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The impact of atmospheric pressure on the Occurrence of eclampsia

THESIS

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BY

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Born on 11 October 1994 in Ghana

TO OBTAIN A MEDICAL DOCTORATE

KEYWORDS

Eclampsia – Atmospheric pressure – Preeclampsia – Hypertension – Impact

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HIPPOCRATIC OATH

At the time of being admitted as a member of the medical profession:
I solemnly pledge to dedicate my life to the service of humanity;
the health and well-being of my patient will be my first consideration;
I will respect the autonomy and dignity of my patient;
I will maintain the utmost respect for human life;
I will not permit considerations of age, disease or disability, greed, ethnic origin, gender, nationality, political affiliation, race, sexual orientation, social standing or any other factor to intervene between my duty and my patient;
I will respect the secrets that are confided in me, even after the patient has died;
I will practice my profession with conscience and dignity and in accordance with good medical practices;
I will foster the honor and noble traditions of the medical profession;
I will give to my teachers, colleagues, and students the respect and gratitude that is their due
I will share my medical knowledge for the benefit of the patient and the advancement of healthcare;
I will attend to my health, well-being, and abilities in order to provide care of the highest standard;
I will not use my medical knowledge to violate human rights and civil liberties, even under threat;
I make these promises solemnly, freely and upon my honour.

Declaration of Geneva, 1948

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LISTE ARRETEE LE 01/02/2021

DEDICATION

I dedicate this thesis to …

Glory be to God almighty through Christ our Lord
To my mother Esther who gave me everything and deprived herself of everything for me
To my brothers who stood by me through thick and thin
To an older sister who checks on me every single day and never gives up on me
To my dad, even though you were not there as much, thanks for giving me life
To Appiah, I appreciate you for we shared many a toil.
To Christopher Tebboth, thanks you for giving me a safe environment to nascent, bourgeon and blossom and your help
And, to the many few whom stance and circumstance have brought my way.
Our paths have crossed per fortune or opportunity;
A fleeting glimpse of all of you and suddenly this world is renamed possibility
So, thank you for the eyes that have gazed
And, not only gazed, for we have shed many a tear together
And, we have shared our hearts.
Hopefully, we will share crunch glasses of not tears but healthy drinks in the future.
So, thank you for the ears that listened, to the heartbroken, and the soul weakened.
Thank you for the strong hands
And the words that became a song
From the burning flames of your hearts.
Thank you from the depths of my heart.

Dr. Ouassim Mansoury

Burning the mid night candle to revise your own work can be understood to a certain degree. But doing that to revise one of your student's work transcends human imagination. If the word altruism could ever be redefined, your name has to appear in the definition. Because that is what you did when revising my statistical values, go all night trying to find and correct if necessary the nitty-gritty and make my work as genuine as possible without asking anything in return. Maybe it is just passion for your work, maybe it is just your altruistic instinct functioning, but whatever it is make sure you never lose it, Sir. The same way I saw it, someone somewhere will see it too one day. I'm very grateful sir.

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Thank you good friend for helping since the first day I arrived at this faculty to now and counting. Words here cannot express it and you know it so I will keep it brief.

Maternal intensive care unit team

What a group of people you have assembled there. Noble, welcoming, courteous, hardworking, fun yeah fun the list of these values they possess is endless. They make work enjoyable and exquisite. Irrespective of the fun they have doing their works that is the department I saw least human errors in all my rotations at the hospital. From the second you arrive there to the microsecond before you leave you are part of a team and a family. A special thanks to Mr. Ahmed the head of the Nurses and Madam Ghizlane the secretary. It was an honour to be among you and be considered a family.

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PROFESSOR LAILA ADARMOUCH

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PROFESSOR YASSIR AIT BENKADDOUR

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ABBREVIATIONS

Abbreviations were avoided in this work
to the best of our knowledge

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OUTLINE

INTRODUCTION

The impact of climate on human health had been suggested as early as the works of Hippocrates. In the middle Ages, the “mighty air” was identified with the epidemics which occurred in Europe(1). The mighty air notion being the weather. However, these climatic conditions could not be properly studied until the development in physics. The impact of atmospheric pressure on human pathologies has been mentioned in various studies but less on eclampsia. We noticed a higher number of eclampsia patients during changing weather conditions, especially in the winter. A brief descriptive study by Ljesic M et al (2) at the Marrakech university hospital showed that the frequency of eclampsia increases during winter and colder temperature conditions. Knowing that atmospheric pressure increases dramatically during this time of the year(3) with decreasing temperature, we decided to study a possible link between atmospheric pressure, temperature and eclampsia.

Finding a link between atmospheric pressure and eclampsia will help to better manage patients during extreme weather conditions. This will be done by recognizing that the number of patients will automatically increase so put in place measures to help care for the drastic increase. It will also help in eclampsia prevention by educating the patients.

The Paris agreement signed by 189 countries in 2016 clearly demonstrates that humans are beginning to realize the vast impact of weather conditions on our health and thus have started taking actions. To be able to reinforce this though, studies like ours must be conducted on regular basis to further improve our knowledge of the impact of atmospheric conditions on our health. This will make organizations and governments adopt ways that preserve good atmospheric conditions and prevent many diseases.

PATIENTS AND METHOD

As the main objective of our study is to demonstrate a possible link between atmospheric pressure, temperature and eclampsia, we explored three possible ways atmospheric pressure could affect the occurrence of eclampsia. The first is the variability of the atmospheric pressure (rapid increments and reductions in the atmospheric pressure in specific time-lapses and its differential), secondly its extremes (highest and lowest daily pressures), the daily mean atmospheric pressure in a specific area. And lastly, temperature, the daily lowest and highest.

I. Patients

1. Type of study:

A retrospective analytical study concerning eclampsia patients at the maternal Intensive Care Unit of the Marrakech university hospital.

2. Duration explored:

The study spanned a period of 2 years from January 2019 to November 2020

3. Population studied:

All patient files of 2019 and 2020 were grouped to have a fair idea of the number of eclampsia patients in the 2 years. We selected the patient files from the file cabinet of the maternal intensive care unit of the university hospital Mohamed VI.

4. Selection Requirement

4.1. Inclusion criteria

- Eclampsia in patients more than 20 weeks of gestation. Seizure of a pregnant woman more than 20th week of gestation without any other cause capable of explaining this seizure.
- Complete file

Eclampsia is defined by the American College of Obstetricians and gynecologists (ACOG) as new-onset tonic-clonic, focal, or multifocal seizures in the absence of other causative conditions such as epilepsy, cerebral arterial ischemia and infarction, intracranial hemorrhage, or drug use(4). It typically occurs during or after the 20th week of gestation or in the postpartum period(5).

4.2. Exclusion criteria:

Incomplete file

Eclampsia less than 20 weeks of gestation

II. Methods

1. Collecting Data For Atmospheric Pressure

We assembled all atmospheric pressures from the Moroccan meteorological body's website(3).Marrakesh region Pressures were taken a day before and the specific day of incidence of eclampsia with regards to every patient and those for all the days without eclampsia were also gathered in our study period.

We compiled the hourly recording of the atmospheric pressure in our study period. The daily 24 hours recordings were taken in order to calculate the mean daily pressure, the daily

maximum, the daily minimum, daily differential (difference between the maximum and minimum daily) and the pressure variability which is the sum of all absolute values of the 24 hours variability. And the lowest and highest daily temperature as well.

It should be reiterated that a decrease in pressure reduces the amount of oxygen available to breathe. This is usually demonstrated at higher altitudes. A 2hPa reduction in pressure can suddenly reduce the amount of oxygen.

We asked ourselves the question, does pressure sinking too low or too high with regards to the usual pressure in a region cause a lot of preeclampsia patients to have a seizure? To find the response to this, we decided to look at the pressure of days with every eclampsia and the pressure of days without eclampsia. We calculated the mean lowest and highest pressures of the day before and the day of eclampsia of all the days with eclampsia and did the same for all the days without eclampsia. That is:

A. Mean lowest mean pressure for days with eclampsia; the day before and the day of eclampsia
B. Mean highest mean pressure for days with eclampsia; the day before and days of eclampsia
C. mean lowest pressure for days without eclampsia; the day before and the day of eclampsia
D. mean highest pressure for days without eclampsia; the day before and the day of eclampsia

2. Atmospheric pressure variation

Pressure variation could affect the occurrence of eclampsia similar to constantly exerting positive and negative pressure on a balloon causing it to burst. We assumed a rapidly varying pressure can cause micro blood vessels to rupture and bring about eclampsia like studied by Hakim et al(6) on the implications of atmospheric pressure on aortic aneurysm rupture. To verify this we compared the pressure variations on the days with and days without eclampsia in the study period

3. Mean atmospheric pressure

We compared the Marrakech region mean atmospheric pressure of the days with eclampsia and days without eclampsia to see if a daily mean atmospheric pressure influenced eclampsia occurrence

4. Differential

Daily differential pressure was taken. Defined in the study as the difference between the highest and lowest pressure. Can a higher or lower value be a cause of eclampsia? We compared these differentials for days with eclampsia and days without eclampsia.

5. Seasons

We looked at the frequency of eclampsia during the seasons as well as months and defined the season as follows:

Summer; 20th June to 20th September

Autumn; 20th September to 20th December

Winter; 20th December to 20th March

Spring; 20th march to 20th June

Looking at raw data from the Moroccan meteorological website, atmospheric pressure tends to increase during colder periods of the year and decrease during the hotter ones. The mean daily pressure, the maximum pressure and the minimum pressure were recorded hourly. The pressure variation was recorded every 3 other hours. Maximum and minimum temperatures were also recorded hourly. The mean daily of these variables was calculated by adding the hourly values and dividing it by the 24 daily hours. These pressures were taken for each day there was an incident of eclampsia throughout the two years study period. They were also recorded for

each day preceding eclampsia representing days before an incident. Pressure for days without eclampsia was taken for each of the variables in order to compare the pressure of days with incidence and that of days without incidence.

We also defined colder days as days where the lowest temperature was less or equal to 16° Celsius in Marrakech because those are usually the days the maximum pressure goes above the normal day mean pressure in Marrakech. The normal mean pressure in Marrakech ranges between 1016 and 1018hPA. When the daily temperature goes below 16°, the daily minimum pressure starts going above this normal mean pressure during the year. We, therefore, decided to compare the number of eclampsia we had when the minimum temperature fell below 16° and those we had when the temperature was above 16 to that of the atmospheric pressure. Hotter days, minimum temperature greater than 16° Celsius. We compared eclampsia of the colder days and that of hotter days with the atmospheric pressure by using binary logistic regression and the independent t test in the SPSS statistic software.

6. Statistical analysis

In addition to finding a link between barometric pressure and eclampsia, the incidences of other risk factors of eclampsia were studied. These factors included maternal age, gynaecological factors, diabetes, gestational high blood pressure and maternal gestational age. All atmospheric pressure values were measured in Hectopascal (hPA), the temperature in degree Celsius (°c) and that of blood pressure in millimetres mercury (mmHg). All values were rounded to two decimal places if necessary. With the help of the SPSS statistic software, we calculated the mean and the standard deviations for each variable using descriptive statistics. We were then able to get the p-value, odd ratio and confident interval using the binary logistic regression.

We defined the p-value as statistically significant when less than 0.05

RESULTS

A total of 115 patients were admitted to the maternal ICU for eclampsia in the 2-year study period, with 100 patients with complete files meeting the selection criteria. The study spanned a total of 730 days (2019 and 2020). An incident of eclampsia was recorded in 100 out of the 730 days and represented "Days with". The remaining 630 days without an incident of eclampsia were dubbed "Days without".

I. Maternal age

The mean maternal age of the patients was 25 years. The minimum age was 17 and the maximum 42. The age group with the highest number of patients was 20-24 and that with the least was 40-44

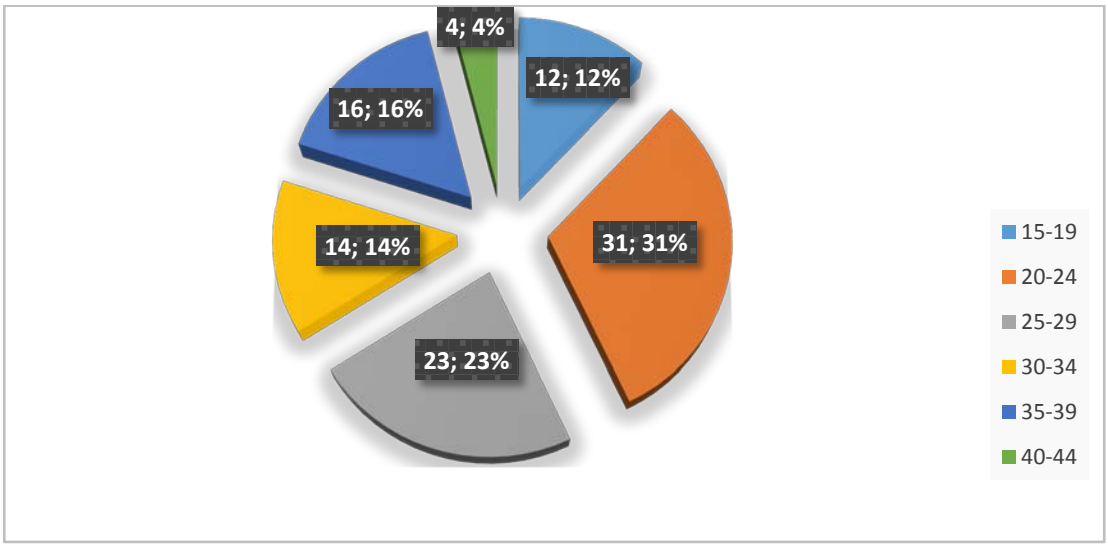


Figure 1: Distribution of eclampsia with regards to maternal age

II. Gestational age

We grouped our patients into 4 categories according to their pregnancy term. We noticed that the gestational age group most represented was those with gestational age above 37 weeks of pregnancy. The least were those less than 28 weeks of pregnancy.

