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Study of mortality among neonates with congenital heart defects in Mohammed VI University Hospital of Marrakech

THESIS

PRESENTED AND PUBLICLY DEFENDED ON 28 /03/2023

BY

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Born on the 18th of February 1995 in Lusaka;

TO OBTAIN A MEDICAL DOCTORATE

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اللهم إنا نسألك علما نافعا و قلبا خاشعا وشفاء

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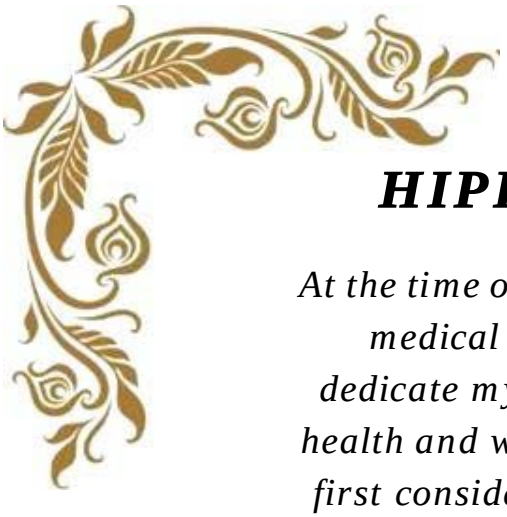

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At the time of being admitted as a member of the medical profession: I solemnly pledge to dedicate mylife to the service of humanity; the health and well- being of my patient will be my first consideration; Iwill respect the autonomy and dignity of 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;
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Liste arrêtée le 26/09/2022

DEDICATION

I dedicate this thesis to ...

"I know how to be brought low, and I know how to abound. In any and every circumstance, I have learned the secret of facing plenty and hunger, abundance and need. I can do all things through him who strengthens me." Philippians 4:12-13

I THANK THE ALMIGHTY GOD FOR HIS UNENDING LOVE. HE HAS SHOWN AND BEEN WITH ME EVERY STEP OF THE WAY. HE IS TRULY GOD.

To the best parents on earth

Mr Raphael kabuswe mwila and Mrs Beatrice Kombe Kabuswe thank you sincerely for the many sacrifices you've made for me and my siblings.
You've set an example of what unconditional love is. My prayer for you is long-life. May you both live to see your great grandchildren.

To My siblings

My younglings!! You guys are loved and cherished. I am super proud of all of your achievements this far. THE WORLD IS YOUR OYSTER.

To Mulenga mucheleka SC-Rambo

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To my Marrakech family You all are rockstars!

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PROFESSOR BENNAOUI FATIHA

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This experience alone explains why I wanted you to be part of this project. I am grateful that my work will be associated with someone of your reputation. Thank you, professor.

PROFESSOR RADA NOUREDDINE

When I was an extern in your department we did a round together and during that round you asked me a question; I didn't know the answer to that question but instead of lashing out at me,you kindly and gently guided me until I remembered the answer.

A minute experience that had a huge impact.

Thank you for accepting to be part of this project and thankyou for the life lesson.

ABBREVIATIONS

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ABBREVIATIONS

WHO : World health organisation
NRDS : New-born respiratory distress syndrome
IUGR : Intra-uterine growth retardation
HR : Heart rate
RR : Respiratory Rate
HB : Haemoglobin
CRP : C-Reactive protein
WBC : White blood cells
ToF : Transposition of Fallot
ToGA : Transposition of great arteries
CoA : Coarctation of the aorta
DORV : Double outlet right ventricle
TAPVR : Total anomalous pulmonary venous return
RVH : Right Ventricle hypertrophy
VSD : Ventricle septal defect
ASD : Atrial septal defect
PDA : Patent ductus arteriosus
AVSD : Atrioventricular septal defect
PAPVR : Partial anomalous pulmonary venous return
TA : Tricuspid Atresia
PA : Pulmonary Atresia
AS : Atrial Stenosis
HLHS : Hypo-plastic left heart syndrome
PAH : Pulmonary Hypertension
LVH : Left ventricle hypertrophy
IUFD : Intra-uterine fœtal death
CHD : Congenital heart defects
CBC : Complete blood count
UNICEF : United nations international children's Fund
SDG : Sustainable development goal
% : Percentage

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INTRODUCTION

Newborns are generally fragile beings; more so during their first month of life. It is for this reason that many countries are now investing in research, infrastructure, medical protocols and procedures to try and reduce neonatal mortality.

Neonatal Mortality remains a huge social, economic and public health problem especiallyfor low income countries. Many low income communities are still grappling with very high levels of neonatal mortality and more has to be done.

