنظير القولون دون التأثير على نجاح الإجراء الفني. وجدت الدراسة أن التعرض للواقع الافتراضي يقلل من قلق المرضى وألمهم وانزعاجهم خلال تنظير القولون، دون الإبلاغ عن أي آثار سلبية. كما يُحسن الرضا لدى المرضى وبالتالي الامتثال للفحوصات والمتابعات.

APPENDIXES

Index 1

المركز الاستشفائي الجامعي محمد السادس مراكش
Centre Hospitalier Universitaire Mohammed VI Marrakech

MARRAKECH جامعة القاضي عياض UNIVERSITÉ CADI AYYAD
كلية الطب والصيدلة - مراكش
FACULTÉ DE MÉDECINE ET DE PHARMACIE - MARRAKECH

ASSESSMENT SHEET

The purpose of this study is to evaluate VR's effect on reducing pain and anxiety during colonoscopy. This questionnaire serves on evaluating pre-colonoscopy anxiety levels, pain levels perceived during the procedure as well as the satisfaction and willingness to undergo further colonoscopies

T1 : BASELINE CHARACTERISTICS :

1. Personal Information :

First/last name	
IP	
Age	
Gender	
Level of education	

2. Clinical Information :

- Medical History :

  Diabetes Hypertension Cardiopathy Neoplasia Nephropathy

  Other : .....

- Surgical History :

  ○ No
  ○ Yes : .....

- Allergies/Medication history :

  Allergies :
  ○ No
  ○ Yes : .....

  Medications :
  ○ No
  ○ Yes : .....

- Substance Abuse history :

  None Alcohol Tabacco Cannabis

  Other : .....

3. Previous colonoscopies

O None

O Yes

4. Previous experience with VR

O None

O Yes

4. Colonoscopy Indication :

O Colorectal cancer
O Abdominal pain
O Chronic constipation
O Rectorrhagia
O Chronic diarrhea
O Melenas

O IBD Screening
O Monitoring of IBD
O Acute IBD flair-up
O Anemia Screening
O General deterioration check up

5. Results of the Colonoscopy :

O Colonoscopy without abnormalities
O Rectocolic Polyposis
O Rectocolic Tumor

O Inflammatory Bowl Disease
O Diverticulosis
O Angiodysplasia of the colon

Other : .....

T2 : EVALUATION OF PRE-COLONOSCOPY ANXIETY LEVELS :

Below are some of the statements that people often use to describe themselves. Read each statement and choose the appropriate expression on the right to indicate your most appropriate feeling AT THE MOMENT. There is no right or wrong answer.

	Here's how you feel at the moment.	Not at all	Somewhat	Moderately so	Very much so
05	I feel at ease*	O	O	O	O
10	I feel comfortable*	O	O	O	O
15	I am relaxed*	O	O	O	O
16	I feel content*	O	O	O	O
19	I feel steady*	O	O	O	O
20	I feel pleasant*	O	O	O	O
	Here's how you feel often.	Not at all	Somewhat	Moderately so	Very much so
21	I feel pleasant*	O	O	O	O
23	I feel satisfied with myself*	O	O	O	O
26	I feel rested*	O	O	O	O
27	I am 'calm, cool and collected'*	O	O	O	O
30	I am happy*	O	O	O	O
33	I feel secure*	O	O	O	O
36	I am content*	O	O	O	O

STATE :

.....

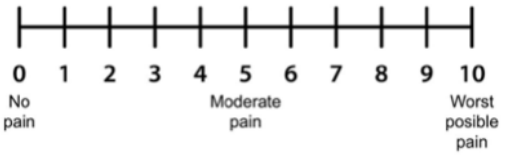
TRAIT :

.....

T3 : EVALUATION OF PAIN AND COMFORT :

1) Pain :

From a scale of 0 to 10; 0 being '**no pain at all**' whereas 10 is '**the worst pain ever possible**' please circle the number that represents best the pain level you felt during the procedure.



2) Comfort :

Score	Scale	Description
1	No	No discomfort, talking/resting comfortably throughout
2	Minimal	One or two episodes of mild discomfort (without distress)
3	Mild	More than two episodes of mild discomfort (without distress)
4	Moderate	Significant discomfort experienced several times with some distress
5	Severe	Extreme discomfort frequently during the test

Score :

.....

T4 : REEVALUATION OF ANXIETY LEVELS AFTER THE PROCEDURE :

	Here's how you feel at the moment.	Not at all	Somewhat	Moderately so	Very much so
05	I feel at ease*	①	②	③	④
10	I feel comfortable*	①	②	③	④
15	I am relaxed*	①	②	③	④
16	I feel content*	①	②	③	④
19	I feel steady*	①	②	③	④
20	I feel pleasant*	①	②	③	④
	Here's how you feel often.	Not at all	Somewhat	Moderately so	Very much so
21	I feel pleasant*	①	②	③	④
23	I feel satisfied with myself*	①	②	③	④
26	I feel rested*	①	②	③	④
27	I am 'calm, cool and collected'*	①	②	③	④
30	I am happy*	①	②	③	④
33	I feel secure*	①	②	③	④
36	I am content*	①	②	③	④

STATE :

.....

T5 : EVALUATION OF SATISFACTION AND WILLINGNESS TO UNDERGO FURDER COLONOSCOPIES :

1) How satisfied are you with your experience ?

○ Very dissatisfied ○ Dissatisfied ○ Satisfied ○ Very satisfied

2) From the pictures below, choose the one that best describes your experience :

3) How much do you agree with the following statement : I'am willing to undergo further colonoscopies in the futur.

○ Strongly disagree ○ disagree ○ Agree ○ Strongly agree

PROCEDURE CHARACTERISTICS

Patient		☐	Control
Indication		☐	Intervention

Caecal Intubation	☐ Yes	Time :
	☐ No	Explanation :
Completed Colonoscopy	☐ Yes	Total time :
	☐ No	Explanation :
Acceptance of VR*	☐ Yes	
	☐ No	Explanation :

Endoscopist's Input - VR group :

1) How would you rate your experience from a scale of 0 to 10 ?