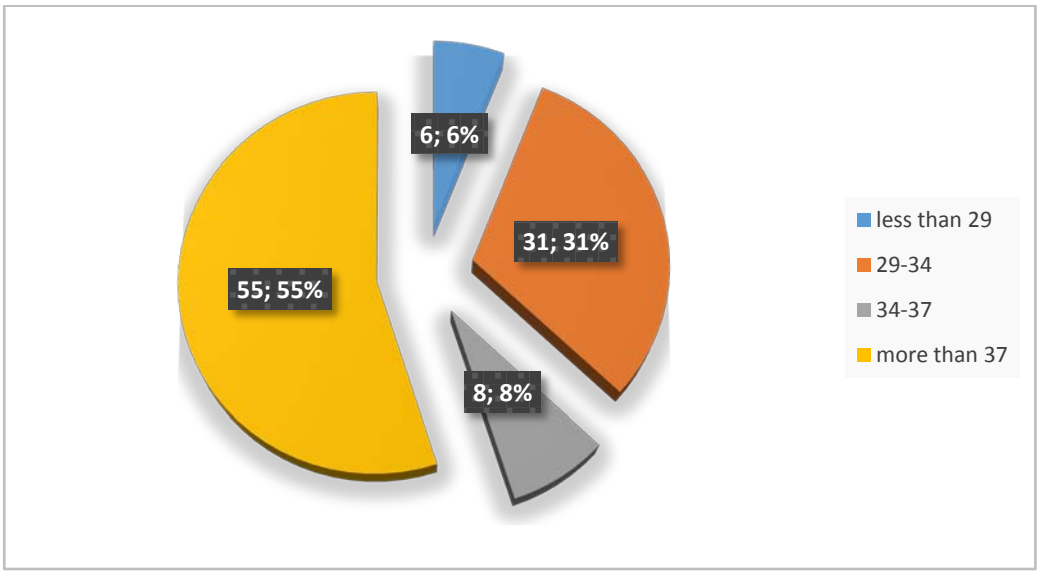


Figure 2: Distribution of eclampsia with regards to gestational age

III. Parity

Patients were categorized into 3 groups based on the number of births: primiparous (first-time births), pauciparous (2 to 3 births), and multiparous (more than 3 births). Primiparous patients were the most represented (53%).

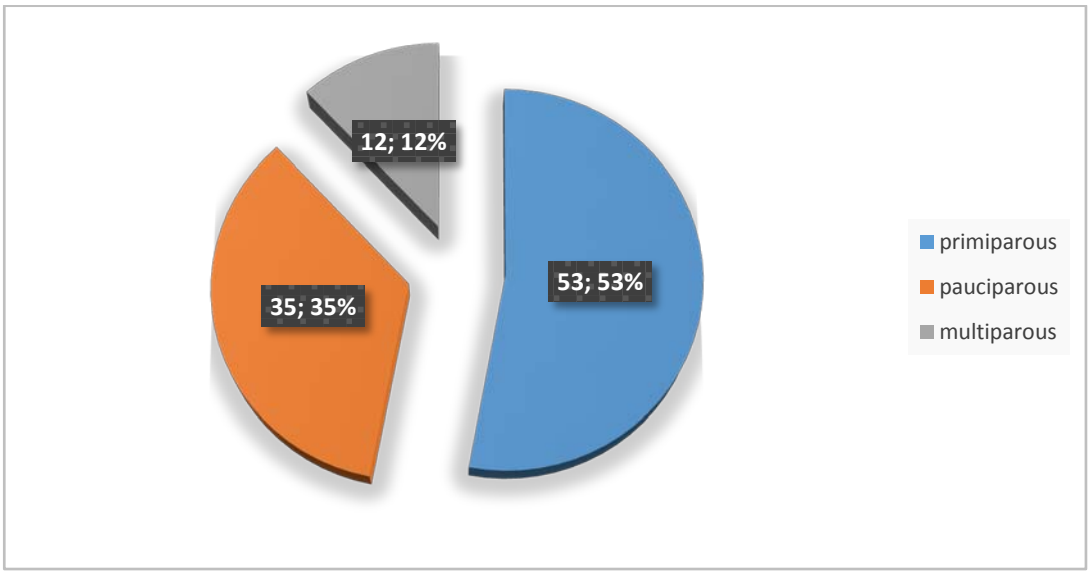


Figure 3: Distribution of eclampsia with regards to parity

IV. Patients medical history

Out of our 100 patients, 14 presented significant medical histories. Diabetes was the highest (5 patients) among the patients studied. We did not select patients who had chronic high blood pressure before an incidence of eclampsia. The result is as shown in the bar graph below:

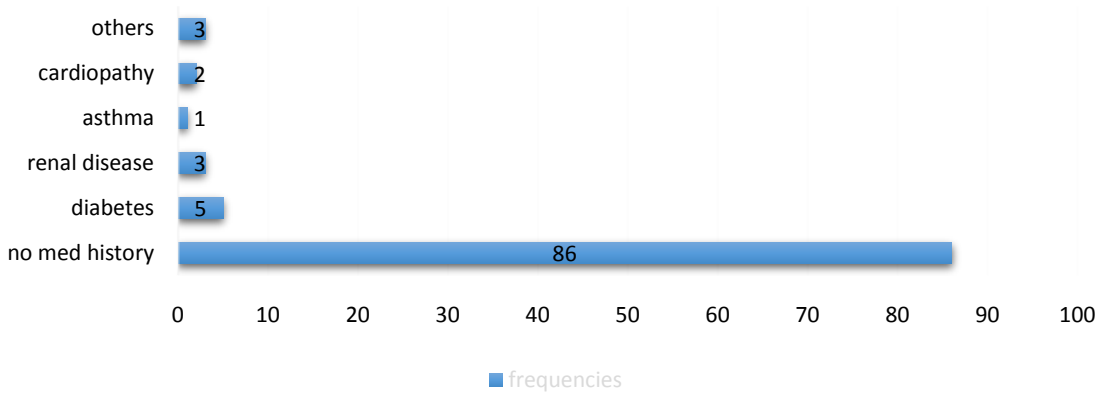


Figure 4: Distribution of eclampsia with regards to the various medical histories

V. Obstetric and gynaecological history

In total 32 patients presented various obstetrical and gynaecological histories. Gestational hypertension was the most presented (15). The histories and their frequencies are illustrated by the chart below:

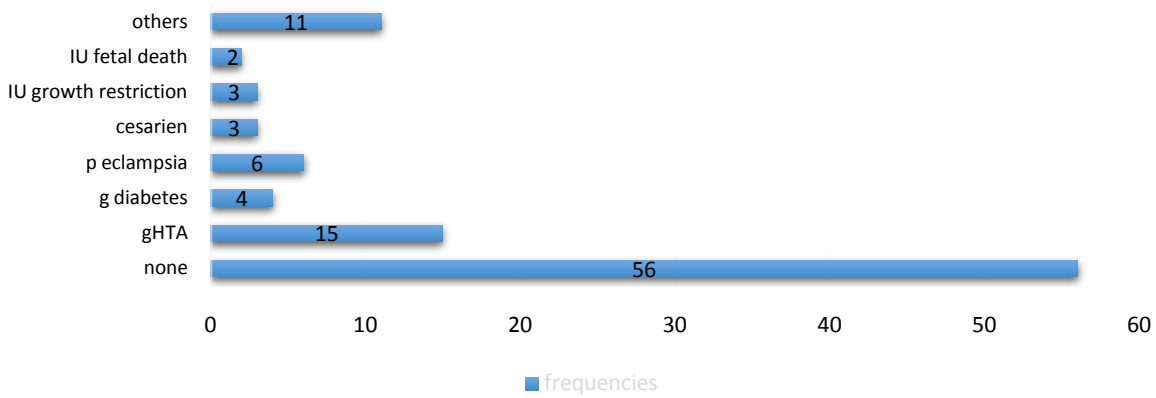


Figure 5: Distribution of eclampsia with regards to the various gynaecological and obstetrical histories

VI. Systolic blood pressure of admission

Out of the 100 patients, 55 had a systolic blood pressure of more or equal to 160mmhg. The highest systolic pressure recorded was 250mmhg and the lowest was 100mmgh. The mean systolic pressure being 172mmgh. 17 patients though had normal systolic pressure.

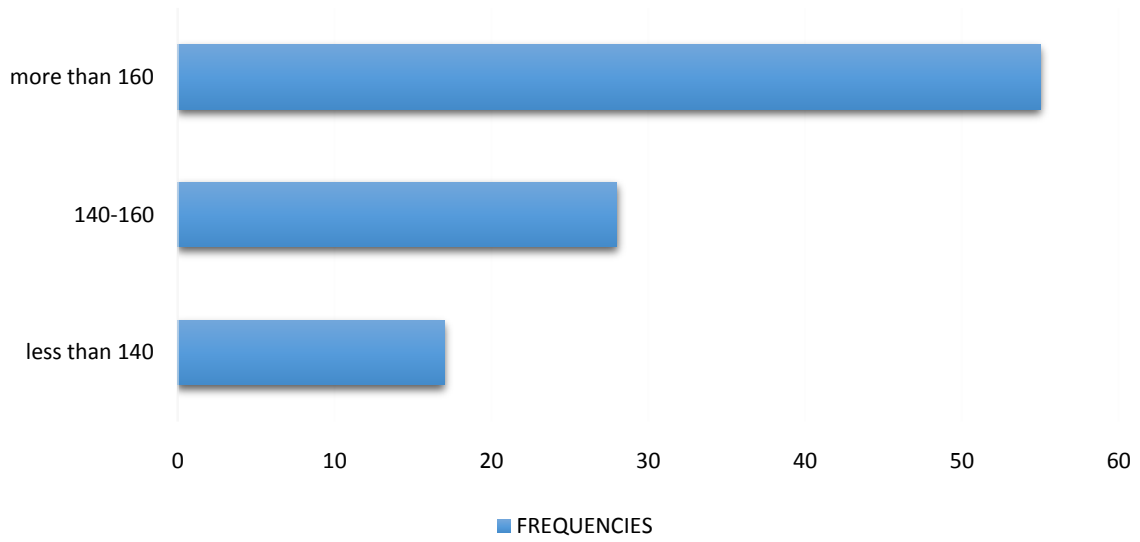


Figure 6:Systolic pressure distribution in our patients

VII. Diastolic blood pressure

We then examined if the diastolic pressure had a similar distribution to that of the systolic. The highest diastolic pressure was 135mmgh while the lowest was 50mmgh and the mean being 98mmhg. 45 had diastolic pressure more than 110 and 28 presented normal diastolic pressure that is less than 90mmgh. The diastolic pressure distribution is illustrated in the figure below:

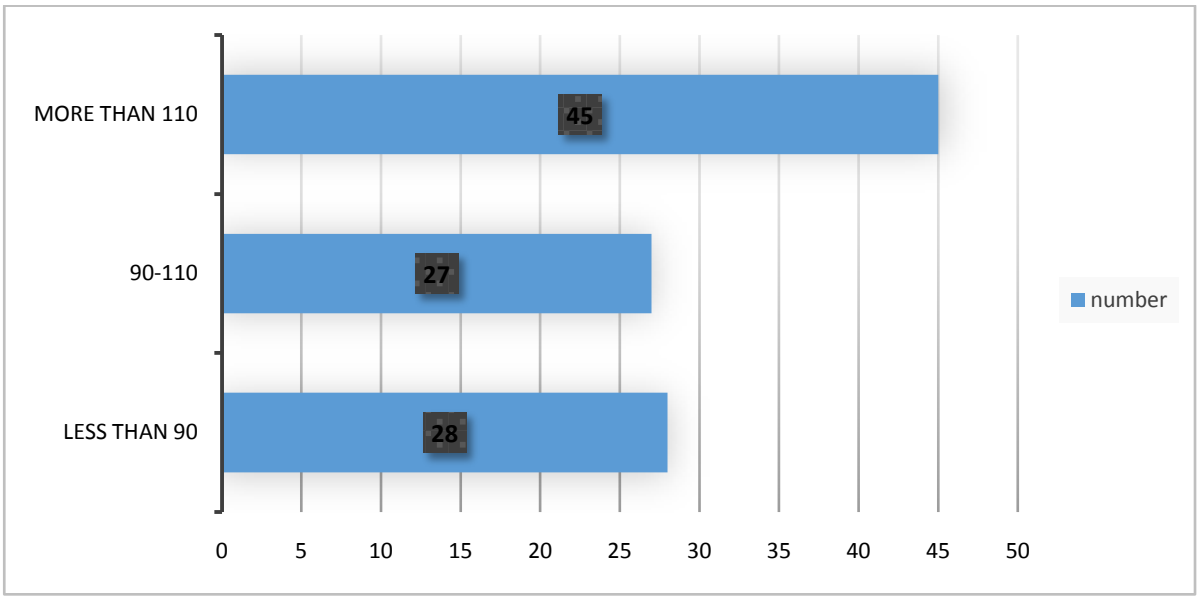


Figure 7: distribution of diastolic pressure in our patients

VIII. Seasons

The seasonal and monthly distributions of eclampsia are given in figure 8 and figure 9respectively. We noticed a significant increase in the incidence of eclampsia in the lower temperature periods that is winter and autumn for seasons and January to march for months