Just like maternal mortality; neonatal mortality can be used as a yard stick with which tomeasure the quality of health care of a given population (12). It can be used to evaluate theprevailing conditions so as to enable policy changes which will in turn address and improve them.

A report published in January of 2022 by the World health organization (WHO), estimated that in 2020 alone 2.4 million newborns died and that nearly half (47%) of these deaths occurred in the new-born period (the first 28 days of life), an increase from 1990 (40%) (52).

As at 2020, sub-Saharan Africa held the highest neonatal mortality rate at 27 (25-32) deaths per 1000 live births, followed by central and southern Asia with 23 (21-25) deaths per 1000 live deaths. A child born in sub-Saharan Africa is 10 times more likely to die than a child born in a high income country (2). Country level neonatal mortality ranged between 1 and 44 and the risk of mortality was 56 times higher in low income countries in contrast with high income countries(3).

According to UNICEF data, Morocco's mortality rate has significantly reduced from 80.6 per1000 live births in 1990 to 18.7 per 1000 live births in 2020. This is as a result of the many effortsthe Country has made in this regard.

Congenital heart defects (CHD) Is one of the most common birth defects affecting approximately 0.8% to 1.2% of live births worldwide.

The British heart foundation factsheet published in August of 2022 reports that; CHD is diagnosed in around 1 in 10 births globally, with more diagnoses later in life. That's an estimated

1.2 Million babies a year; an average of 3300 per day.

It further reports that CHD is the direct cause of at least 220, 000 deaths each year; the majority are before their first birthday (4).

In Morocco, it is estimated that 1 newborn out of a 100 births is born with cardiac malformation and that each year almost 8000 newborns are born with a cardiac malformation.

Unfortunately; data as regards mortality due to CHDs is not concrete or not easily accessible.

This is a retrospective study with the objective of studying the frequency of mortality among neonates with congenital heart defects at CHU Mohammed VI of Marrakech and studies some risk factors of mortality. This will help us to make recommendations on how the status quocan be changed. The specific objectives include;

1. Study the frequency of neonatal mortality among neonates with congenital heart defects at CHU Mohammed VI of Marrakech from 2016-2019
2. Study some risk factors of Mortality related to mortality of neonates with congenital heart defects.

MATERIEL & METHODES

I. The place of study

The department of neonatology found within the CHU Mohammed VI is composed of 3 hospitalization units with 1 room where baby bottles are stored and treated and a few administrative offices.

The department has 24 bed spaces. The department has:

- Personnel: 1 chief nurse, 1person responsible for the pharmacy and materials.
- 23 Nurses (Nurse/patient ratio: 0, 96), 5 mid-wives.
- Doctors: 3 Professors; some residents and interns in varying numbers.
- Materials : 27 Incubators
- 10 Resuscitation tables
- 5 sources of phototherapy (2 intensives et 3 conventional).
- 5 CPAP, 10 Respirators, 16 Monitors.

II. The type and population of study

Our study is a retrospective study done on neonatal deaths among neonates with congenital heart defects which occurred at CHU Mohammed VI of Marrakech between 2016 and 2019. It's a descriptive and analytical study done on hospital files. These files were explored using a data collection form that was pre-done. This data collection form contained information necessary to help us with the analysis of the frequency of neonatal death as well as some risk factors that would have played a role in these deaths.

III. The methodology

The study seeks to analyze files of newborns admitted in the intensive care unit of the neonatology department of the CHU Mohammed VI during the period stretching from 1st January 2016 to 31 December 2019; these deaths should have occurred within the first

28 days of life

These newborns came from either the maternity wing at the mother and children's hospital of CHU Mohammed VI, or the maternity wing of Ibn tofail hospital or their neonatology department. Some are transfers from provincial and regional hospitals while others came directly from their homes.

1. Sampling and Size of the sample population

All treatable files from the intensive care unit of the neonatology department at CHU Mohammed VI from 2016-2019 were explored. As such we can conclude that the sampling was exhaustive.

2. Study variables

2.1. Maternal factors

- The age of the mother at birth.
- Gestity: Number of pregnancies carried by a woman including stillbirths, miscarriages and abortions.
- Parity: Number of pregnancies carried with a gestational age of 28 weeks or more.
- Obstetrical history
- Social status
- Pregnancy screening
- Disease during pregnancy
- Presence of chronic disease
- Consanguinity of husband
- Drug intake, intake of toxins and exposition to radiation during pregnancy

2.2. Neonatal factors

- Age of birth
- Age of diagnosis
- Gestational age
- Sex
- Origin of parents
- Condition of patient at birth
- Associated malformations
- Type of cardiopathy
- Weight of patient
- Place, cause, time and period of death

3. Study criteria

3.1. Inclusion criteria:

All the newborns that died before the 28th day of life in the intensive care unit of the neonatology department at CHU Mohammed VI during the period of study were included with a focus on cardiac neonatal death.