0 1 2 3 4 5 6 7 8 9 10

Poor **Excellent**

2) How comfortable where you during the procedure ?

0 1 2 3 4 5 6 7 8 9 10

▲ ▲ ▲

Very Uncomfortable **Neutral** **Very Comfortable**

Index 2

EARTH 4K - Relaxation Film - Peaceful Relaxing Music - Nature 4k Video UltraHD - OUR PLANET
https://www.youtube.com/watch?v=KJwYBJMSbPI

Forest 4K • Nature Relaxation Film • Peaceful Relaxing Music • 4k Video UltraHD
https://www.youtube.com/watch?v=RzVvThhjAKw&t=1s

BIBLOGRAPHY

1. McEntire J, Sahota J, Hydes T, Trebble TM.
An evaluation of patient attitudes to colonoscopy and the importance of endoscopist interaction and the endoscopy environment to satisfaction and value. Scand. J. Gastroenterol. 2013;48:366–73.
2. Shah SG, Brooker JC, Thapar C, Williams CB, Saunders BP.
Patient Pain During Colonoscopy: An Analysis Using Real-Time Magnetic Endoscope Imaging. Endoscopy 2002;34:435–40.
3. Bushnell MC, Čeko M, Low LA.
Cognitive and emotional control of pain and its disruption in chronic pain. Nat. Rev. Neurosci. 2013;14:502–11.
4. Wernli KJ, Brenner AT, Rutter CM, Inadomi JM.
Risks Associated With Anesthesia Services During Colonoscopy. Gastroenterology 2016;150:888–94; quiz e18.
5. Leung J, Mann S, Siao-Salera R, Ransibrahmanakul K, Lim B, Canete W, et al.
A randomized, controlled trial to confirm the beneficial effects of the water method on U.S. veterans undergoing colonoscopy with the option of on-demand sedation. Gastrointest. Endosc. 2011;73:103–10.
6. Harewood GC, Wiersema MJ, Melton LJ.
A prospective, controlled assessment of factors influencing acceptance of screening colonoscopy. Am. J. Gastroenterol. 2002;97:3186–94.
7. Silva APD, Niriella MA, Nandamuni Y, Nanayakkara SD, Perera KRP, Kodisinghe SK, et al.
Effect of audio and visual distraction on patients undergoing colonoscopy: a randomized controlled study. Endosc. Int. Open 2016;04:E1211–4.
8. Graff V, Cai L, Badiola I, Elkassabany NM.
Music versus midazolam during preoperative nerve block placements: a prospective randomized controlled study. Reg. Anesth. Pain Med. 2019;44:796–9.
9. Gurram P, Narayanan V, Chandran S, Ramakrishnan K, Subramanian A, Kalakumari AP.
Effect of Heartfulness Meditation on Anxiety and Perceived Pain in Patients Undergoing Impacted Third Molar Surgery. J. Oral Maxillofac. Surg. 2021;79:2060.e1–2060.e7.
10. Çelebi D, Yılmaz E, Şahin ST, Baydur H.
The effect of music therapy during colonoscopy on pain, anxiety and patient comfort: A randomized controlled trial. Complement. Ther. Clin. Pract. 2020;38:101084.
11. Rostami E, Khanjari S, Haghani H, Amirian H.
Effect of video games on preoperative anxiety in 3- to-6-year-old of a sample of Iranian children undergoing elective surgery. J. Educ. Health Promot. 2022;11:135.
12. He ZH, Yang HM, Dela Rosa RD, De Ala MB.
The effects of virtual reality technology on reducing pain in wound care: A meta-analysis and systematic review. Int. Wound J. 2022;19:1810–20.
13. Scapin S, Echevarría-Guanilo ME, Boeira Fuculo Junior PR, Gonçalves N, Rocha PK, Coimbra R.
Virtual Reality in the treatment of burn patients: A systematic review. Burns 2018;44:1403–16.

14. Jones T, Moore T, Choo J.
The Impact of Virtual Reality on Chronic Pain. PLOS ONE 2016;11:e0167523.
15. Wong CL, Lui MMW, Choi KC.
Effects of immersive virtual reality intervention on pain and anxiety among pediatric patients undergoing venipuncture: a study protocol for a randomized controlled trial. Trials 2019;20:369.
16. Jivraj BA, Schaeffer E, Bone JN, Stunden C, Habib E, Jacob J, et al.
The use of virtual reality in reducing anxiety during cast removal: A randomized controlled trial. J. Child. Orthop. 2020;14:574–80.
17. Atzori B, Lauro Grotto R, Giugni A, Calabrò M, Alhalabi W, Hoffman HG.
Virtual Reality Analgesia for Pediatric Dental Patients. Front. Psychol. [Internet] 2018 [cited 2024 Apr 29];9. Available from: https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2018.02265/full
18. Cieślik B, Mazurek J, Rutkowski S, Kiper P, Turolla A, Szczepańska-Gieracha J.
Virtual reality in psychiatric disorders: A systematic review of reviews. Complement. Ther. Med. 2020;52:102480.
19. Maples-Keller JL, Bunnell BE, Kim SJ, Rothbaum BO.
The Use of Virtual Reality Technology in the Treatment of Anxiety and Other Psychiatric Disorders. Harv. Rev. Psychiatry 2017;25:103.
20. Zasadzka E, Pieczyńska A, Trzmiel T, Hojan K.
Virtual Reality as a Promising Tool Supporting Oncological Treatment in Breast Cancer. Int. J. Environ. Res. Public. Health 2021;18:8768.
21. Wiederhold B.
Virtual Reality Assisted Anesthesia (VRAA) during Upper Gastrointestinal Endoscopy: Report of 115 Cases— Analysis of Physiological Responses. Surg. Res. Updat. [Internet] 2017 [cited 2023 May 10];5. Available from: http://www.synergypublishers.com/downloads/sruv5a1/
22. Nguyen N, Lavery WJ, Capocelli KE, Smith C, DeBoer EM, Deterding R, et al.
Transnasal Endoscopy in Unsedated Children With Eosinophilic Esophagitis Using Virtual Reality Video Goggles. Clin. Gastroenterol. Hepatol. Off. Clin. Pract. J. Am. Gastroenterol. Assoc. 2019;17:2455–62.
23. Sooriyaghandan IV, Mohamad Jailaini MF, Nik Abeed NN, Ng BH, Yu-Lin AB, Shah SA, et al.
Satisfaction and tolerability using virtual reality (VR) as adjunctive treatment during flexible bronchoscopy: a randomized control trial. BMC Pulm. Med. 2023;23:1–10.
24. Turrado V, Guzmán Y, Jiménez-Lillo J, Villegas E, de Lacy FB, Blanch J, et al.
Exposure to virtual reality as a tool to reduce peri-operative anxiety in patients undergoing colorectal cancer surgery: a single-center prospective randomized clinical trial. Surg. Endosc. 2021;35:4042–7.
25. Fernández-Cisnal A, Silla B, María Ramón J, Valero E, García-Blas S, Núñez J, et al.
Efficacy of virtual reality reducing anxiety during CTO revascularization: the ReViCTO trial design. REC Interv. Cardiol. Engl. Ed. 2023;10440.