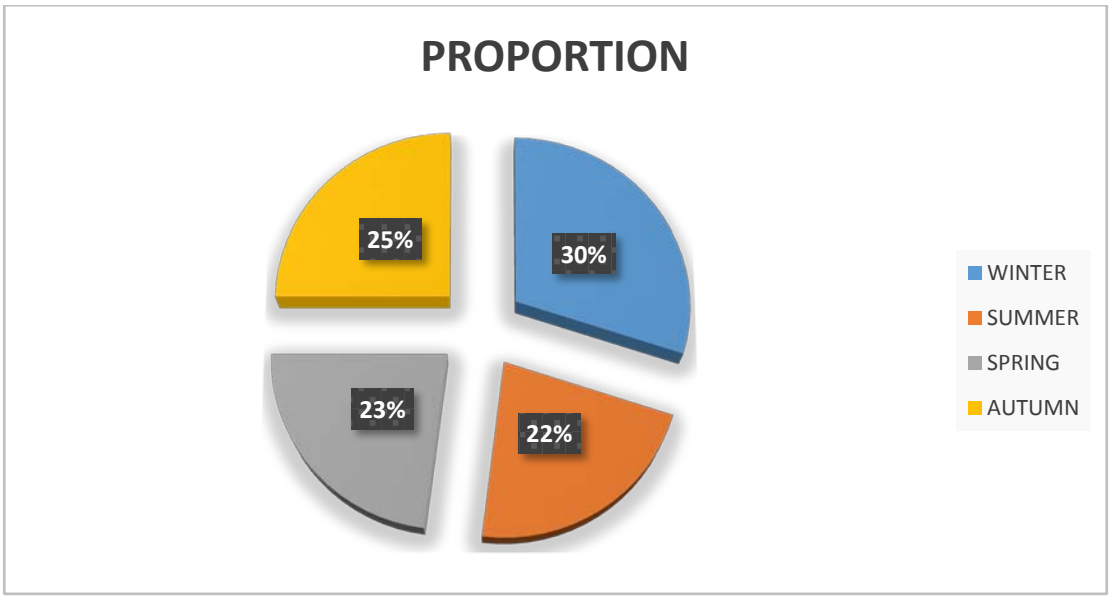


Figure 8: seasonal distributions of eclampsia

IX. Months of the year

Atmospheric pressure rocketed in January and February. This increase concerned the daily maximum pressure but especially the daily minimum pressure. Looking at raw data, these are the months with the highest number of eclampsia. As we advanced in the year, another peculiar change was noticed; this happened around the months of October and November. The maximum daily pressure stabilised but the minimum daily pressure kept rising. These months also recorded fairly high numbers of eclampsia.

The Months of May and June had the least number of eclampsia. These months also recorded the least mean, maximum, minimum atmospheric pressures in the year. The temperature, on the other hand, was opposite to the pressure concerning rising and falling. The temperature was low during the first two months of the year and kept increasing gradually. An abrupt elevation was noticed in May and June.

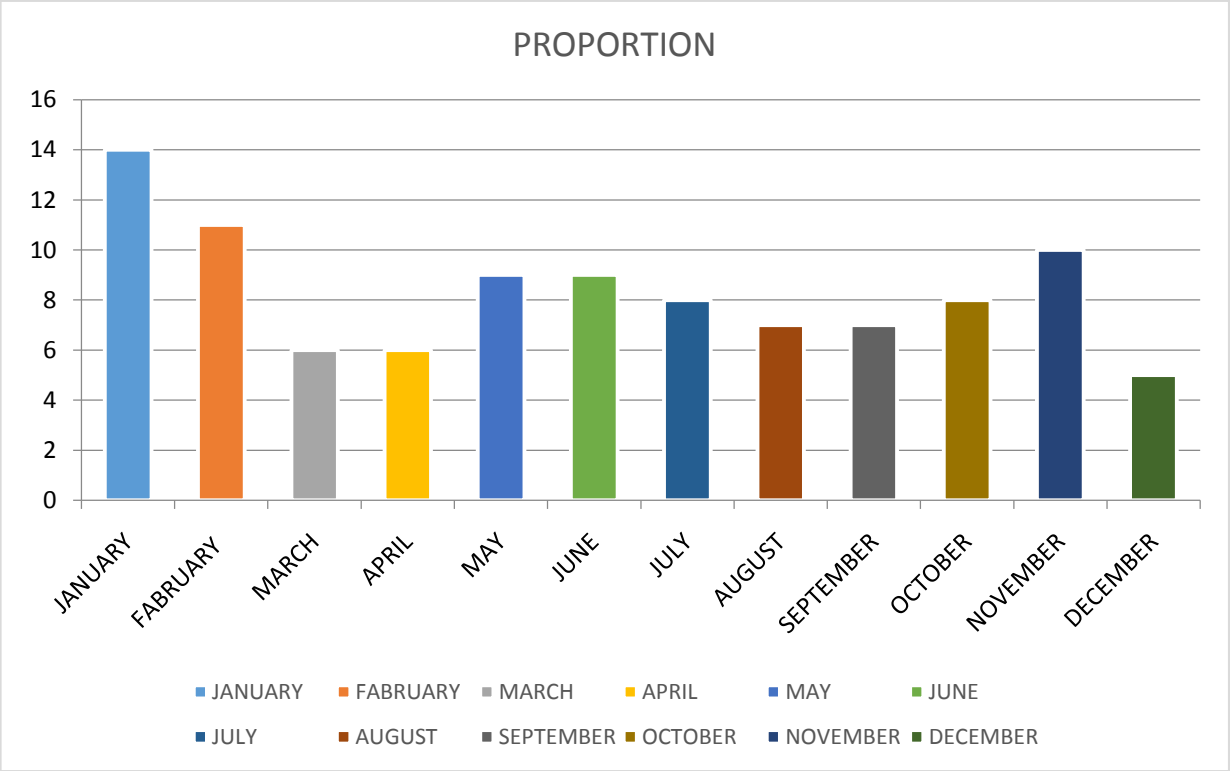


Figure 9: Monthly distribution of eclampsia

X. Atmospheric pressure

The impact of the five different aspects of atmospheric pressure on eclampsia is tabulated below:

Table I: atmospheric pressure difference of days WITH and days WITHOUT an incident of eclampsia

Days with				days without			
100 days				630 days			
Pressure (hPA)	mean	SD	p	mean	SD	OR	CI
Daily mean pressure							
Day of incident	1017.5	5.8	**0.002**	1015.6	6.1	1.07	[1.03-1.11]
Day before	1017.4	6.0	0.382	1017.9	4.8	0.98	[0.95-1.02]
Daily minimum							
Day of incident	1014.7	5.7	**0.001**	1006.8	3.65	1.56	[1.42-1.71]
Day before	1014.6	6.2	**0.001**	1006.8	3.67	1.48	[1.36-1.61]
Daily maximum							
Day of incident	1019.6	5.9	**0.001**	1023.5	4.8	0.838	[0.796-0.883]
Day before	1019.4	5.9	**0.001**	1023.5	4.8	0.831	[0.789-0.876]
Daily differential							
Day of incident	4.85	1.4	0.54	4.76	1.3	1.04	[0.90-1.22]
Day before	4.86	1.4	0.74	4.8	1.68	1.021	[0.90-1.15]
Daily variation							
Day of incident	7.O1	1.56	**0.026**	6.6	1.5	1.16	[1.02-1.32]
Day before	6.87	1.4	0.24	7.04	1.8	0.94	[0.83-1.07]

SD- STANDARD DEVIATION, P- P VALUE, OR-ODD RATIO, CI- CONFIDENCE INTERVAL

The bar chart below compares the mean barometric pressure of days with and days without incident of eclampsia for specific days eclampsia occurred and that of 24 hours before eclampsia. Overall, there was a significant difference between the means of the barometric pressure for specific days we had eclampsia (1017.5) and days without eclampsia (1015.6). In contrast, the mean pressure for a day before every incident of eclampsia (1017.4) was similar to that of days without eclampsia (1017.9).

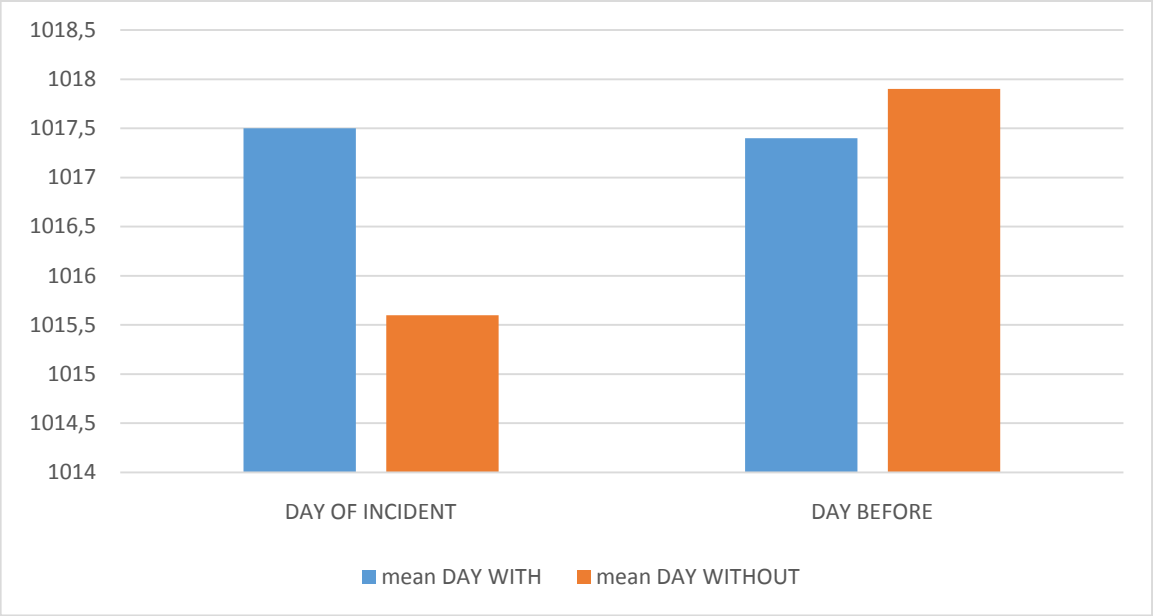


Figure 10: Mean pressure days with and days without

The figure below illustrates the means of the maximum barometric pressure of days with and days without eclampsia and that of 24 hours before an incident of eclampsia. In total, the maximum atmospheric pressure of days without eclampsia was considerably higher (1023.5) than that of days with eclampsia (1019.6). We had the same trend for a day before eclampsia with the mean been lower than that of the mean maximum of all other days.

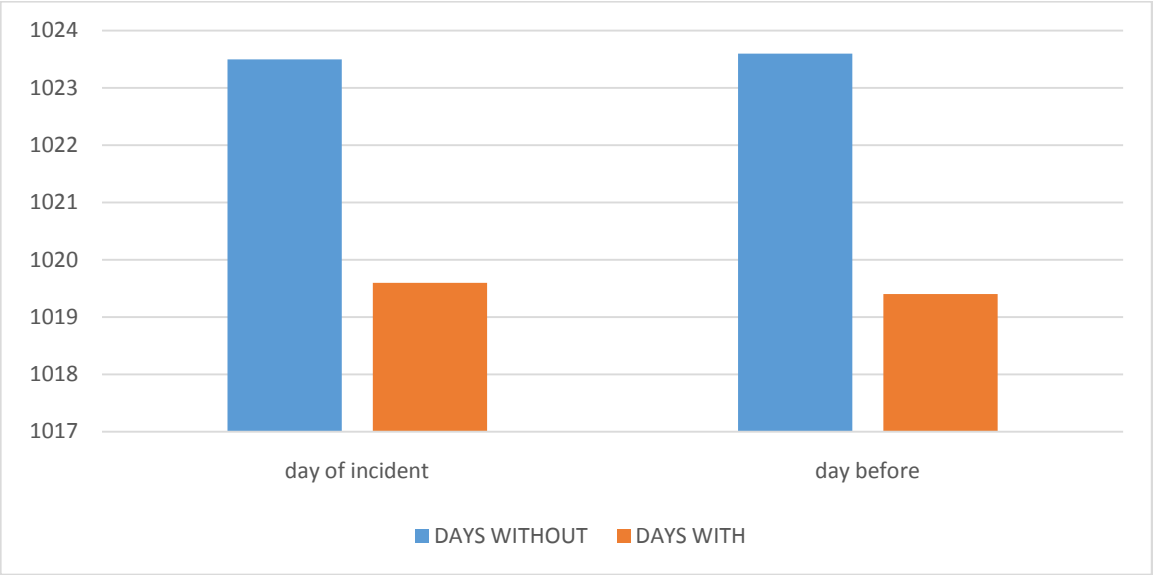


Figure 11: Comparing mean of maximum atmospheric pressure for days with and days without

The chart shows the means of the minimum atmospheric pressure for days with and days without eclampsia. In all, the minimum atmospheric pressure was substantially higher on days with eclampsia (1014.7) than days without eclampsia (1006.8). This goes a long way to demonstrate that the minimum pressure rocketed on days we had this illness. A similar finding was obtained with regards to a day before eclampsia (1014.6).