3.2. Exclusion criteria:

We excluded all newborns not admitted in the intensive care unit of the neonatology department of CHU Mohammed VI plus the newborns that died after 28 days of life.

4. The limitations of the study

The study dealt with all the constraints of a retrospective study based on the collection ofdata from files. The quality of the data is affected by the absence of complete data in some files. Some files had missing pages, while others had a lot of information gaps.

5. Data analysis

Statistical analysis of the collected data was done with the help of the SPSS statistics data V25 Application and Excel 2012.

The analysis of the collected data allowed us to express the statistical results found into diagrams and tables of frequency and subsequently their percentages.

RESULTS

I. Global Frequency

Between 01 January 2016 and 31 December 2019, 4,248 newborns were admitted in the neonatology department of the Mohammed VI university hospital of Marrakech.

922 deaths were recorded during this period that is 21.7% of the admitted newborns.

1. Cardiac related deaths

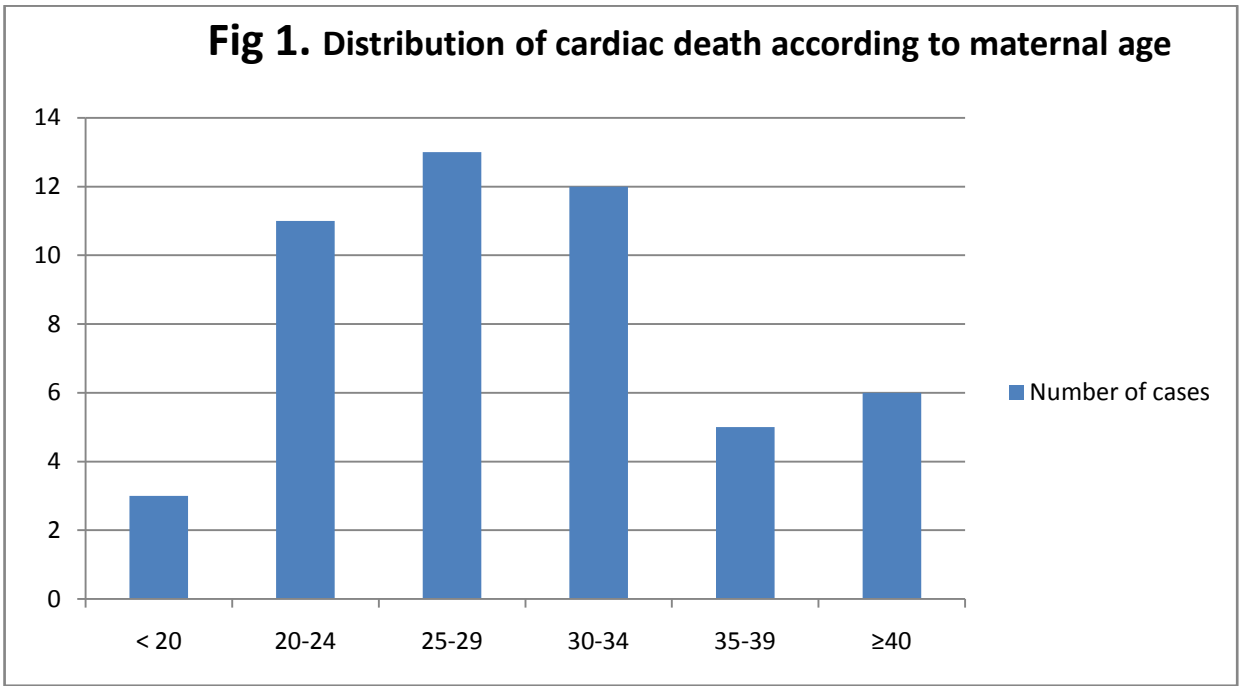
Of the 922 recorded deaths our results revealed that 5.4% were due to cardiac related causes notably congenital heart defects.

II. Characteristics of Mothers

1. The distribution of cardiac death according to maternal age

Table I: Division of cardiac death according to maternal age

Age (years)	Number of cases	Percentage %
< 20	3	6
20-24	11	22
25-29	13	26
30-34	12	24
35-39	5	10
≥40	6	12



The mean age of the mothers was 29.36 with standard deviation of 6.889; The minimum age noted was 19 and the oldest mother was 43years.