26. Mosso-Vázquez JL, Gao K, Wiederhold BK, Wiederhold MD.
Virtual Reality for Pain Management in Cardiac Surgery. Cyberpsychology Behav. Soc. Netw. 2014;17:371–8.
27. The State-Trait Anxiety Inventory | Revista Interamericana de Psicología/Interamerican Journal of Psychology. 2020 [cited 2023 Dec 1];Available from: https://journal.sipsych.org/index.php/IJP/article/view/620
28. Zhou Z, Wang Y, Niu Y, He Z, Huang M, Zhou Y, et al.
How we assess the perioperative anxiety of surgical patients with pulmonary nodules: the revision of state-trait anxiety inventory. J. Cardiothorac. Surg. 2020;15:324.
29. Breivik H, Borchgrevink PC, Allen SM, Rosseland LA, Romundstad L, Hals EKB, et al.
Assessment of pain. Br. J. Anaesth. 2008;101:17–24.
30. Conjoint Board of the Royal College of Physicians and Royal College of Surgeons Working Group. Guidelines for the Implementation of a National Quality Assurance Program in GI Endoscopy - Version 2.0. Royal College of Physicians of Ireland [Internet]. [cited 2024 Feb 12];Available from: https://rcpi-live-cdn.s3.amazonaws.com/wp-content/uploads/2016/01/Guidelines-for-the-Implementation-of-a-National-Quality-Assurance-Programme-in-GI-Endoscopy.pdf
31. Monu J, Sunil S.
The Net Promoter Score with Friends and Family Test applied to arthroscopic shoulder surgery. Clin. Shoulder Elb. 2023;26:20–4.
32. Huisman TAGM, Kellenberger CJ. MR imaging characteristics of the normal fetal gastrointestinal tract and abdomen. Eur. J. Radiol. 2008;65:170–81.
33. Richard L. Drake, Wayne Vogl, Adam W. M.
Mitchell. Gray's Anatomy for Students [Internet]. 2019 [cited 2024 May 2];Available from: https://www.mea.elsevierhealth.com/grays-anatomy-for-students-mobile-mea.html
34. Stauffer CM, Pfeifer C.
Colonoscopy [Internet]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2024 [cited 2024 Apr 30]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK559274/
35. Ellis H, Mahadevan V.
Anatomy of the caecum, appendix and colon. Surg. Oxf. 2014;32:155–8.
36. Waye JD, Aisenberg J, Rubin PH. Practical Colonoscopy. John Wiley & Sons; 2013.
37. Nguyen DL, Wieland M.
Risk Factors Predictive of Poor Quality Preparation during Average Risk Colonoscopy Screening: the Importance of Health Literacy. J. Gastrointestin. Liver Dis. 2010;19:369–72.
38. Hassan C, Fuccio L, Bruno M, Pagano N, Spada C, Carrara S, et al.
A Predictive Model Identifies Patients Most Likely to Have Inadequate Bowel Preparation for Colonoscopy. Clin. Gastroenterol. Hepatol. 2012;10:501–6.
39. Chokshi RV, Hovis CE, Hollander T, Early DS, Wang JS.
Prevalence of missed adenomas in patients with inadequate bowel preparation on screening colonoscopy. Gastrointest. Endosc. 2012;75:1197–203.