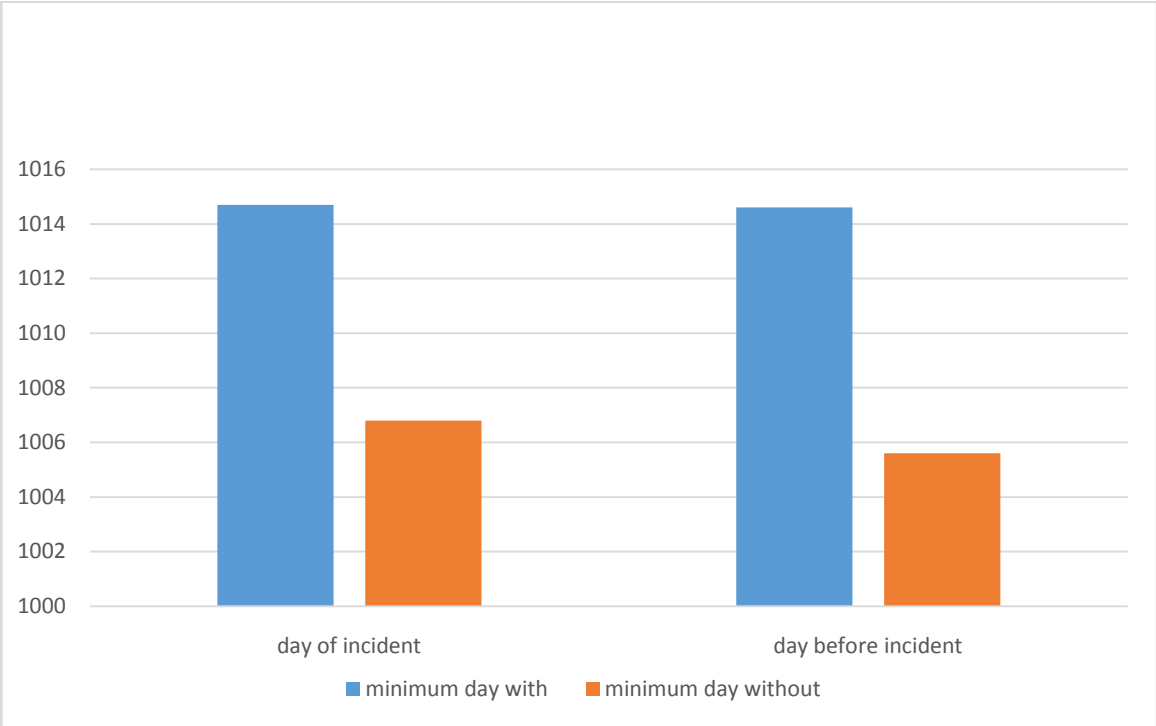


Figure 12: comparing the mean of minimum atmospheric pressure days with and days without

The bar chart compares the means of differential pressures of days with eclampsia with that of days without eclampsia. The two means were similar in value demonstrating no significant changes happened to differential pressure on these separate occasions.

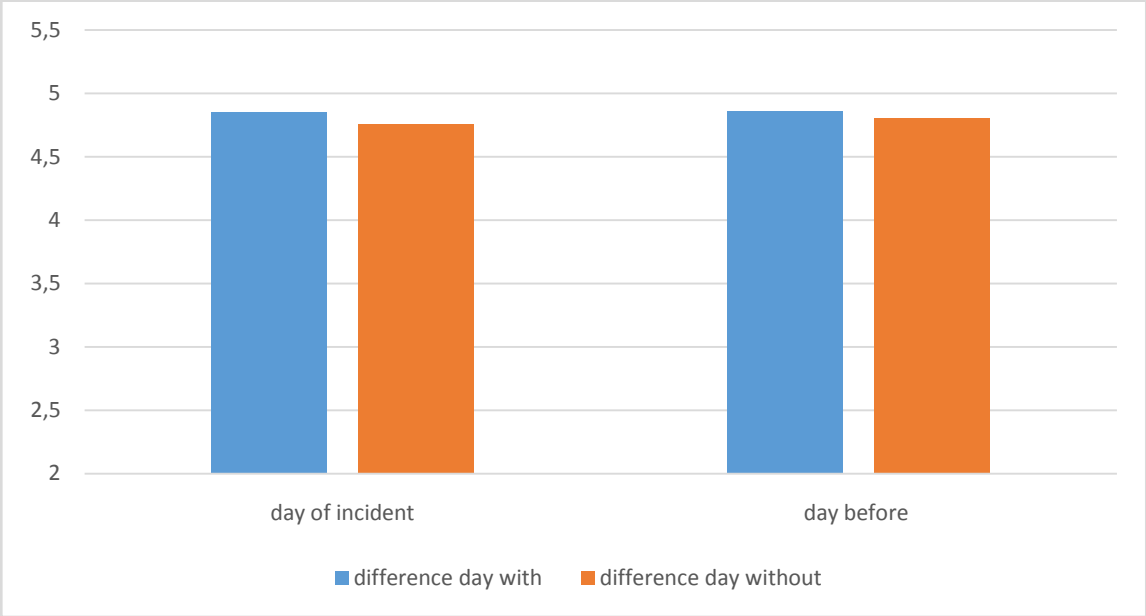


Figure13: Comparing the mean of differential pressure days with days without

The Figure below shows the means of variation of barometric pressure on days with eclampsia and days without eclampsia. Overall, the difference between the means of the atmospheric pressure variation on specific days of eclampsia was higher than that of a day before an incident happened.

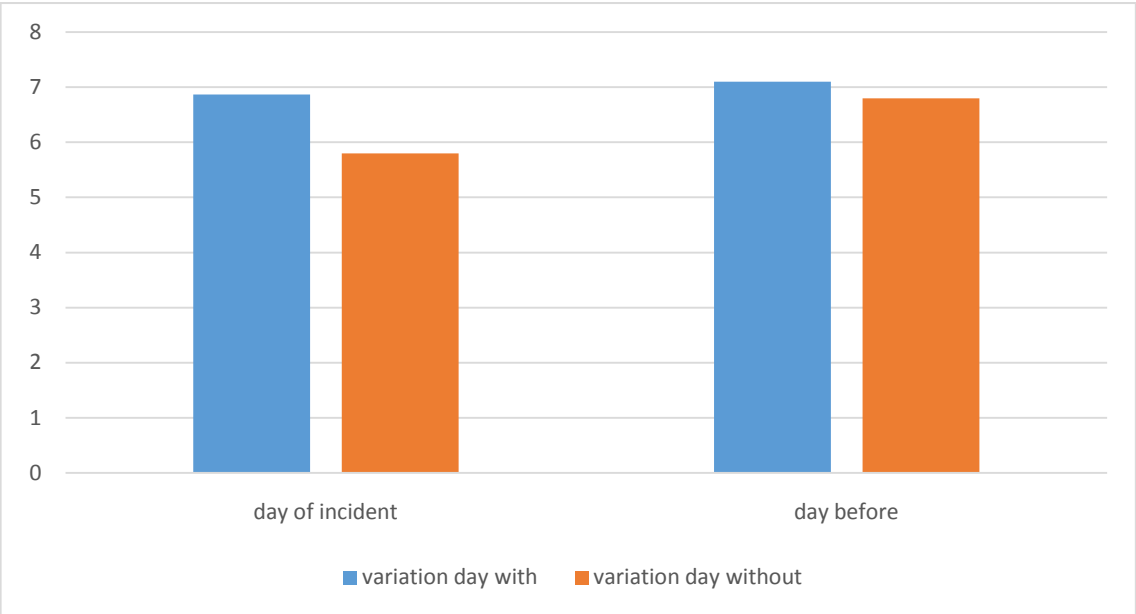


Figure 14: Comparing mean variation pressure of day with and day without

XI. Temperature

Table II: impact of daily minimal and maximal temperature on eclampsia

	Days with			days without			
Temperature	mean	SD	p	mean	SD	OR	CI
Daily minimal							
Day of incident	12.8	5.23	0.23	13.4	5.17	0.97	[0.94-1.02]
Day before	13.1	5.70	0.53	13.46	5.17	0.98	[0.95-1.03]
Daily maximal							
Day of incident	28.3	6.60	0.21	29.18	6.07	0.98	[0.95-1.01]
Day before	28.6	6.77	0.33	29.18	6.07	0.98	[0.95-1.02]

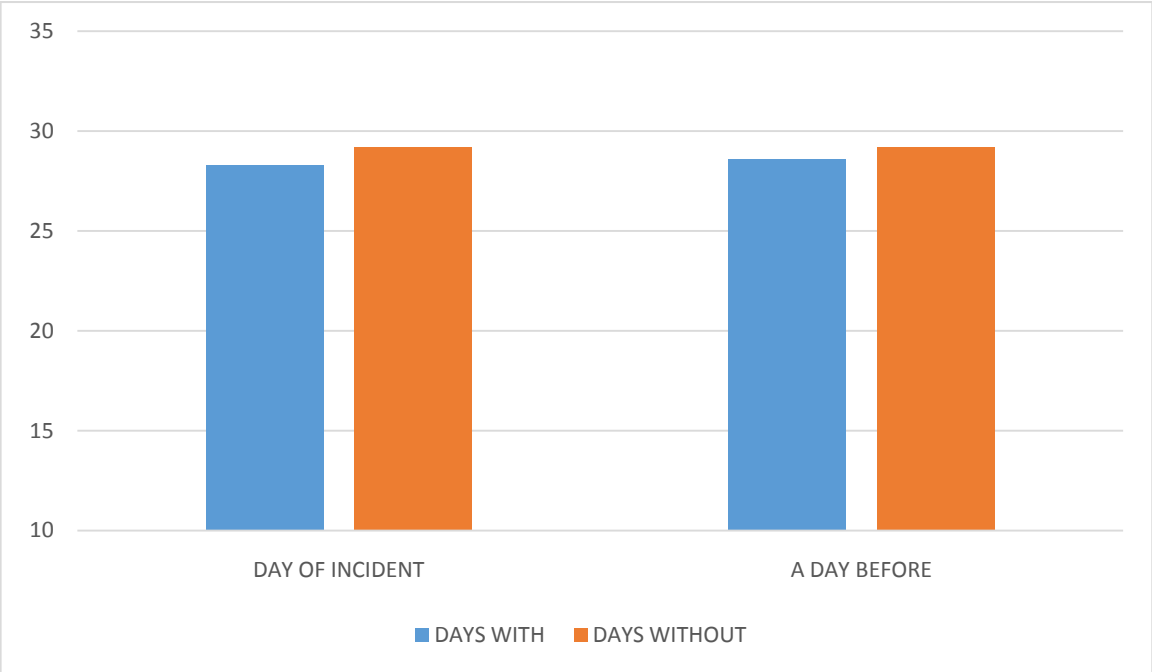


Figure 15: Comparing maximum temperature of days with to that of days without eclampsia

The bar chart above illustrates the means of the maximum temperature of days with eclampsia and that of days without eclampsia. In total, the maximum temperature of days with eclampsia was slightly lower than that of days without eclampsia. The same trend was seen when the mean of maximum temperature 24 hours before an incident was compared to days without eclampsia.

The bar chart below illustrates the means of the minimum temperature of days with eclampsia and that of days without eclampsia. Overall, the minimum temperature of days with eclampsia was slightly lower, but not statistically significant, than that of days without eclampsia. The same trend was seen when the mean of minimum temperature 24 hours before an incident was compared to days without eclampsia.

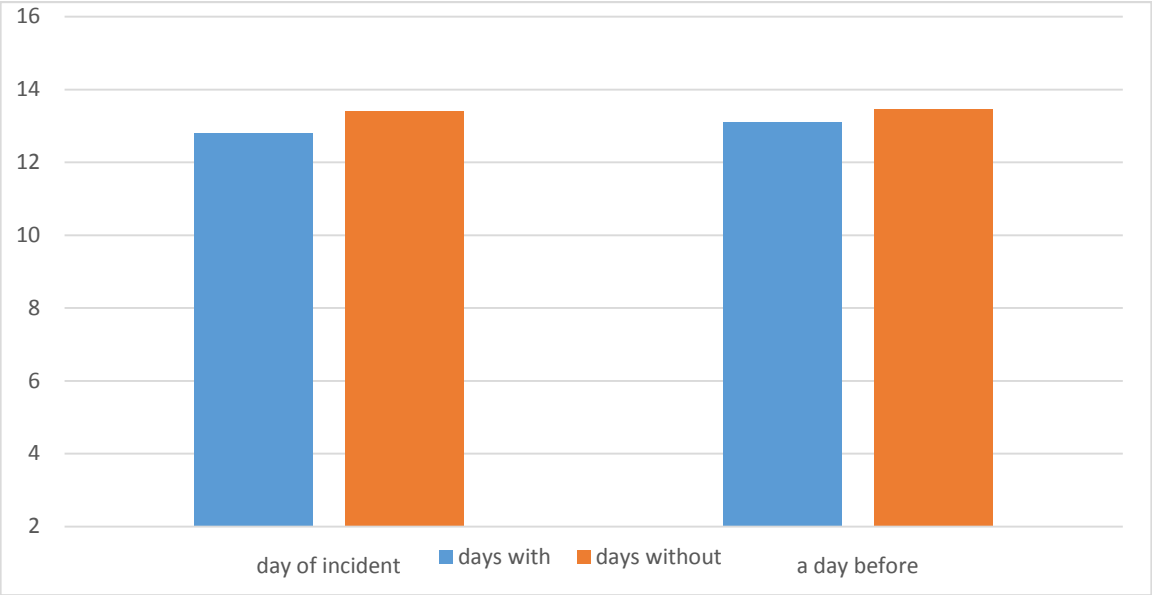


Figure 16

XII. Pressure impact oncolder days and hotter days.

Comparing the effects of atmospheric pressure on eclampsia on the colder days and that of hotter days. (Which time did the pressure influence the occurrence of eclampsia most, when it was hot or cold?)