We observed that the majority of death occurred in mothers between the ages of 25 and 29 years that is 26%; 24% for mothers between the ages of 30 and 34 then 22% for mothers

between 20 and 24.

2. The distribution of cardiac death according to maternal parity

Table II: Distribution of cardiac death according to mothers Parity

Parity	Number of cases	Percentage %
I	11	22
II	8	16
III	16	32
IV and more	15	30

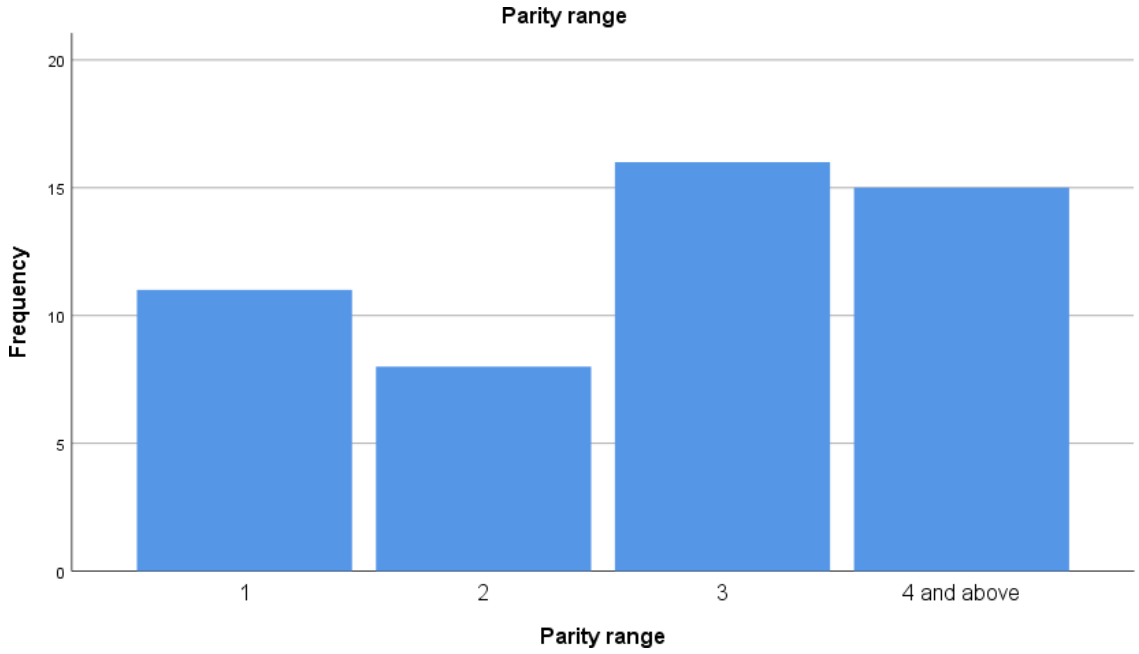


Figure 2: Distribution of cardiac death according to mothers Parity

The highest percentage is observed in mothers with 3 children 32%, followed by parents with 4 children and above 30%. The least percentage points are observed in mothers with 2 children at 16%.

Table III: Distribution of cardiac death according to parity III and history

Medical History	Number of cases	Percentage %
YES	11	68.75
NO	5	31.25

Table IV: Distribution of cardiac death according to parity IV and history

Medical History	Number of cases	Percentage %
YES	10	66.67
NO	5	33.33

We observed that in mothers with a parity of 3, 68.75% of them had obstetrical history while 31.25% had no history. Some of the history includes; intra-uterine death, neonatal death, miscarriage and some cases an association of 2 more.