40. Hendry PO, Jenkins JT, Diament RH.
The impact of poor bowel preparation on colonoscopy: a prospective single centre study of 10 571 colonoscopies. Colorectal Dis. 2007;9:745–8.
41. Rex DK, Imperiale TF, Latinovich DR,
Bratcher LL Impact of bowel preparation on efficiency and cost of colonoscopy. Am. J. Gastroenterol. 2002;97:1696–700.
42. Anderson JC, Baron JA, Ahnen DJ, Barry EL, Bostick RM, Burke CA, et al.
Factors Associated With Shorter Colonoscopy Surveillance Intervals for Patients With Low-Risk Colorectal Adenomas and Effects on Outcome. Gastroenterology 2017;152:1933–1943.e5.
43. Saltzman JR, Cash BD, Pasha SF, Early DS, Muthusamy VR, Khashab MA, et al.
Bowel preparation before colonoscopy. Gastrointest. Endosc. 2015;81:781–94.
44. Parra-Blanco A, Ruiz A, Alvarez-Lobos M, Amorós A, Gana JC, Ibáñez P, et al.
Achieving the best bowel preparation for colonoscopy. World J. Gastroenterol. WJG 2014;20:17709–26.
45. Millien VO, Mansour NM.
Bowel Preparation for Colonoscopy in 2020: A Look at the Past, Present, and Future. Curr. Gastroenterol. Rep. 2020;22:28.
46. Martens P, Bisschops R.
Bowel preparation for colonoscopy: efficacy, tolerability and safety. Acta Gastro-Enterol. Belg. 2014;77:249–55.
47. Hassan C, East J, Radaelli F, Spada C, Benamouzig R, Bisschops R, et al.
Bowel preparation for colonoscopy: European Society of Gastrointestinal Endoscopy (ESGE) Guideline – Update 2019. Endoscopy 2019;51:775–94.
48. Cho J, Lee S, Shin JA, Kim JH, Lee HS.
The Impact of Patient Education with a Smartphone Application on the Quality of Bowel Preparation for Screening Colonoscopy. Clin. Endosc. 2017;50:479–85.
49. Lee JY, Calderwood AH, Karnes W, Requa J, Jacobson BC, Wallace MB.
Artificial intelligence for the assessment of bowel preparation. Gastrointest. Endosc. 2022;95:512–518.e1.
50. Guo X, Yang Z, Zhao L, Leung F, Luo H, Kang X, et al.
Enhanced instructions improve the quality of bowel preparation for colonoscopy: a meta-analysis of randomized controlled trials. Gastrointest. Endosc. 2017;85:90–97.e6.
51. Parker S, Zipursky J, Ma H, Baumblatt GL, Siegel CA.
A Web-based Multimedia Program Before Colonoscopy Increased Knowledge and Decreased Anxiety, Sedation Requirement, and Procedure Time. J. Clin. Gastroenterol. 2018;52:519–23.
52. Nguyen DL, Jamal MM, Nguyen ET, Puli SR, Bechtold ML.
Low-residue versus clear liquid diet before colonoscopy: a meta-analysis of randomized, controlled trials. Gastrointest. Endosc. 2016;83:499–507.e1.
53. Rostom A, Jolicoeur E.
Validation of a new scale for the assessment of bowel preparation quality. Gastrointest. Endosc. 2004;59:482–6.

54. Aronchick CA.
Bowel preparation scale. Gastrointest. Endosc. 2004;60:1037–8.
55. Lai EJ, Calderwood AH, Doros G, Fix OK, Jacobson BC
The Boston Bowel Preparation Scale: A valid and reliable instrument for colonoscopy-oriented research. Gastrointest. Endosc. 2009;69:620–5.
56. Calderwood AH, Jacobson BC.
Comprehensive validation of the Boston Bowel Preparation Scale. Gastrointest. Endosc. 2010;72:686–92.
57. Kluge MA, Williams JL, Wu CK, Jacobson BC, Schroy PC, Lieberman DA, et al.
Inadequate Boston Bowel Preparation Scale scores predict the risk of missed neoplasia on the next colonoscopy. Gastrointest. Endosc. 2018;87:744–51.
58. Halphen M, Heresbach D, Gruss HJ, Belsey J.
Validation of the Harefield Cleansing Scale: a tool for the evaluation of bowel cleansing quality in both research and clinical practice. Gastrointest. Endosc. 2013;78:121–31.
59. Gerard DP, Foster DB, Raiser MW, Holden JL, Karrison TG.
Validation of a New Bowel Preparation Scale for Measuring Colon Cleansing for Colonoscopy: The Chicago Bowel Preparation Scale. Clin. Transl. Gastroenterol. 2013;4:e43.
60. Kastenberg D, Bertiger G, Brogadir S.
Bowel preparation quality scales for colonoscopy. World J. Gastroenterol. 2018;24:2833–43.
61. Kothari ST, Huang RJ, Shaukat A, Agrawal D, Buxbaum JL, Fehmi SMA, et al.
ASGE review of adverse events in colonoscopy. Gastrointest. Endosc. 2019;90:863–876.e33.
62. Kobe EA, Sullivan BA, Qin X, Redding TS, Hauser ER, Madison AN, et al.
Longitudinal assessment of colonoscopy adverse events in the prospective Cooperative Studies Program no. 380 colorectal cancer screening and surveillance cohort. Gastrointest. Endosc. 2022;96:553–562.e3.
63. Stapakis JC, Thickman D.
Diagnosis of pneumoperitoneum: abdominal CT vs. upright chest film. J. Comput. Assist. Tomogr. 1992;16:713–6.
64. Pedersen L, Sorensen N, Lindorff-Larsen K, Carlsen CG, Wensel N, Torp-Pedersen C, et al.
Colonoscopy adverse events: are we getting the full picture? Scand. J. Gastroenterol. 2020;55:979–87.
65. Reumkens A, Rondagh EJA, Bakker MC, Winkens B, Masclee AAM, Sanduleanu S.
Post-Colonoscopy Complications: A Systematic Review, Time Trends, and Meta-Analysis of Population-Based Studies. Off. J. Am. Coll. Gastroenterol. ACG 2016;111:1092.
66. Cortés P, Corral JE, Umar S, Bilal M, Brahmbhatt B, Farraye FA, et al.
Splenic injury is an under-recognized adverse event of in-patient colonoscopy: a nationwide analysis. Endosc. Int. Open 2022;10:E178–82.
67. Piccolo G, Di Vita M, Cavallaro A, Zanghì A, Lo Menzo E, Cardì F, et al.
Presentation and Management of Splenic Injury After Colonoscopy: A Systematic Review. Surg. Laparosc. Endosc. Percutan. Tech. 2014;24:95.