Table III: Daily mean pressure of hot and cold days

Days	Mean	Standard Deviation	Odd Ratio	Confidence Interval Low high	Significance Level p	Case of eclampsia
Cold Days	1020.31	5.75	1.434	1.24 -1.66	.0001	60
Hot Days	1013.24	2.25				40

Table IV:Daily maximum pressure of cold and hot days

Days	Mean	Standard Deviation	Odd Ratio	Confidence Interval Low high	Significance Level p	Case of eclampsia
Cold Days	1022.52	5.80	1.467	1.25 -1.72	.0001	60
Hot Days	1015.22	2.22				40

Table V: DAILY MINIMUM PRESSURE OF COLD AND HOT DAYS

Days	Mean	Standard Deviation	Odd Ratio	Confidence Interval Low high	Significance Level p	Case of eclampsia
Cold Days	1017.52	5.75	1.42	1.23 -1.64	.0001	60
Hot Days	1010.56	2.33				40

Table VI: DAILY DIFFERENTIAL PRESSURE OF COLD AND HOT DAYS

Days	Mean	Standard Deviation	Odd Ratio	Confidence Interval Low high	Significance Level p	Case of eclampsia
Cold Days	4.99	1.63	1.202	0.88-1.64	0.241	60
Hot Days	4.65	1.03				40

Table VII: DAILY VARIATION PRESSURE OF COLD AND HOT DAYS

Days	Mean	Standard Deviation	Odd Ratio	Confidence Interval Low high	Significance Level p	Case of eclampsia
Cold Days	7.15	1.65	1.164	0.89-1.52	0.268	60
Hot Days	6.80	1.40				40

DISCUSSION

I. GENERAL

Eclampsia and preeclampsia complicate about ten percent of pregnancies worldwide(7). These conditions have been recognised and described for years despite a lack of clear understanding of the pathophysiology that causes them. In the fifth century, Hippocrates noticed that some pregnant women exhibited unexplained signs like drowsiness, convulsions, and headaches. Varandaeusa Greek physician coined the name “eclampsia” in 1619 which means “like a bolt from the blue” or unexpected(8).

To clearly comprehend this work, we will briefly define some essential terms used [for more detail, see annex].

1. Preeclampsia:

Preeclampsia is a pregnancy-associated disorder with new-onset hypertension, which occurs most often after 20 weeks of gestation and frequently near term. Although often accompanied by new-onset proteinuria, hypertension and other signs or symptoms of preeclampsia may present in some women in the absence of proteinuria(4)

2. Eclampsia:

Eclampsia, which is considered a complication of severe preeclampsia, is commonly defined as new onset of a tonic-clonic generalised seizure and/or unexplained coma during pregnancy or postpartum in a woman with signs or symptoms of preeclampsia. It typically occurs during or after the 20th week of gestation or in the postpartum period(5)

In our study, we noticed a general trend with regards to some risk factor of eclampsia

II. RISK FACTORS

1. Maternal age

Maternal age could be a possible risk factor in the occurrence of eclampsia. According to our study, most patients with eclampsia were concentrated around the age group 20-30 accounting for about 54%. 31% of these were between the ages of 20-24.

Table VIII: Comparing the incidence of maternal age of our patients with other studies

Maternal age group	Percentages in each study			
	Onoh et al Nigeria(9)	Ljesic et al morocco(2)	Dassah et al Ghana(10)	This study
15-19	5.1	27.7	8.5	12
20-24	25.6	34.8(20-25 YEARS)	28.2	31
25-29	36.6	22.3(26-30)	32.3	23
30-34	20.9	9 (31-35)	24.5	14
35-39	9.0	6.2(˃35YRS)	13.7	16
≥40	2.8		1.3	4
MEAN AGE	27±5	34±6	28±2	25

According to a cohort study conducted by Ljesic et al at the Marrakech university hospital in 2008, the maternal age most prone to this condition was less than 25(11) and a similar cohort conducted by Onoh et alin Nigeria and Dassah et al from Ghana showed that parturients with maternal age between 25-30 are most susceptible to this disease.(9,10)

2. Parity

Most of the patients in our study were primiparous. This confirms a well-documented notion that preeclampsia and eclampsia mostly affected women giving birth for the first time. Globally, 3-7% of primiparous run the risk of having eclampsia compared to 1% of multiparous(11,12).

In our study 54% of our patients were primiparous. This means patients during booking at the hospital should be carefully surveyed in search of possible preeclampsia and cared for accordingly.

Table XI: Comparisons between our studies and other research on parity and eclampsia in percentages

PARITY	STUDIES			
PRIMOPAROUS	BAYE SENEGAL(13)	LJESIC MOROCCO(2)	DASSAH GHANA(10)	OUR STUDY
	64.28	66	61.2	53
PAUCIPAROUS	20.2	26	30.5	35
MULTIPAROUS	15.52	8	8.3	12
REPRESENTATION OF PRIMIPAROUS	Almost 64%	66%	61%	53%

A series study by Baye in Senegal puts the proportion of primiparous prone to eclampsia as high as 66%. Similarly, Ljesic and Dasseh estimated this value at 66% and 61 percent respectively.

3. Gestational age

Eclampsia can happen during antepartum, intrapartum or postpartum. For Sibai et al, eclampsia of antepartum represents about 53%, that of intrapartum 18-36% and postpartum 11%(14). In our study, eclampsia of ante and intra-partum represented about 92% and thegestational ages most affected were those greater than 37 weeks. 94% of eclampsia happened after 28 weeks of gestation showing that increasing gestational term increases the frequency of eclampsia.

Table X: Comparing gestation age of patients in this study to other findings

TERM OF PREGNANCY	STUDY			
	LJESIC MOROCCO(2)	SIBAI THE USA(14)	ONOH NIGERIA(9)	THIS STUDY
<29	11.6	5.6	19.2	6
29-34	25	49.2	15.1	31
35-37	4.5		22.6	8
>37	52.6	45.2	43.1%	55
% AT ADEQUATE TERM	52%	45%	43.1	55%

In all these studies eclampsia mostly occurred in pregnant women with gestational age greater or equal to 37TH week of gestation cementing the view that this pathology increases with increasing gestational age.

4. Medical history

Over the years, some patients' medical histories have been linked to eclampsia(15). Diabetes was the highest medical history seen in our patients. Some studies suggest that developing preeclampsia increases twofold the risk of developing chronic and gestational diabetes. In those studies, eclampsia is a risk factor for developing diabetes by increasing insulin resistance(16,17). Other studies suggest the opposite, insinuating that chronic or gestational diabetes is a risk factor of pre-eclampsia and eclampsia(18). One thing is common in these literature studies; eclampsia and diabetes are mostly associated with each other as seen in our study. Renal diseases were fairly high. They were found in three of our patients.

Table XI: Comparing histories usually manifested by patients with other literature findings.

STUDY	MOST POPULAR HISTORY	Sample size	Risk
ODEGARD(19)	HYPERTENSION	906	2.83
ROS(20)	TWIN PREGNANCY	75	2.37
LEE(21)	DIABETES	29375	3.56
DUKLER(22)	HISTORY OF PRE ECLAMPSIA	24620	7.19
COONROD(23)	PRIMIPAROUS	37988	2.91
VAN HOORN(24)	OBESITY	64789	2.47
MANUCK ET AL(25)	ANTIPHOSPHOLOPID SYNDROM	1802	9.72

According to Odegard, a patient with chronic hypertension has more than double the risk of developing eclampsia than someone without chronic hypertension. Similarly, Lee postulates that a patient with chronic diabetes has almost 4 times the risk of developing eclampsia than a patient without.

5. Gynaecological and obstetric history

These histories were largely presented and associated with the gravity of eclampsia. Most patients denoted as serious had one or more obstetrical histories. Gestational hypertension was very much at the forefront seen in 15% of them. Gestational hypertension is a type of hypertension that starts during pregnancy, usually after the 20th week of gestation. A bulk of our patients presented it slightly confirming its frequent association. A lot of studies have tried to find the mechanism of this association but none has presented any concrete explanation(26,27). Other histories include Intrauterine growth restriction and death which were fairly high.

6. Gestational Hypertension

A study by Patrick Soudan et Al(26) showed that only 20-25% of women with gestational hypertension will develop pre-eclampsia and about 1 in every 200 women with preeclampsia will develop eclampsia. Furthermore, the study suggested that 72% of eclampsia patients presented gestational hypertension. Knowing that a pregnant woman can develop eclampsia without obvious signs of preeclampsia.

7. Seasons

Several observational studies have suggested a link between eclampsia and seasons especially the colder seasons. Subramanian et al (28)studied the influence of the colder monsoon season of India on eclampsia and found a significant association between them, Okafor et al (29)studied the link between colder rainy season in the tropics of Nigeria and found eclampsia was significantly high during this condition. In our study, we recorded the highest number of eclampsia during the winter followed by late autumn which are the coldest seasons in Marrakech. We found a significant difference between these two colder seasons compared to the two hottest seasons of the year (summer and late spring) and eclampsia. Also, Months of the year followed the same trend in

that the coldest months of the year recorded the highest numbers of eclampsia. January and February recorded the highest number in our two-year study period (21% of the total).

Table XII: Comparison of seasonal incidence of eclampsia in our study with other findings

MONTHS	STUDIES AND SEASONAL PERCENTAGES OF ECLAMPSIA			
	SHAGHAIBI ET AL(30) TUNISIA	MRCOG ET AL(31) KUWAIT	LJESIC(2) MOROCCO	OUR STUDY
WINTER DECEMBER-FEBRUARY	30	35.8	34.8	30
SPRING MARCH-MAY	24.1	27.4	25.8	22
SUMMER JUNE -SEPTEMBER	19.8	19.9	10.8	23
AUTUMN OCTOBER-DECEMBER	25.1	22.7	28.6	25

A comparison was made between this study and other research works done in similar geographical locations and settings knowing that atmospheric pressure varies massively from one place to another. Eclampsia was consistently higher in winter and the months of January and February in all these studies.

III. ATMOSPHERIC PRESSURE AND HEALTH

The air around us has weight, and it presses against everything it touches. That pressure is called atmospheric pressure, or air pressure. In simple terms, it is the force exerted on a surface by the air above it as gravity pulls it to Earth. Over the years humans have suspected the impact of weather on their health. Many studies have proved a link between atmospheric conditions and human pathologies.

BOUINEAU ET al (32)studied the influence of atmospheric pressure on the occurrence of premature rupture of the membrane. Their study centred on finding a link between atmospheric pressure variation and premature membrane rupture. They concluded that rapid variation of this pressure especially as abrupt reduction can contribute to premature rupture of membrane. They defined pressure variation as an abrupt 2hPa increase or decrease in 3 hours and realise that there were more membrane ruptures when there was a reduction of 2hPa within 3 hours.

It has been suggested that a decrease in Atmospheric Pressure increases BP via the sympathetic nervous system and the immune system (1).

Kasdi et al studied the impact of atmospheric pressure on the occurrence of aortic dissection and aneurysm rupture(33)

Jochen Schuld et al studied the impact of meteorological conditions on abdominal aortic aneurysm(34)

Vidya Subramaniam et al researched the seasonal variation in the incidence of preeclampsia and eclampsia in tropical climatic conditions. They noticed that the incidence of eclampsia is significantly higher in monsoon when the weather is colder(28)

They retrospectively collected and analyzed data from a maternity center in India over a period of 36 months, recording the incidence of eclampsia. Then they acquired Meteorological data from the regional meteorological center recording the monthly average temperature, humidity, barometric pressure and rainfall during the study period. The study period was then divided into two climate conditions: monsoon season and dry season. The incidence of eclampsia was then compared between these two seasons in their study which concluded that eclampsia was higher in monsoon when it was colder

Most of our patients were primiparous suggesting the notion that eclampsia increases in women giving birth for the first time

When we look at raw data from the Moroccan meteorological website, we realize that atmospheric pressure increases massively during the colder period than the hotter periods of the year, especially the daily minimum pressure. It is higher during winter and autumn than in summer.

Eclampsia was highest during these periods of the year for the 2-year study period. Some studies have suggested that eclampsia increases during colder conditions.(28)

A study by Gideon Charach et al also suggested that atmospheric pressure might have an impact on high blood pressure in the general population (1). They measured the blood pressure of 182 hypertensive patients in a clinic with constant room temperature but varying atmospheric pressure according to the local climate in 5 years.The results of their study confirmed a direct relationship between high (>1016 hPa) atmospheric pressure and both systolic blood pressure and diastolic blood pressure levels in hypertensive patients

So If 72% of eclampsia patients presented hypertension in our studies and atmospheric pressure exacerbates hypertension according to Charach et al, then atmospheric pressure might impact eclampsia. So, we examined the systolic and diastolic blood pressure of our patients at the admission and noticed that 55% had high blood pressure.

1. Mean Atmospheric pressure

The daily mean atmospheric pressure on days we had eclampsia was significantly higher than that of the days we did not have eclampsia [p less than 0.001; OR=1.07; CI (1.03-1.11)]. This means that the mean atmospheric pressure increasing may cause eclampsia in women with preeclampsia in Marrakech. A unit increase in the daily mean pressure in the region of Marrakech can significantly engender a rise in the number of eclampsia patients according to this study. It has been suggested by Bergstrom S et al(35) that the means pressure is associated with eclampsia/birth ratio. In their study, a 12-month retrospective study was conducted where a monthly average of temperature and pressure were tabulated with the eclampsia birth of each month. They realize that when one takes eclampsia out of the equation, the birth ratio was almost the same in all the months. However, when one takes eclampsia into consideration, the eclampsia birth ratio varied with the months with peaks around July and August when the weather was coldest and the mean pressure changed. Bouineau et al(32) suggested that mean atmospheric pressure might be associated with premature rupture of membrane.