The case is similar with mothers who had a parity of 4 and more; 66.67% had

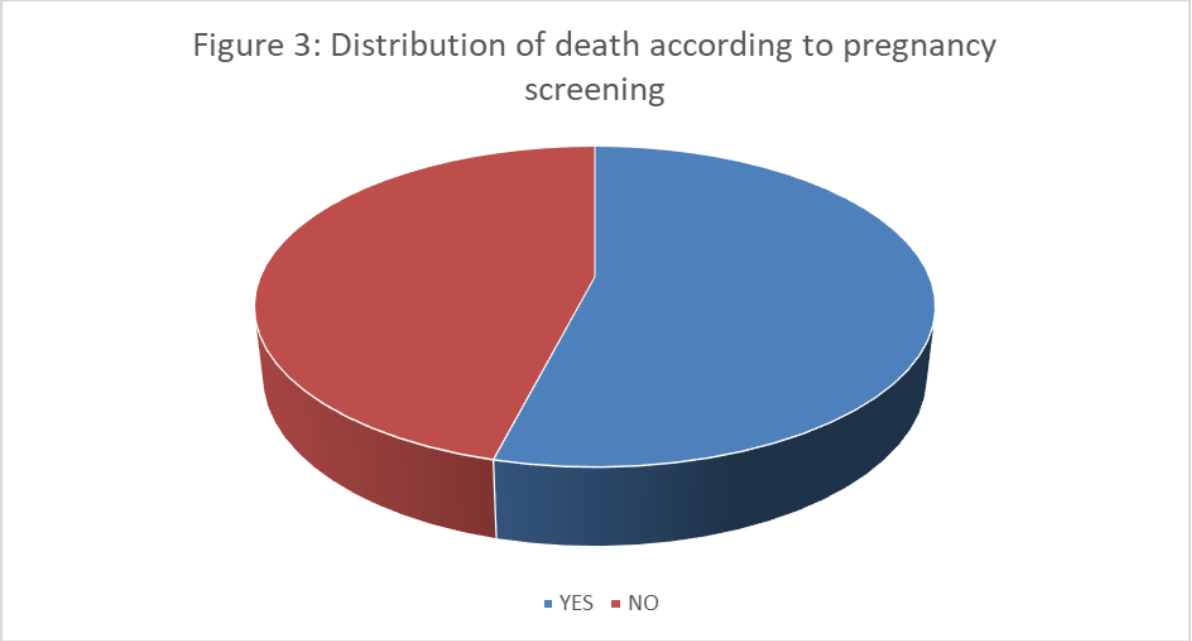
obstetrical history while 33.33% had no history. The history is similar to that of parity 3 but in this case we even had a mother who had had 4 deaths.

These results suggest a biological or specifically a genetic issue. It was also observed that a good number of the newborns of mothers with a parity of 3 and 4 and more presented with malformations.

3. Obstetrical characteristics

Table V: Distribution of cardiac death according to pregnancy follow-up

Screened	Number of cases	Percentage %
YES	27	54
NO	23	46



In our study out of the 50 mothers under study; 27 of them which represents 54% of all the mothers were either not screened or did not meet the recommended number of contacts according to WHO.

Only 23 mothers (46%) were fully screened either by a gynecologist or a general doctor.

We could not precise who did the screening due to lack of documentation.

4. Distribution of cardiac death according to obstetrical history

Table VI: Distribution according to obstetrical history

Obstetrical history	Number of cases	Percentage %
Without history	31	62
Extra-uterine pregnancy	1	2
1 Neonatal death	3	2
1 premature death	1	2
Intra-uterine fœtal death	4	8
IUFD, Miscarriage	2	4
Miscarriage	6	12

We observed that 31 mothers, representing 62% of the cases under study didn't have any noted history. Of those with documented obstetrical history 6 mothers had previously had miscarriages; that is 12% of all the cases. 4 mothers (8%) had experienced Intra uterine fetal death while 2 (4%) had both a miscarriage and IUFD. Note that some mothers had had 2 or more deaths.

5. Distribution of cardiac death according to Mothers' chronic disease

Table VII: Distribution of cardiac death according to presence of Diabetes in mother

Presence of diabetes	Number of cases	Percentage %
YES	12	24
NO	38	76

Table VIII Distribution of cardiac death according to specific types of Diabetes

Type of Diabetes	Number of cases	Percentage %
Without Diabetes	38	76
Type 1	2	4
Gestational	4	8
Unprecise	6	12

Only a meagre 24% (12 mothers) had diabetes which was distributed as follows; 2 mothers (4%) had Type 1 diabetes, 4 mothers representing (8%) had gestational diabetes while the rest (6%) were unprecise. Of the 12 mothers that had diabetes; 7 mothers, that is 58% of the women under study had history of death in their previous pregnancies.