68. Rutter CM, Johnson E, Miglioretti DL, Mandelson MT, Inadomi J, Buist DSM.
Adverse events after screening and follow-up colonoscopy. Cancer Causes Control 2012;23:289–96.
69. Ko CW, Riffle S, Shapiro JA, Saunders MD, Lee SD, Tung BY, et al
. Incidence of minor complications and time lost from normal activities after screening or surveillance colonoscopy. Gastrointest. Endosc. 2007;65:648–56.
70. Ryhlander J, Ringstrom G, Simrén M, Stotzer PO, Jakobsson S.
Undergoing repeated colonoscopies – experiences from patients with inflammatory bowel disease. Scand. J. Gastroenterol. 2019;54:1467–72.
71. Bugajski M, Wieszczy P, Hoff G, Rupinski M, Regula J, Kaminski MF.
Modifiable factors associated with patient-reported pain during and after screening colonoscopy. Gut 2018;67:1958–64.
72. Ghevariya V, Duddempudi S, Ghevariya N, Reddy M, Anand S.
Barriers to screening colonoscopy in an urban population: a study to help focus further efforts to attain full compliance. Int. J. Colorectal Dis. 2013;28:1497–503.
73. Shah SG, Brooker JC, Thapar C, Williams CB, Saunders BP.
Patient Pain During Colonoscopy: An Analysis Using Real-Time Magnetic Endoscope Imaging. Endoscopy 2002;34:435–40.
74. Loeve AJ, Fockens P, Breedveld P.
Mechanical Analysis of Insertion Problems and Pain During Colonoscopy: Why Highly Skill-Dependent Colonoscopy Routines are Necessary in the First Place... and How They May be Avoided. Can. J. Gastroenterol. Hepatol. NaN/NaN/NaN;27:293–302.
75. Prechel JA, Sedlack RE, Harreld FA, Sederquest MM.
Looping and Abdominal Pressure: A Visual Guide to a Successful Colonoscopy. Gastroenterol. Nurs. 2015;38:289.
76. Hussein AM, Bartram CI, Williams CB. Carbon dioxide insufflation for more comfortable colonoscopy. Gastrointest. Endosc. 1984;30:68–70.
77. Memon MA, Memon B, Yunus RM, Khan S.
Carbon Dioxide Versus Air Insufflation for Elective Colonoscopy: A Meta-Analysis and Systematic Review of Randomized Controlled Trials. Surg. Laparosc. Endosc. Percutan. Tech. 2016;26:102–16.
78. Baumann UA.
Water intubation of the sigmoid colon: water instillation speeds up left-sided colonoscopy. Endoscopy 1999;31:314–7.
79. Church JM.
Warm water irrigation for dealing with spasm during colonoscopy: simple, inexpensive, and effective. Gastrointest. Endosc. 2002;56:672–4.
80. Cadoni S, Falt P, Gallittu P, Liggi M, Mura D, Smajstrla V, et al.
Water Exchange Is the Least Painful Colonoscope Insertion Technique and Increases Completion of Unsedated Colonoscopy. Clin. Gastroenterol. Hepatol. Off. Clin. Pract. J. Am. Gastroenterol. Assoc. 2015;13:1972–1980.e1–3.

81. Fisher DA, Maple JT, Ben-Menachem T, Cash BD, Decker GA, Early DS, et al.
Complications of colonoscopy. Gastrointest. Endosc. 2011;74:745–52.
82. Avgerinos A, Kalantzis N, Rekoumis G, Pallikaris G, Arapakis G, Kanaghinis T.
Bowel preparation and the risk of explosion during colonoscopic polypectomy. Gut 1984;25:361–4.
83. Ladas SD, Karamanolis G, Ben-Soussan E.
Colonic gas explosion during therapeutic colonoscopy with electrocautery. World J. Gastroenterol. WJG 2007;13:5295–8.
84. Carnovali M, Spada C, Uebel P, Bocus P, Cannizzaro R, Cavallaro F, et al.
Factors influencing the presence of potentially explosive gases during colonoscopy: Results of the SATISFACTION study. Clin. Transl. Sci. 2023;16:759–69.
85. Gallagher EA, Clarke E, Connor M, Shanahan I, Smyth MR, Lennon JR, et al.
A study of intracolonic hydrogen and methane levels during colonoscopy. Ir. J. Med. Sci. 1992;161:582–5.
86. Ertem S, Oltulu G, Demirli S.
Colonoscopy and Infectious Diseases [Internet]. In: Engin O, editor. Colon Polyps and Colorectal Cancer. Cham: Springer International Publishing; 2021 [cited 2024 May 18]. page 83–92.Available from: https://doi.org/10.1007/978-3-030-57273-0_5
87. Albana MF, Hameed D, Bains SS, Dubin J, Mont MA, Nace J, et al.
Antibiotic prophylaxis prior to colonoscopy with biopsy does not decrease risk of prosthetic joint infection in total knee arthroplasty recipients. J. Orthop. 2024;53:82–6.
88. Ko CW, Dominitz JA.
Complications of Colonoscopy: Magnitude and Management. Gastrointest. Endosc. Clin. N. Am. 2010;20:659–71.
89. Jalal A, Khatiwada P, Shoreibah M, Dauer R.
Intramural Hematoma and Retroperitoneal Hematoma Following a Routine Colonoscopy: An Uncommon Complication of a Common Procedure. Case Rep. Gastroenterol. 2022;16:515–20.
90. Cooper GS, Kou TD, Rex DK.
Complications following colonoscopy with anesthesia assistance: a population-based analysis. JAMA Intern. Med. 2013;173:551–6.
91. Bielawska B, Hookey LC, Sutradhar R, Whitehead M, Xu J, Paszat LF, et al.
Anesthesia Assistance in Outpatient Colonoscopy and Risk of Aspiration Pneumonia, Bowel Perforation, and Splenic Injury. Gastroenterology 2018;154:77–85.e3.
92. Ko CW, Riffle S, Michaels L, Morris C, Holub J, Shapiro JA, et al.
Serious complications within 30 days of screening and surveillance colonoscopy are uncommon. Clin. Gastroenterol. Hepatol. Off. Clin. Pract. J. Am. Gastroenterol. Assoc. 2010;8:166–73.
93. Warren JL, Klabunde CN, Mariotto AB, Meekins A, Topor M, Brown ML, et al.
Adverse events after outpatient colonoscopy in the Medicare population. Ann. Intern. Med. 2009;150:849–57, W152.