However, the mean atmospheric pressure one day before the actual day of eclampsia did not have statistical significance on the occurrence of this disease. Simply put; the mean atmospheric pressure of a day before did not have any impact whatsoever on women having eclampsia in our study [p=0.381; OR=0.98; CI (0.95-1.02)].

2. Maximum atmospheric pressure of the day

A brief look at values of the daily maximum atmospheric pressure showed a slight increase when the weather is colder. This means higher in winter and autumn. The mean of the daily maximum atmospheric pressure was lower for days with eclampsia than that of days without eclampsia. Our statistical analysis showed a significant relation between the daily maximum pressure and eclampsia but contrary to our initial hypothesis. An increase in the daily maximum pressure seems to protect against eclampsia according to our study. This could be the reason why we had a spike in the daily maximum pressure around the months of June and July and still had a lower number of eclampsia patients. This statistical significance [p less than 0.01; OR=0.838; CI= (0.796-0.883)] means a higher daily maximum pressure in Marrakech is a factor in eclampsia occurrence. This phenomenon could not explain the peak increase in the maximum atmospheric pressure during winter and the rise in the number of eclampsia. We had similar findings for daily maximum pressure for a day before eclampsia [p less than 0.01; OR=0.831; CI (0.789-0.876)] which seems to be a factor in eclampsia. So when the maximum pressure decreases, it augments the chances of pregnant women at risk, having a seizure.

3. Minimum atmospheric pressure of the day

Now we are back to answer the question earlier. Does the lower pressure of everyday cause eclampsia? We noticed that the mean minimum pressure of days with eclampsia was higher than that of days without eclampsia. The highest numbers of minimum daily pressure were recorded when the weather was cold. Of all the various aspects of pressure investigated,

the minimum had the biggest alterations to its value when the weather changed. We recorded a significant association between eclampsia and the minimum daily pressure [p less than 0.001; OR= 1.56 CI (1.42-1.71)]. And that of one day before our patients had a seizure was similar [p less than 0.001; OR= 1.48; CI (1.36-1.68)]

This could explain why we had more eclampsia in the winter and autumn it has been claimed that minimum pressure is associated with abdominal aneurysm rupture(6). The minimum atmospheric pressures in winter and autumn were higher than the rest of the year thereby making most of our patients seize. In addition to this, the decrease in the minimum daily pressure in summer could be the reason the number plunged. It will be interesting in the future to prospectively study the minimum atmospheric pressure and its impact.

4. Difference between the minimum and the maximum pressure of the day

We tried to find out the impact of the daily differential on eclampsia. We realize that the mean daily difference on days with eclampsia and days without eclampsia were similar to each other. Statistically, there was no significant difference between that of days with and days without [p =0.54; OR=1.04; CI (0.90-1.22)]. We had a similar finding for a day before we had eclampsia [p=0.74; OR=1.02; CI (0.90-1.15) as was done in a similar study that looked at the impact of barometric pressure on migraine(36). In their study, 28 patients who kept diaries of the days they had eclampsia were selected. A retrospective analysis of the pressure difference 2 days before and 5 days after they had had the migraine was done. It was seen that the frequency of migraine increased when the difference in barometric pressure from the day the headache occurred to the day after was lower by more than 5 hPa, and decreased when the difference in barometric pressure from the day the headache occurred to 2 days later was higher by more than 5 hPa.

5. Daily pressure variation

Rapid changes in compression and depression on materials may alter their form in a short period(37). What about the atmospheric pressure? These changes could possibly alter the human system if it is rapid and the body does not have time to adapt to these changes. In our study, we delved into the possibility that these changes could induce seizures in patients known to have preeclampsia thereby causing eclampsia. The statistical analysis of our data showed a significant difference between the pressure variations of days with and that of days without especially on specific days we had an incident of eclampsia [p=0.001; OR=1.16; CI(1.01-1.32)]. This showed that the pressure variation maybe a cause of eclampsia as was demonstrated in a similar study about the pressure variation and premature rupture of membrane(32).

Conversely, the analysis of the mean pressure variation of a day before eclampsia showed there was no statistical significance between days with and days without.

6. Temperature

We focused on the daily minimum and daily maximum temperature. Our statistical analysis showed no significant correlation between eclampsia and temperature, be it the specific day of an incident or a day before an incident. Most studies have shown an increase in the incidence of eclampsia during the colder seasons(28,35). Our study showed that minimum daily pressure increasing during colder conditions could be the cause of this increase in eclampsia in these colder conditions and not the temperature itself. We also demonstrated that decreasing temperature alone does not have any effect on this condition unless this decrease is associated with augmenting daily minimum pressure and/or the daily pressure variation and/or decreasing maximum daily pressure.

The Maximum daily temperature of a day before an incident of eclampsia [p=0.597 OR=0.983 CI (0.950-1.017)] had no statistical significance on the occurrence of eclampsia in the study period.

Similarly, the minimum daily temperature of a day before eclampsia did not have any impact whatsoever on its occurrence [p=0.134 OR=1.162, CI (1.018-1.327)]. With regards to daily maximum temperature of the specific day eclampsia took place, nothing demonstrated any correlation or its link to eclampsia. The daily minimum temperature of the specific day of eclampsia gave similar results (P=0.944 OR=0976 CI (0.937-1.016)]. This might loud the aforementioned theory that temperature has been a confounding factor confusing others as an accelerator of eclampsia while the real culprit has been pressure all along according to this study.

7. Pressure and temperature

Several studies have mentioned a possible causality between temperature and eclampsia in the literature. Most of these studies did not take into account the existence of pressure hence completely omitting it(38,39). Atmospheric pressure may be the actual perpetrator with regards to this study. We noticed the minimum daily atmospheric pressure rising (a day prior to or on the specific day of eclampsia) and rapid pressure variation has a direct link to the occurrence of eclampsia. On the other hand, we had the opposite result when it came to maximum daily pressure. This seems to cause a higher proportion of eclampsia when decreased and lesser when increased. Mean daily pressure increasing on a specific day had a direct link to the incidence of eclampsia. When it comes to daily differential pressure though, no such link was found. Simply put, daily pressure difference did not have any effect whatsoever on eclampsia's occurrence in our patients. Temperature similarly, did not affect eclampsia's onset in our study.

8. Pressure impact on colder days and hotter days.

Overall, atmospheric pressure on colder days was higher than that of hotter days. The biggest rise was seen in minimum daily pressure. Eclampsia seems to follow the same pattern as barometric pressure, increasing as the weather gets colder and decreasing otherwise. It goes a

long way to show that minimum pressure accelerated the occurrence of this condition on colder days than on hotter days.

In addition to this finding, we were able to demonstrate a statistical significance between pressure on chilly days and eclampsia. This correlation was more pronounced when considering minimum daily pressure [p=0.001, OR=1.23, CI (1.23-1.64)] and mean daily pressure [p=0.001, OR=1.43, CI (1.24-1.66)]. However, there was no indication of pressure variation or differential pressure or increasing the frequency of eclampsia on colder more than hotter days.

9. Practical implications of our study

Although our study did not conclude with certainty that atmospheric pressure is a cause of eclampsia, knowing from the research that minimum, mean atmospheric pressures and pressure variations are possible culprits of an occurrence of eclampsia will help plan for an increase in the number of admitted patients during periods of sudden spurs in these pressures. Currently, ignorance of this fact causes massive congestions during specific periods resulting in shortages of materials used for treating these patients. With this Knowledge, Prior organization will certainly increase proper patient care.

In addition, our study will pave way for others to delve deep into a possible link between eclampsia and atmospheric pressure which will eventually lead to the possible production of more efficient drugs in the management of this sickness. This will also help others to study similar links between human pathologies and atmospheric conditions like blood pressure and atmospheric pressure.

With the knowledge of our study, we hope simple devices can be manufactured to measure the room atmospheric pressure where patients with eclampsia are hospitalized similar to the glucometer. This with the prospect of modulating room and local pressure will considerably help reduce the number of seizures and possibly help in the prevention of severe preeclampsia.

Moreover, there could be primary prevention of women by educating and stringent surveillance of women at risk of having this pathology.

Finally, in terms of general impact, our study may participate to further improve human knowledge of the influence of atmospheric conditions on our health (39).

10. Limitations of the study

Overall, we had some convincing results in the research. Nevertheless, the availability of some material as well as situations could have substantially improved the power of the study. In general, there were limited resources in the literature concerning this specific subject. Most studies rather researched a link between temperature and eclampsia with ambiguous results(29,38,40). Hence limiting the capacity to compare and contrast our findings.

An essential factor that limited the power of the study was the presence of different other known risk factors of eclampsia such as diabetes, chronic hypertension and others in our patients. Almost 70 percent of all the patients presented one or more known risk factors. This hindered the ability to spot atmospheric pressure as the sole cause of the seizure at a specific given time.

Furthermore, increasing the size of the sample will go a long way to improve the statistical power level of our study. Most patient files at the university hospital were not complete with the important pieces of information for the research. Eventually, this made us decide to limit the number of the sample to only those containing the essential information.

Another way our study was slightly limited was with regards to the origin of our patients especially high altitude locations. Atmospheric pressure as we all know differs considerably just by looking at two areas separated by a couple of Kilometers. In this respect, we considered atmospheric pressure at Marrakech for all our patients whereas some of them might be experiencing a different level of pressure before being transferred quickly to the emergency department of the university hospital. This caused a bit of disparity between the real pressure

experienced and the variations of pressure these individuals were subjected to as a result of the abrupt transfer from one location to another.

Another shortcoming of the study is the fact that our work is a retrospective work with all the limitations that this implies.

Finally, one essential question was, could the pressure a week before, two weeks before or a month before an incident of eclampsia have an impact on the occurrence of this malady? In our study, we chose an arbitrary 24-hour pressure before eclampsia occurrence in order to find possible associations with the eclampsiaand pressure. It is possible that the actual pressure that triggers eclampsia occurs well before the 24 hours considered, possibly a week or a month before the day the incident happens. Collecting the data and researching this, even though, will be exhaustive, could have shed more light on our results and bolster the power level of the study.

CONCLUSION

To sum up, our study is the firstin the world, in our knowledge, on finding a link between atmospheric conditions (pressure and temperature) and eclampsia. This goal was accomplished to some degree. We looked at different aspects of the atmospheric pressure notably mean daily, maximum, minimum, differential and variation. It was noticed that daily minimum pressure, daily mean pressure and pressure variation influenced the occurrence of eclampsia..

On other hand, daily pressure differential did not have any impact whatsoever on eclampsia this study. However, the rise in the daily maximum atmospheric pressure seems to reduce the occurrence of eclampsia.

We also realized that asudden increase in minimum daily pressure seems to occur when the weather is cold hence augmenting the number of seizures in winter and the colder months hence minimum daily pressure influenced the occurrence of eclampsia more on colder days than hotter ones.

According to our findings, the temperature did not affect the occurrence of eclampsia contrary to what some research papers might have insinuated in the past. It is possible temperature has been a confounding factor in this fact.

The knowledge in this study will help better manage patients, help in primary prevention of eclampsia and future development of effective drugs in treating this illness.

Our study was not without limits. The possibility of a well-structured prospective study in the future will be intriguing but remains a velleity at the moment. We hope this though will pave way for others since there are limited resources on this subject.

ANNEX

I. PREECLAMPSIA:

1. Overview

Preeclampsia is a pregnancy complication with serious consequences for mother and infant(41). It is a condition that begins during pregnancy, usually after the 20th week. A woman with preeclampsia develops high blood pressure and usually protein in her urine, and she often has swelling (edema) of the legs, hands, face, or entire body(42).

Maternal mortality related to preeclampsia has reduced due to strict surveillance of pregnancies at risk and rapid delivery in case there is a complication.

This management has changed little in the last 100 years, and it is very effective at reducing maternal mortality mostly, in developed countries. However, maternal morbidity remains high with preeclampsia, which continues to be one of the leading causes for the admission of pregnant women to intensive care units(43).

Also, fetal mortality and morbidity are considerable, related to the effects of the disease on the fetus as well as prematurity. The indicated delivery of women to prevent the progression of preeclampsia is responsible for 15% of all preterm births(44).