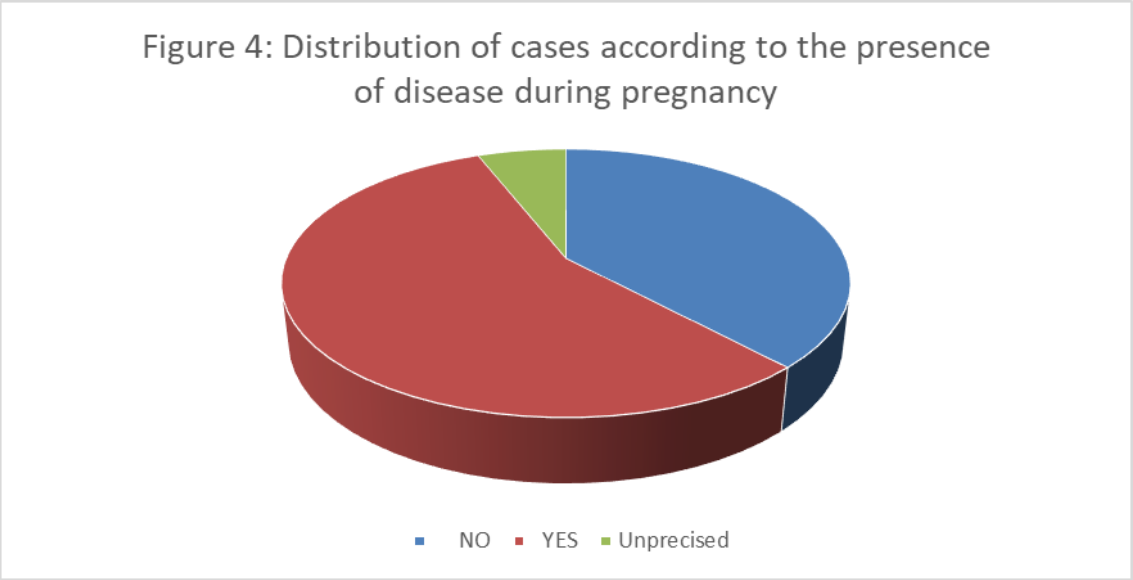
Of the 3 newborns who presented with Macrosomia at birth, 2 were from diabetic mothers.

NB: We only studied diabetes under chronic diseases because the form used to collect data in the neonatology department of Mohammed VI university hospital has diabetes listed and thus those filling it do not find the need to add other chronic diseases.

6. Distribution of cardiac death according to disease during pregnancy

Table IX: Distribution of cardiac death according to presence of disease during pregnancy

Disease during pregnancy	Number of cases	Percentage %
NO	19	38
YES	28	56
Unprecised	3	6



We observed that 28 mothers (56%) had presented a disease during their pregnancy. 38%had healthy pregnancies while the rest were either unprecise or undocumented.

Table X: Distribution of cardiac death according to specific diseases during pregnancy

Type of disease	Number of cases
Amniotic fluid abnormalities	1
Anaemia	1
Genital infection/fever/Urinary infection/Positive infection interrogation	16
HBP due to pregnancy	1
Metrorrhagia	1
Premature rupture of membranes	3
Prolonged labor, Pre-eclampsia	1
Threatened preterm labor	1
Hydramniosis	1

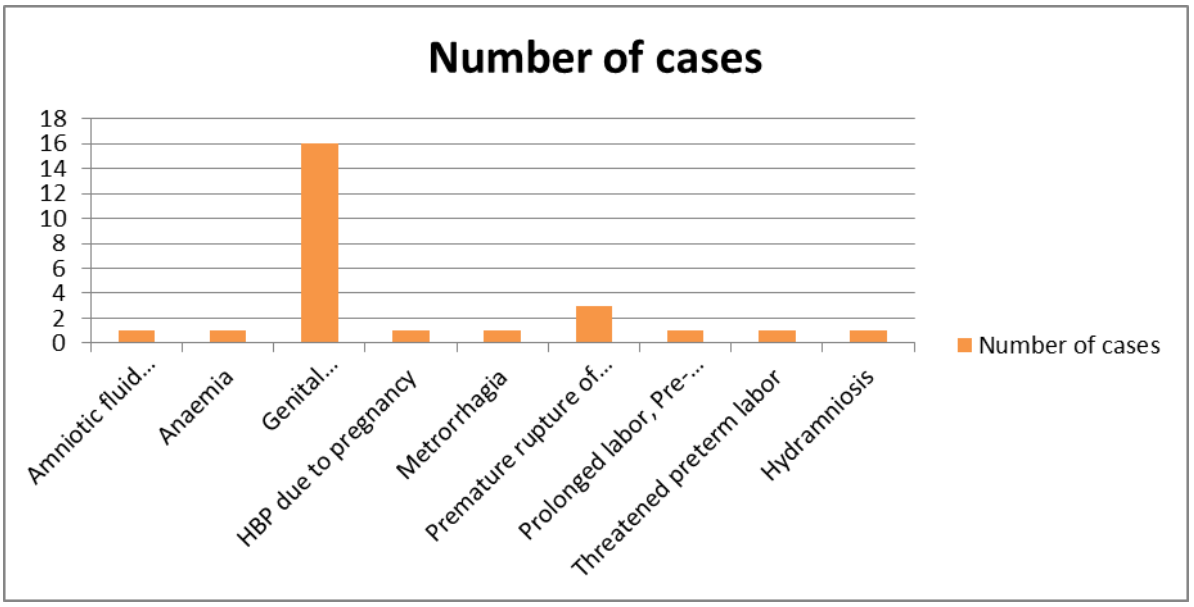


Figure 5: Distribution of cardiac death according to specific diseases during pregnancy