94. Rex DK, Khalfan HK.
Sedation and the Technical Performance of Colonoscopy. Gastrointest. Endosc. Clin. 2005;15:661–72.
95. Early DS, Lightdale JR, Vargo JJ, Acosta RD, Chandrasekhara V, Chathadi KV, et al.
Guidelines for sedation and anesthesia in GI endoscopy. Gastrointest. Endosc. 2018;87:327–37.
96. Pontone S, Palma R, Donato G, Borghini R, Frattaroli S, Raniolo M, et al.
Efficacy of Sedation by Midazolam in Association With Meperidine or Fentanyl and Role of Patient Distress During Elective Colonoscopy. Gastroenterol. Nurs. Off. J. Soc. Gastroenterol. Nurses Assoc. 2020;43:258–63.
97. Singh H, Poluha W, Cheang M, Choptain N, Inegbu E, Baron K, et al.
Propofol for sedation during colonoscopy. Cochrane Database Syst. Rev. [Internet] 2008 [cited 2024 May 20];Available from: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD006268.pub2/full
98. Alaygut E.
Anesthesia in Colonoscopy [Internet]. In: Engin O, editor. Colon Polyps and Colorectal Cancer. Cham: Springer International Publishing; 2021 [cited 2024 May 19]. page 23–43.Available from: https://doi.org/10.1007/978-3-030-57273-0_2
99. Seleem WM, El Hossieny KM, Abd-Elsalam S.
Evaluation of Different Sedatives for Colonoscopy. Curr. Drug Saf. 2020;15:20–4.
100. Aljebreen AM, Almadi MA, Leung FW.
Sedated vs unsedated colonoscopy: A prospective study. World J. Gastroenterol. WJG 2014;20:5113–8.
101. Liang M, Zhang X, Xu C, Cao J, Zhang Z.
Anesthesia Assistance in Colonoscopy: Impact on Quality Indicators. Front. Med. [Internet] 2022 [cited 2024 May 19];9. Available from: https://www.frontiersin.org/articles/10.3389/fmed.2022.872231
102. Bannert C, Reinhart K, Dunkler D, Trauner M, Renner F, Knoflach P, et al.
Sedation in Screening Colonoscopy: Impact on Quality Indicators And Complications. Off. J. Am. Coll. Gastroenterol. ACG 2012;107:1837.
103. Wernli KJ, Inadomi JM. Anesthesia for colonoscopy: too much of a good thing? JAMA Intern. Med. 2013;173:556–8.
104. Cohen LB. Sedation Issues in Quality Colonoscopy. Gastrointest. Endosc. Clin. 2010;20:615–27.
105. Adams MA.
Putting the Horse Back in the Barn: Right-Sizing Use of Anesthesia Assistance for Routine Gastrointestinal Endoscopy. Clin. Gastroenterol. Hepatol. 2019;17:2434–6.
106. Takahashi Y, Tanaka H, Kinjo M, Sakumoto K.
Sedation-Free Colonoscopy. Dis. Colon Rectum 2005;48:855–9.
107. Morrison RS, Ahronheim JC, Morrison GR, Darling E, Baskin SA, Morris J, et al.
Pain and discomfort associated with common hospital procedures and experiences. J. Pain Symptom Manage. 1998;15:91–101.

108. Trevisani L, Zelante A, Sartori S.
Colonoscopy, pain and fears: Is it an indissoluble trinomial? World J. Gastrointest. Endosc. 2014;6:227–33.
109. Reynolds LM, Bissett IP, Consedine NS.
Emotional predictors of bowel screening: the avoidance-promoting role of fear, embarrassment, and disgust. BMC Cancer 2018;18:518.
110. Yang C, Sriranjan V, Abou-Setta AM, Poluha W, Walker JR, Singh H.
Anxiety Associated with Colonoscopy and Flexible Sigmoidoscopy: A Systematic Review. Am. J. Gastroenterol. 2018;113:1810.
111. Pontone S, Lauriola M, Palma R, Panetta C, Tomai M, Baker R.
Do difficulties in emotional processing predict procedure pain and shape the patient's colonoscopy experience? BMJ Open 2022;12:e050544.
112. Davis M, Oaten M, Occhipinti S, Chambers SK, Stevenson RJ.
An investigation of the emotion of disgust as an affective barrier to intention to screen for colorectal cancer. Eur. J. Cancer Care (Engl.) 2017;26:e12582.
113. Klasko-Foster LB, Keller MM, Kiviniemi MT.
Is it disgusting or am I just easily disgusted? The relation between situational disgust, dispositional disgust, and colonoscopy intentions. Eur. J. Cancer Care (Engl.) 2020;29:e13244.
114. Kiviniemi MT, Jandorf L, Erwin DO.
Disgusted, embarrassed, annoyed: Affective associations relate to uptake of colonoscopy screening. Ann. Behav. Med. Publ. Soc. Behav. Med. 2014;48:112–9.
115. Chung YW, Han DS, Yoo KS, Park CK.
Patient factors predictive of pain and difficulty during sedation-free colonoscopy: A prospective study in Korea. Dig. Liver Dis. 2007;39:872–6.
116. Campbell CM, Edwards RR.
Mind-body interactions in pain: the neurophysiology of anxious and catastrophic pain-related thoughts. Transl. Res. J. Lab. Clin. Med. 2009;153:97–101.
117. Neblett R.
Pain catastrophizing: An historical perspective. J. Appl. Biobehav. Res. 2017;22:e12086.
118. Lauriola M, Tomai M, Palma R, La Spina G, Foglia A, Panetta C, et al.
Procedural Anxiety, Pain Catastrophizing, and Procedure-Related Pain during EGD and Colonoscopy. South. Med. J. 2020;113:8–15.
119. Roy M, Lebuis A, Peretz I, Rainville P.
The modulation of pain by attention and emotion: a dissociation of perceptual and spinal nociceptive proce
120. S. M. LaValle, Virtual Reality.
Cambridge University Press, 2023.
121. B. Schöne, J. Kisker, L. Lange, T. Gruber, S. Sylvester, and R. Osinsky,
"The reality of virtual reality," *Front. Psychol.*, vol. 14, Feb. 2023, doi: 10.3389/fpsyg.2023.1093014.