In third world countries, where inadequate prenatal care limits preeclampsia surveillance, maternal mortality is still high, accounting for over 50 000 deaths yearly(45)

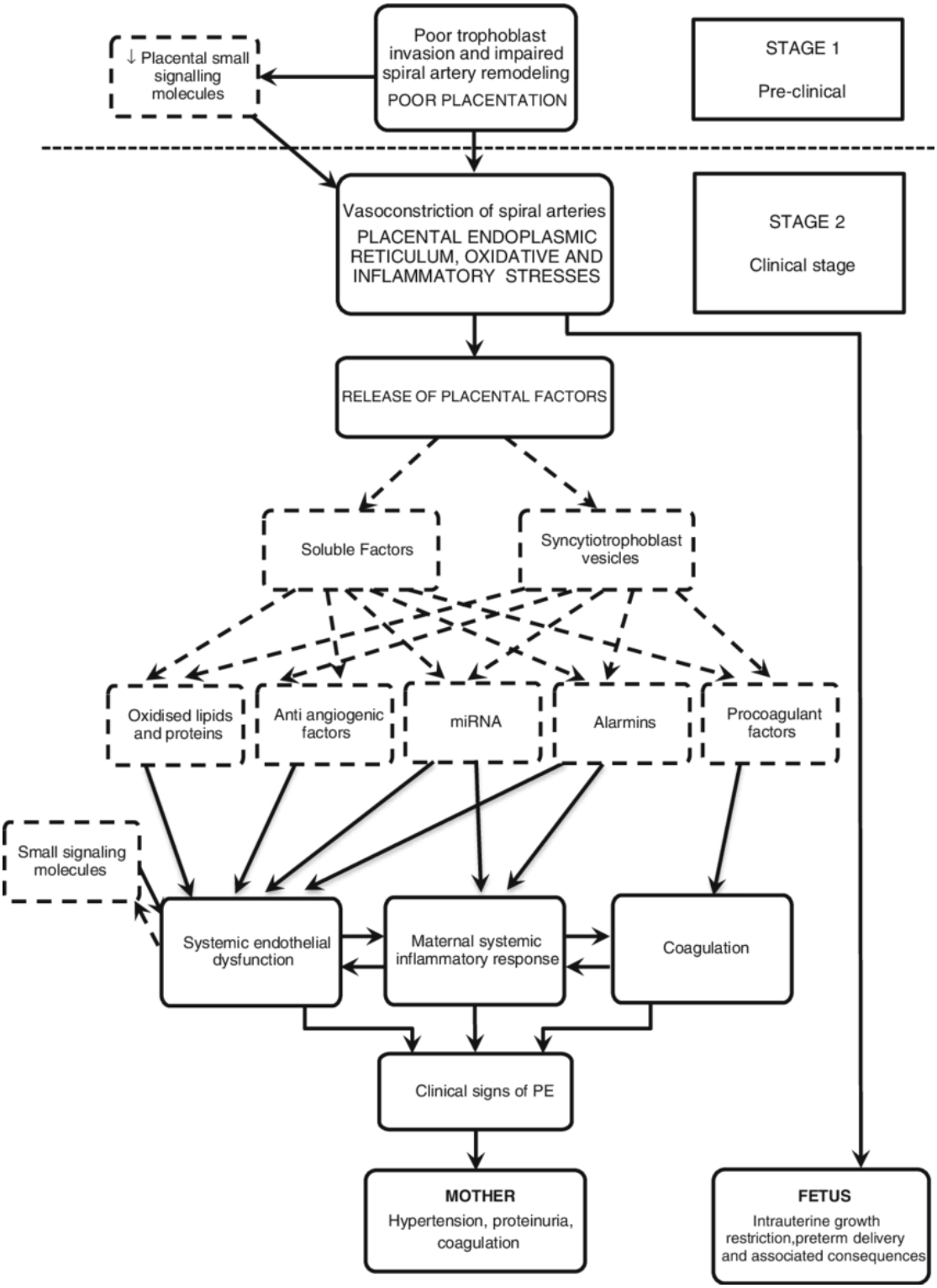
2. Pathophysiology of preeclampsia

The pathophysiology of preeclampsia is not completely understood. A 2-stage model of preeclampsia has been proposed as useful to address its pathophysiology.

Stage 1 of preeclampsia, reduced placental perfusion(46), is considered the primary cause. It sometimes evolves, in some but not all women, into stage 2.

Stage 2: the multisystem maternal syndrome of preeclampsia(47,48). Although much still remains unknown in both of these areas, the major questions are: why does reduced placental perfusion result in preeclampsia in only some women, and what links these 2 stages?

3. A flowchart of pathophysiology of severe preeclampsia



II. ECLAMPSIA:

1. Overview

Eclampsia, which is considered a complication of severe preeclampsia, is commonly defined as new onset of grand mal seizure activity and/or unexplained coma during pregnancy or postpartum in a woman with signs or symptoms of preeclampsia. It typically occurs during or after the 20th week of gestation or in the postpartum period(5)

2. Cerebral pathophysiology in eclampsia

The pathophysiology of eclampsia is still not well known. However, two theories have been proposed(49). Two hypotheses exist regarding the vascular changes associated with eclampsia.

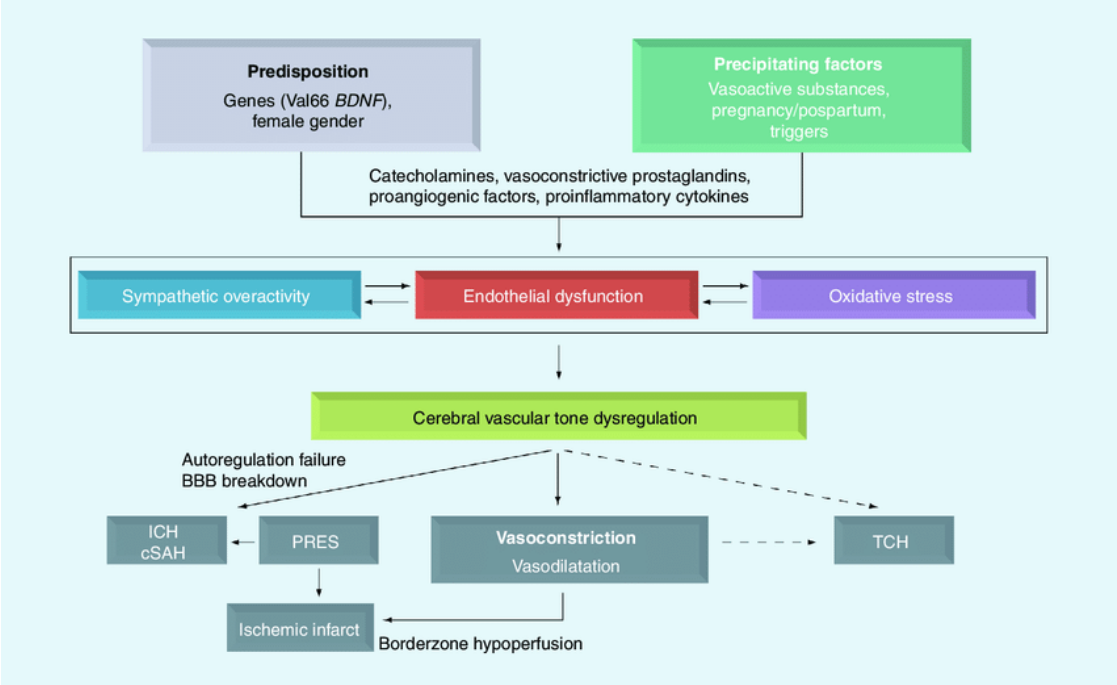
1. Vasospasm causing local ischemia will result in arterial necrosis and disruption of the blood-brain barrier, which leads to cerebral edema(50)(51). With regards to our study, we asked, does the atmospheric pressure have an impact on the high blood pressure in eclamptic patients thereby causing this vasospasm(1). Angiographic studies have demonstrated both cerebral edema and vasospasm (52).
2. Vasoconstriction in the cerebral artery as a result of extreme blood pressure. Some studies suggest this vasoconstriction protects the arteries against rupture by preventing uncontrolled arterial perfusion(49). Can extreme atmospheric pressure disrupt this normal human response and accelerate the occurrence of eclampsia? Will et al(53) put it plainly that if eclampsia is occurring, then some environmental factors might have compromised this process.

On the other hand, some studies have suggested that the aforementioned vasoconstriction could accelerate vascular rupture by causing extra pressure exertion. At high arterial pressures, the vascular smooth muscle may reach the limits of its strength and then dilate.

Firstly, short segments vasodilate, but they extend until the length of the vessel is compromised (54,55). At the stage of vasodilation, there is increased cerebral blood flow accompanied by damaged vessel walls and cerebral edema. Many articles have tried to find the specific hypothesis that results in the seizure and the changes we see during eclampsia to no avail(5,51,53).

But eclampsia does not affect only the brain; it affects other vital organs in the body. Similar pathological changes are occurring in women dying of eclampsia(41). In the heart, endocardial necrosis similar to that seen in hypovolemic shock. Infarction, necrosis, and intraparenchymal hemorrhage are noticed in the liver. Glomerular endotheliosis is seen in the kidney(56)

3. Chart showing the various cerebral dysfunction during an incident of eclampsia



Proposed pathophysiology of reversible cerebral vasoconstriction syndromes.

CSAH : Cortical subarachnoid haemorrhage,
ICH : Intracerebral haemorrhage;
PRES : Posterior reversible encephalopathy syndrome;
TCH : Thunderclap headache.

4. Treatment of eclampsia

The treatment of eclampsia largely depends on the gestational age of the pregnancy and the gravity of this condition at that particular moment; knowing that most of these women are well or remise after birth. A good coordination between doctors is primordial in successful treatment especially the gynaecologist and the intensive care specialists. In some cases, the only logical treatment is foetal extraction. In other cases symptomatic treatments such as seizure stability and reducing the extremely high blood pressure are essential.

Seizure stability and blood pressure reduction have a main objective, stabilise the mother for obstetrical decision making: Extraction or not. Does this work most time? Not really but it the best option in terms of giving the mother and the foetus a change of life.

The Treatment is grouped into 3 main categories:

1. Respiration and hemodynamic stability.
2. Symptomatic treatment of the seizure and the high blood pressure.
3. Obstetrical decision with aim of saving the mother and if possible the will-be baby.

4.1 Initial conditioning phase

Conditioning of the patient is the first step in the treatment. This has the objective of preventing blockage of patient airways, secure the environment to avoid injuries to the mother and the baby during an episode of seizure, measure the glycaemia to be sure the mother has enough glucose in the blood and restore a survivable vital pulse.

First actions to be taken during or just after convulsion have been carefully laid down by the medical community:

A. Securing the environment of the patient and make sure it injury-free
B. The patient has to be in a lateral decubitus position preferably left.
C. Air pathway liberation to ensure the mother is breathing accurately

D. Oxygen therapy if the patient is in a well-equipped hospital environment. This, in most cases, is stopped after the convulsive episode since the mother can respire well.

E. Blood glucose measurement.

Oxygen therapy is necessary in most cases because it supplies the foetus with good oxygen levels for survival. Maternal hypoxemia is ethereal to the foetus and the mother in most cases by facilitating the development of pulmonary oedema.

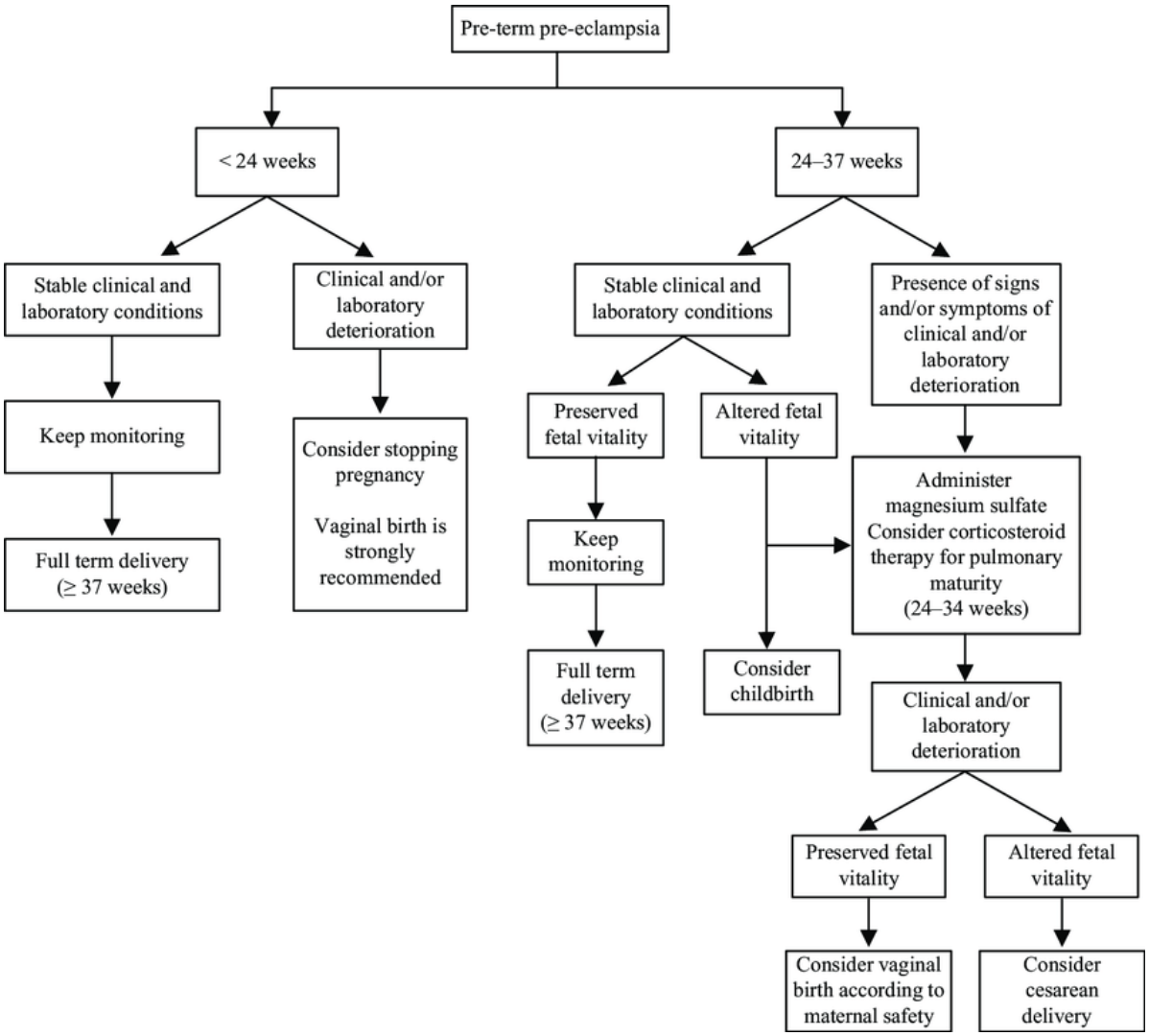
The treatment of eclamptic patients needs, first and foremost, peripheral line. This is usually done just after an episode of convulsion. This line will be used in administering drugs to the patient as well as nourishment.