We observe that 11 of the 50 mothers had genital infection during pregnancy, 3 had premature rupture of membranes and 3 had urinary infections.

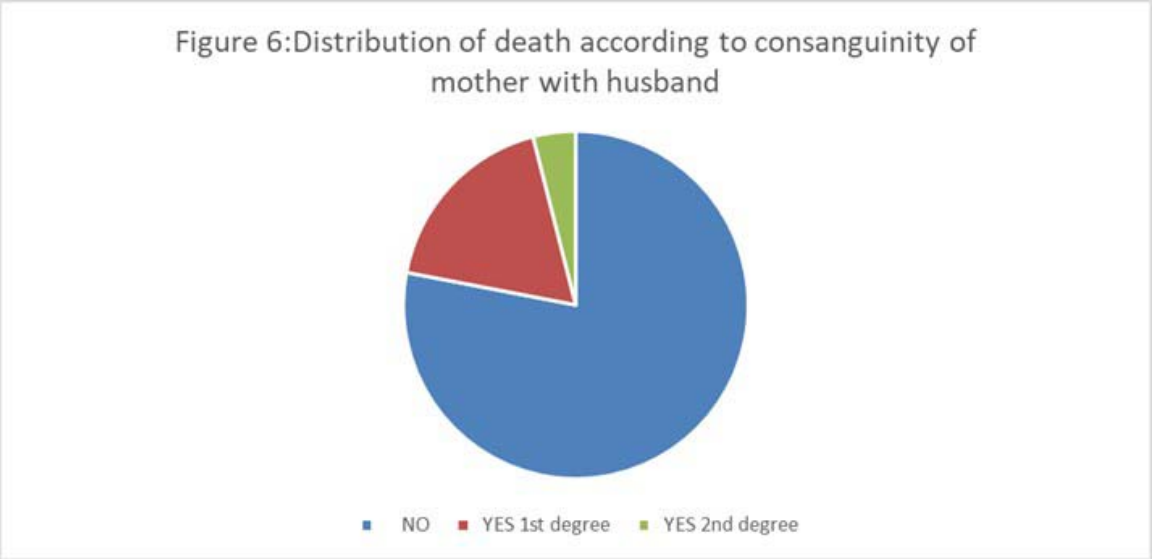
The rest presented with; amniotic fluid abnormalities, anaemia, fever, metrorrhagia, prolonged labor, pre-eclampsia and hydramniosis.

Note that the first bar on the bar chart represents the number of mothers that had healthy pregnancies.

7. Distribution of cardiac death according to consanguinity of mother with husband

Table XI: Distribution of cardiac death according to consanguinity of mother with husband

Consanguinity	Number of cases	Percentage %
NO	39	78
YES 1st degree	9	18
YES 2nd degree	2	4



We note that 39 mothers (78%) had no consanguinity with their husbands. Out of the 12 mothers (22%) of the mothers that had a consanguinity with their husbands, 9 mothers (18%) were a 1st degree consanguinity while 2 mothers (4%) represented 2nd degree consanguinity.

The 22% who had consanguinity are distributed as follows: 1st degree had 4 suspected cardiopathy, 4 complex cardiopathy and 1 simple cardiopathy while 2nd degree had 1 suspected cardiopathy and 1 complex cardiopathy.

8. Distribution of cardiac death according to social status

Table XII: Distribution of cardiac death according to social status

Social status	Number of cases	Percentage %
Low	36	72
Medium	6	12
High	1	2
Unprecise	7	14

The social-economic status of the parents is low in 36 cases which represent 72% of allcases under study.

The parent with a high status was noted as farmer- High status in the file.

Table XIII: Distribution of cardiac death according to profession of father

Fathers profession	Number of cases
Builder	1
Businessman	3
Carpenter	1
Day to Day	1
Driver	1
Electrician	1
Farmer	3
Gardner	1
Instable	1
Restaurant worker	1
Security Guard	3
Taxi Driver	1
Tile setter	1
Vendor	1
Unknown	26

The majority of the fathers' professions were not documented thus the 26 Unknown.