122. B. Xie et al.,
"A Review on Virtual Reality Skill Training Applications," *Front. Virtual Real.*, vol. 2, Apr. 2021, doi: 10.3389/frvir.2021.645153.

123. E. Salas, K. A. Wilson, C. S. Burke, and H. A.
Priest, "Using Simulation-Based Training to Improve Patient Safety: What Does It Take?," *Jt. Comm. J. Qual. Patient Saf.*, vol. 31, no. 7, pp. 363–371, Jul. 2005, doi: 10.1016/S1553-7250(05)31049-X.

124. M. Portelli, S. Bianco, T. Bezzina, and J. Abela,
"Virtual reality training compared with apprenticeship training in laparoscopic surgery: a meta-analysis," *Ann. R. Coll. Surg. Engl.*, vol. 102, no. 9, pp. 672–684, Nov. 2020, doi: 10.1308/rcsann.2020.0178.

125. R. Q. Mao et al.,
"Immersive Virtual Reality for Surgical Training: A Systematic Review," *J. Surg. Res.*, vol. 268, pp. 40–58, Dec. 2021, doi: 10.1016/j.jss.2021.06.045.

126. P. Y. Chan and S. Scharf, "
Virtual Reality as an Adjunctive Nonpharmacological Sedative During Orthopedic Surgery Under Regional Anesthesia: A Pilot and Feasibility Study," *Anesth. Analg.*, vol. 125, no. 4, pp. 1200–1202, Oct. 2017, doi: 10.1213/ANE.0000000000002169.

127. J. C. Lin, Z. Yu, I. U. Scott, and P. B. Greenberg,
"Virtual reality training for cataract surgery operating performance in ophthalmology trainees," *Cochrane Database Syst. Rev.*, no. 12, 2021, doi: 10.1002/14651858.CD014953.pub2.

128. M. C. Schrempf et al.,
"Virtual reality-based relaxation for enhancement of perioperative well-being and quality of life: protocol for a randomised pilot trial," *BMJ Open*, vol. 11, no. 4, p. e044193, Apr. 2021, doi: 10.1136/bmjopen-2020-044193.

129. A. Flores et al.,
"Using Immersive Virtual Reality Distraction to Reduce Fear and Anxiety before Surgery," *Healthcare*, vol. 11, no. 19, p. 2697, Oct. 2023, doi: 10.3390/healthcare11192697.

130. A. A. Wren et al.,
"Mindfulness-Based Virtual Reality Intervention for Children and Young Adults with Inflammatory Bowel Disease: A Pilot Feasibility and Acceptability Study," *Children*, vol. 8, no. 5, Art. no. 5, May 2021, doi: 10.3390/children8050368.

131. K. L. Du et al.,
"A New Option for Pain Prevention Using a Therapeutic Virtual Reality Solution for Bone Marrow Biopsy (REVEH Trial): Open-Label, Randomized, Multicenter, Phase 3 Study," *J. Med. Internet Res.*, vol. 25, no. 1, p. e38619, Feb. 2023, doi: 10.2196/38619.

132. H. Genç, M. Korkmaz, and A. Akkurt, "
The Effect of Virtual Reality Glasses and Stress Balls on Pain and Vital Findings During Transrectal Prostate Biopsy: A Randomized Controlled Trial," *J. Perianesth. Nurs.*, vol. 37, no. 3, pp. 344–350, Jun. 2022, doi: 10.1016/j.jopan.2021.09.006.

133. D. Karaman and N. Taşdemir,
"The Effect of Using Virtual Reality During Breast Biopsy on Pain and Anxiety: A Randomized Controlled Trial," *J. Perianesth. Nurs.*, vol. 36, no. 6, pp. 702–705, Dec. 2021, doi: 10.1016/j.jopan.2021.04.007.

134. S. J. Blokzijl, K. F. Lamberts, L. A. van der Waaij, and J. M.
Spikman, "Short article: Willingness to undergo colonoscopy with virtual reality instead of procedural sedation and analgesia," *Eur. J. Gastroenterol. Hepatol.*, vol. 31, no. 3, pp. 334–339, Mar. 2019, doi: 10.1097/MEG.0000000000001325.

135. Department of Nursing, Kastamonu University, School of Health Sciences, Kastamonu, Turkey, S. Karaveli Cakir, S. Evirgen, and Division of Gastroenterology, Department of Internal Medicine, Kastamonu University School of Medicine, Kastamonu, Turkey, "The Effect of Virtual Reality on Pain and Anxiety During Colonoscopy: A Randomized Controlled Trial," *Turk. J. Gastroenterol.*, vol. 32, no. 5, pp. 451–457, Aug. 2021, doi: 10.5152/tjg.2021.191081.

136. M. Friedman et al.,
"A pilot study of virtual reality as an alternative to pharmacological sedation during colonoscopy," *Endosc. Int. Open*, vol. 09, no. 3, pp. E343–E347, Mar. 2021, doi: 10.1055/a-1339-0724.

137. M.-A. Găină et al.,
"State-of-the-Art Review on Immersive Virtual Reality Interventions for Colonoscopy-Induced Anxiety and Pain," *J. Clin. Med.*, vol. 11, p. 1670, Mar. 2022, doi: 10.3390/jcm11061670.