4.2 Symptomatic treatment of the seizure and high blood pressure

Reducing the episodes of seizure is important in the hierarchy of treatment of eclampsia. Not only does this increase foetal and maternal survival but also reduces the chances of eclampsia in subsequent pregnancies(57).

This is done firstly by fluid filling. It is giving through the pre-prepared peripheral line and most often, done before giving the antihypertensive drug to prevent extreme hypovolemia. We noticed that most of our patients received these treatments in that order: Left lateral decubitus, medical fluid filling, urinary catheter, stomach tube and glucose measurement. In almost all the cases, our patients received preventive medication to avoid repetitive seizures. This is usually magnesium sulphate(MgSO4)(57). However many studies have argued that this treatment is not efficient after the seizure has started and hence must be given during the pre-eclamptic phase(58).

4.3 A flowchart showing step by step management of a patient presenting preterm preeclampsia/eclampsia



III. GESTATIONAL HYPERTENSION:

Defined as high blood pressure that occurs during pregnancy usually after the 20th week of gestation. Meaning blood pressure in these women is normal until pregnancy. NHBPEP(National High Blood Pressure Education Program) defines it as systolic pressure greater or equal to 140mmgh and diastolic pressure greater or equal to 90mmgh after the 20th week of gestation.

A study by Patrick Soudan et Al showed that only 20-25% of women with gestational hypertension will develop pre-eclampsia and about 1 in every 200 women with preeclampsia will develop eclampsia. Knowing that women can develop eclampsia without obvious signs of preeclampsia(26).

The underlying pathophysiology that upholds this transition to preeclampsia is not well understood; however, it is thought to be related to a mechanism of reduced placental perfusion inducing systemic vascular endothelial dysfunction(27).

This arises due to a less effective cytotrophoblastic invasion of the uterine spiral arteries(59). The resultant placental hypoxia induces a cascade of inflammatory events, disrupting the balance of angiogenic factors, and inducing platelet aggregation, all of which result in endothelial dysfunction manifested clinically as the preeclampsia syndrome(60).

Fiche d'expl0itation

L'impact de la pression atmosphérique et température sur la survenu d'éclampsie
Réanimation gynéco-obstétrique Hôpital mère et enfant Marrakech

1. **Anamnèse**
   Année: N° de dossier : N° de fiche:
   Age:
   .Origin: Urban: Rural:
   Profession:
   Niveau socio-économique:

2. **Admission**
   Date d'admission
   Heure d'admission
   .Mode d'admission : admission direct ; référé
   Pression artériel a l'admission ;

3. **Les conditions météorologiques au moment de la crise**
   Pression atmosphérique la plus haute du jour (PA MAX)
   Pression atmosphérique la plus bas (Pa MIN)
   Pression moyen
   Variabilité de la pression atmosphérique (Pa V)
   Différence entre les 2 pressions extrêmes
   Température du jour(T°)

	Pa MAX	Pa MIN	Pa MOYEN	Pa varia	différence	T° min	T° max
Les jours avec crise							
Les jours sans crise							
Un jour avant les jours de crise							

4. **Antécédents**

Médicaux:

Neuropathie: oui non

Si oui: type

Cardiopathie: oui non

si oui: Type

Néphropathie: oui non

si oui: type

Diabète: oui non

Autre:

Chirurgicaux:

Gynéco-Obstétricaux:

Gestité:

Parité:

Mode d'accouchement: VB: Césarienne:

Éclampsie: oui non

Si oui: Hospitalisation antérieurs: Réanimation oui non

Pré éclampsie: oui non

Si oui: Hospitalisation antérieure: Réanimation service

HTAG: oui non

MFIU: oui non

ÉVOLUTION

Vivant : **oui** **non**

État de conscience

Signe neurosensorielle

Répétition des cries

Déficit neurologique

ABSTRACT

Abstract

To evaluate the influence of atmospheric pressure and temperature on the occurrence of eclampsia. After observing a constant rise in the number of eclampsia patients admitted to the maternal intensive care unit during the colder weather conditions, we decided to take a critical look at the possibility that these atmospheric conditions might have something to do with the advent of eclampsia.

All files of eclampsia patients admitted between January 2019 and November 2020 were compiled. Atmospheric pressure and temperature were recorded from the Moroccan meteorological website. Pressure and temperature for all the days we had eclampsia in the period were assembled separately. Also, pressure and temperature for all the days we did NOT have eclampsia in the study period were compiled. We then compared these two variables looking at 5 aspects of pressure namely daily mean, daily maximum, minimum, differential and pressure variation.

There was a total of 730 days in our study period. Overall we had 100 patients with eclampsia in our research who was admitted on 100 different days dubbed DAYS WITH ECLAMPSIA. Therefore, there were 630 days in our study period without a case of eclampsia denoted DAYS WITHOUT.

Mean pressure [p less than 0.001; OR=1.07; CI (1.03-1.11)]. Minimum pressure [p less than 0.001; OR= 1.56 CI (1.42-1.71)]. Maximum pressure [p less than 0.01; OR=0.838; CI= (0.796-0.883)]. Pressure variation [p=0.001; 0R=1.16; CI (1.01-1.32)]. Differential pressure [p =0.54; OR=1.04; CI (0.90-1.22)]. Minimum temperature [p=0.134 OR=1.162, CI (1.018-1.327)]. Maximum temperature [p=0.597 OR=0.983, CI (0.950-1.017)].

There was a statistically significant association between Minimum daily pressure, daily pressure variation as well as mean daily pressure and eclampsia. This demonstrates that increasing the minimum daily pressure causes a rise in the number of eclampsia patients at the maternal Intensive Care Unit. On the contrary, the association was the reverse for maximum daily pressure. Increasing this variable reduces the number of eclampsia. According to our study, all the other variables notably differential pressure, maximum and minimum temperature did not have any impact on the occurrence of eclampsia.

This is the first study in the world to demonstrate the link between atmospheric pressure variation and the occurrence of eclampsia and may have a great impact on future research and prevention and care of preeclampsia.

Résumé

Évaluer l'influence de la pression atmosphérique et de la température sur la survenue de l'éclampsie. Après avoir observé une augmentation constante du nombre de patientes éclamptiques admises à la réanimation maternels pendant les conditions climatiques plus froides, nous avons décidé d'investiguer la possibilité que ces conditions atmosphériques puissent avoir quelque chose à voir avec l'avènement de l'éclampsie.

Tous les dossiers de patientes éclamptiques admises entre janvier 2019 et novembre 2020 ont été constitués. La pression atmosphérique et la température ont été enregistrées sur le site météorologique marocain du Marrakech. La pression et la température pour tous les jours où nous avons eu une éclampsie pendant la période ont été assemblées séparément. De plus, la pression et la température pour tous les jours où nous n'avons PAS eu d'éclampsie au cours de la période d'étude ont été assemblées. Nous avons ensuite comparé ces deux variables en examinant 5 aspects de la pression, à savoir la moyenne quotidienne, le maximum quotidien, le minimum, le différentiel et la variation de la pression.

Il y avait au total 730 jours dans notre période d'étude. Dans l'ensemble, nous avons eu 100 patients atteints d'éclampsie dans notre recherche qui ont été admis sur 100 jours différents notés JOURS AVEC ÉCLAMPSIE. Par conséquent, il y a eu 630 jours dans notre période d'étude sans cas d'éclampsie noté JOURS SANS.

Pression moyenne [p inférieure à 0,001 ; OR=1,07 ; IC (1.03-1.11)]. Pression minimale [p inférieure à 0,001 ; OR = 1,56 IC (1,42-1,71)]. Pression maximale [p inférieure à 0,01 ; OR = 0,838 ; IC = (0,796-0,883)]. Variation de pression [p=0,001 ; 0R=1,16 ; IC (1,01-1,32)]. Pression différentielle [p =0,54 ; OU=1,04 ; IC (0,90-1,22)]. Température minimale [p=0,134 OR=1,162, IC (1,018-1,327)]. Température maximale [p=0,597 OR=0,983, IC (0,950-1,017)].

Il y avait une association statistiquement significative entre la pression quotidienne minimale, la variation de la pression quotidienne ainsi que la pression quotidienne moyenne et l'éclampsie. Cela démontre que l'augmentation de la pression quotidienne minimale provoque une augmentation du nombre de patientes éclamptiques à Marrakech. Au contraire, l'association était inverse pour la pression quotidienne maximale. L'augmentation de cette variable réduit le nombre d'éclampsie. Selon notre étude, toutes les autres variables notamment la pression différentielle, la température maximale et minimale n'ont pas eu d'impact sur la survenue de l'éclampsie.

Il s'agit de la première étude au monde à démontrer le lien entre la variation de la pression atmosphérique et l'apparition de l'éclampsie et peut avoir un grand impact sur la recherche future et la prévention et les soins du pré éclampsie.

ملخص

تقييم تأثير الضغط الجوي ودرجة الحرارة على بداية تسمم الحمل . بعد ملاحظة الارتفاع المستمر في عدد مرضى الارتعاج الذين تم إدخالهم إلى وحدة العناية المركزة للأمهات خلال ظروف الطقس الأكثر برودة ، قررنا أن نلقي نظرة فاحصة على احتمال أن يكون لهذه الظروف الجوية علاقة بظهور تسمم الحمل.

تم تجميع جميع ملفات مرضى الارتعاج الذين تم إدخالهم بين يناير 2019 ونوفمبر 2020. تم تسجيل الضغط الجوي ودرجة الحرارة من موقع الأرصاد الجوية المغربي. تم تجميع الضغط ودرجة الحرارة لكل الأيام التي كنا نعاني فيها من تسمم الحمل في تلك الفترة بشكل منفصل . أيضًا ، تم تجميع الضغط ودرجة الحرارة لجميع الأيام التي لم نعاني فيها من تسمم الحمل في فترة الدراسة . ثم قمنا بمقارنة هذين المتغيرين بالنظر إلى 5 جوانب للضغط وهي المتوسط اليومي ، والحد الأقصى اليومي ، والحد الأدنى ، والتفاضل وتغير الضغط.

النتائج: كان هناك ما مجموعه 730 يومًا في فترة دراستنا . بشكل عام ، كان لدينا 100مريض مصاب بتسمم الحمل في بحثنا والذين تم قبولهم في 100 يوم مختلف يشير إلى أيام مع ECLAMPSIA. لذلك ، كان هناك 630 يومًا في فترة دراستنا بدون حالة تسمم الحمل تشير إلى أيام بدون.

متوسط الضغط [ف أقل من 0.001؛ أو = 1.07 ؛ CI (1.03-1.11)]. الضغط الأدنى [ف أقل من 0.001 ؛ OR = 1.56 CI (1.42-1.71)]. أقصى ضغط [ف أقل من 0.01 ؛ أو = 0.838؛ CI =(0.796-0.883)]. تغير الضغط [ع = 0.001؛ R = 1.160؛ CI (1.01-1.32)]. الضغط التفاضلي [ع =0.54 ؛ أو=1.04؛ CI (0.90-1.22)]. الحد الأدنى لدرجة الحرارة OR = 1.162 p = 0.134]، CI(1.018-1.327)]. درجة الحرارة القصوى OR = 0.983 p = 0.597]، CI (0.950-1.017)].

توجد علاقة ذات دلالة إحصائية بين الضغط اليومي الأدنى وتغير الضغط اليومي ومتوسط الضغط اليومي وتسمم الحمل. يوضح هذا أن زيادة الحد الأدنى من الضغط اليومي يؤدي إلى ارتفاع عدد مرضى الارتعاج في وحدة العناية المركزة للأمهات. على العكس من ذلك ، كان الارتباط هو العكس بالنسبة لأقصى ضغط يومي . تؤدي زيادة هذا المتغير إلى تقليل عدد حالات تسمم الحمل . وفقًا لدراستنا ، لم يكن لجميع المتغيرات الأخرى ، ولا سيما اختلاف الضغط ، والضغط التفاضلي ، ودرجة الحرارة القصوى والدنيا ، أي تأثير على حدوث تسمم الحمل .

هذه هي الدراسة الأولى في العالم التي توضح العلاقة بين تغير الضغط الجوي وحدوث تسمم الحمل وقد يكون لها تأثير كبير على الأبحاث المستقبلية والوقاية والرعاية من تسمم الحمل.

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سنة 2021 أطروحة رقم 084

تأثير الضغط الجوي على حدوث تسمم الحمل

الأطروحة

قدمت ونوقشت علانية يوم **2021/06/21**

من طرف

السيد رفايل أكبافيتور

المزداد في 11 أكتوبر 1994 بغانا

لنيل شهادة الدكتوراه في الطب

الكلمات الأساسية:

تسمم الحمل - الضغط الجوي - تسمم الحمل - ارتفاع ضغط الدم - التأثير.

اللجنة

السيد	ب. فاخر أستاذ في أمراض النساء والولادة	الرئيس
السيد	أ. غ. الأديب أستاذ في الإنعاش والتخدير	المشرف
السيد	ي. آيتبن قدور أستاذ في أمراض النساء والولادة	الحكام
السيدة	ل. أدرموش أستاذة مبرزة في طب المجتمع	