138. G. Veldhuijzen, N. J. M. Klaassen, R. J. A. Van Wezel, J. P. H. Drenth, and A. A.
Van Esch, "Virtual reality distraction for patients to relieve pain and discomfort during colonoscopy," *Endosc. Int. Open*, vol. 08, no. 07, pp. E959–E966, Jul. 2020, doi: 10.1055/a-1178-9289.

139. K. Johnson, B. Liszewski, K. Dawdy, Y. Lai, and M.
McGuffin, "Learning in 360 Degrees: A Pilot Study on the Use of Virtual Reality for Radiation Therapy Patient Education," *J. Med. Imaging Radiat. Sci.*, vol. 51, no. 2, pp. 221–226, Jun. 2020, doi: 10.1016/j.jmir.2019.12.008.

140. J. Urlings et al.,
"The role and effectiveness of augmented reality in patient education: A systematic review of the literature," *Patient Educ. Couns.*, vol. 105, no. 7, pp. 1917–1927, Jul. 2022, doi: 10.1016/j.pec.2022.03.005.

141. S. R. van der Kruk, R. Zielinski, H. MacDougall, D. Hughes-Barton, and K. M. Gunn,
"Virtual reality as a patient education tool in healthcare: A scoping review," *Patient Educ. Couns.*, vol. 105, no. 7, pp. 1928–1942, Jul. 2022, doi: 10.1016/j.pec.2022.02.005.

142. Q. Liu et al.,
"Implementation of virtual reality technology to decrease patients' pain and nervousness during colonoscopies: a prospective randomised controlled single-blinded trial," *Clin. Med.*, vol. 22, no. 3, pp. 237–240, May 2022, doi: 10.7861/clinmed.2022-0001.

143. F. Ersöz, A. B. Toros, G. Aydoğan, H. Bektaş, O. Ozcan, and S. Arikan,
"Assessment of anxiety levels in patients during elective upper gastrointestinal endoscopy and colonoscopy," *Turk. J. Gastroenterol. Off. J. Turk. Soc. Gastroenterol.*, vol. 21, no. 1, pp. 29–33, Mar. 2010, doi: 10.4318/tjg.2010.0044.

144. H. Stokan, C. Nguyen, and M. Martinez,
"The Effects of Meditation and Music on Stress in College Individuals," *Open J. Psychiatry*, vol. 12, no. 03, pp. 223–231, 2022, doi: 10.4236/ojpsych.2022.123017.

145. C. Ghetti,
"Effect of Music Therapy with Emotional-Approach Coping on Pre-Procedural Anxiety in Cardiac Catheterization," Jun. 2011, Accessed: Apr. 29, 2024. [Online]. Available: https://kuscholarworks.ku.edu/handle/1808/8027

146. S. Umezawa et al.,
"Visual distraction alone for the improvement of colonoscopy-related pain and satisfaction," *World J. Gastroenterol. WJG*, vol. 21, no. 15, pp. 4707–4714, Apr. 2015, doi: 10.3748/wjg.v21.i15.4707.

147. Y. Kim, S. H. Yoo, J. Chun, J.-H. Kim, Y. H. Youn, and H.
Park, "Relieving Anxiety Through Virtual Reality Prior to Endoscopic Procedures," *Yonsei Med. J.*, vol. 64, no. 2, pp. 117–122, Feb. 2023, doi: 10.3349/ymj.2022.0319.

قسم الطبيب

أقْسِم بِالله العَظِيم

أن أراقبَ الله في مِهْنَتِي.

وأن أصُونَ حياة الإنسان في كآفّةِ أطوَارهَا في كل الظروف

والأحَوال باذلا وسْعِي في انقاذها مِن الهَلاكِ والمرَضِ

والألَم والقَلَق.

وأن أحفَظَ لِلنَاسِ كرَامَتهُم، وأسْتر عَوْرَتهُم، وأكتمَ سِرَّهُمْ.

وأن أكونَ عَلى الدوَام من وسائِل رحمة الله، باذلا رعايتي الطبية للقريب والبعيد،

للصالح والطالح، والصديق والعدو.

وأن أثابر على طلب العلم، وأسَخِّرَه لِنَفْعِ الإنْسَان لا لأذَاه.

وأن أُوَقّرَ مَن عَلَّمَني، وأُعَلّمَ مَن يَصْغرَني، وأكون أخا لِكُلِّ زَميلٍ في المِهنَةِ الطِّبِّيَة

مُتعَاونِينَ عَلى البرِّ والتقوى.

وأن تكون حياتي مِصْدَاق إيمَاني في سِرّي وَعَلانيَتي،

نَقِيَّة مِمّا يُشينهَا تجَاهَ الله وَرَسُولِهِ وَالمؤمِنين.

والله على ما أقول شهيد

كليـــــــة الطب
والصيدلة - مراكش
FACULTÉ DE MÉDECINE
ET DE PHARMACIE - MARRAKECH

MARRAKECH
جامعة القاضي عياض
UNIVERSITÉ CADI AYYAD

السنة 2024 الاطروحة رقم 194

فعالية الواقع الافتراضي في تقليل الألم والقلق أثناء تنظير القولون: تجربة عشوائية محكمة.

الأطروحة

قدمت ونوقشت علانية يوم 10/06/2024
من طرف

السيدة : حفصة بلمرابط

المزدادة في 1998/01/04 بمدينة مراكش

لنيل شهادة الدكتوراه في الطب

الكلمات المفتاحية

الواقع الافتراضي – تنظير القولون – القلق – الألم – الراحة – الرضا – تنظير القولون بدون تخدير

اللجنة

السيدة	خ.كراطي استاذة في امراض الجهاز الهضمي.	الرئيسة
السيد	ع.أيت الرامي استاذ في امراض الجهاز الهضمي.	المشرف
السيدة	ز.السملاني استاذة في امراض الجهاز الهضمي.	الحكام
السيدة	ص.أوباها استاذة في علم وظائف الأعضاء.	