9. Distribution of cardiac death according to place of origin

Table XIV: Distribution of cardiac death according to place of origin

Origin	Number of cases	Percentage %
Rural	13	26
Urban	36	72
Unknown	1	2

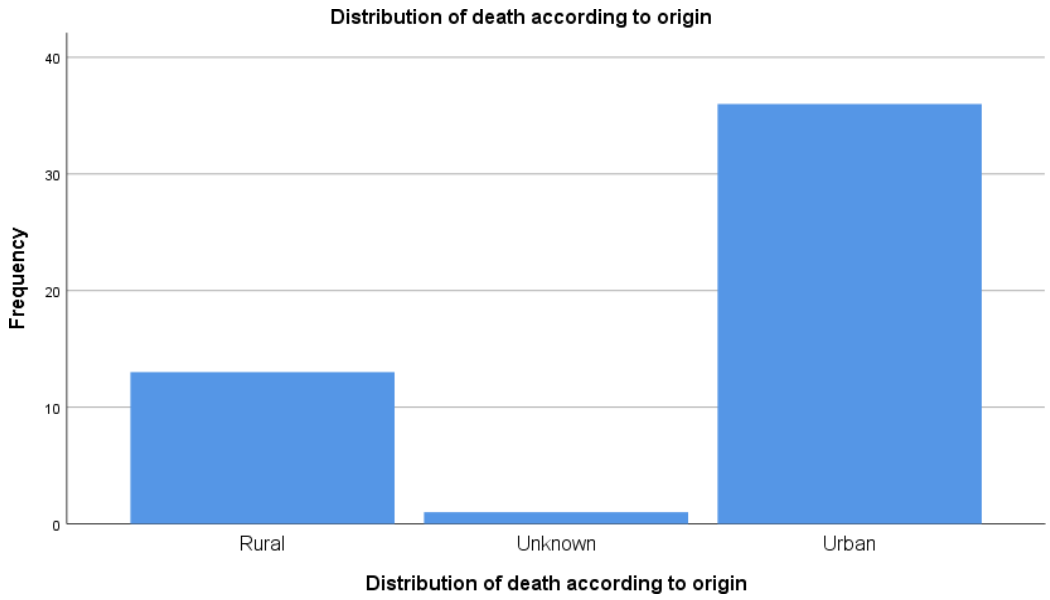


Figure 7: Distribution of cardiac death according to place of origin

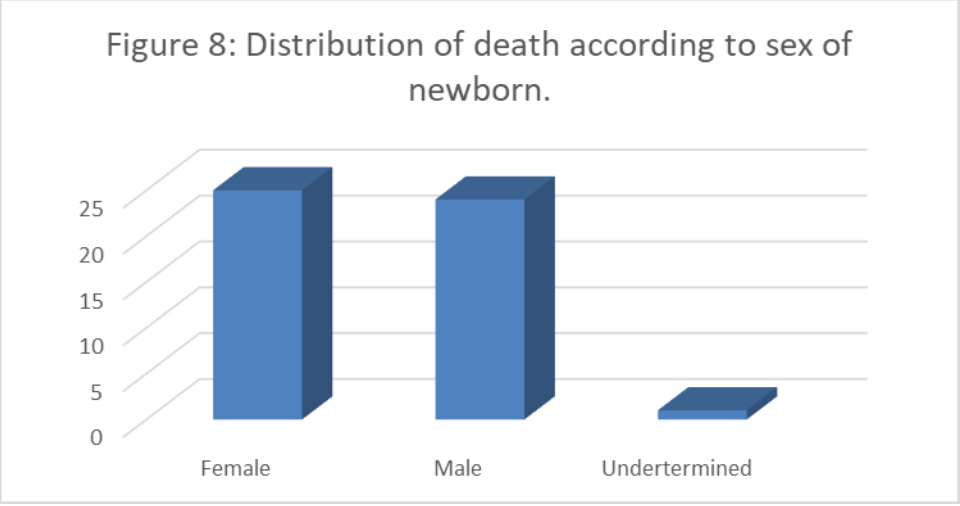
We note that the majority of parents of the deceased neonates came from urban dwellings. 36 sets of parents (72%) were urban based while 13 (26%) were from rural areas. We also had 1 set of parents whose location was undocumented.

III. Characteristics of Newborn

1. Distribution of cardiac death according to newborns' sex

Table XV: Distribution of cardiac death according to sex of newborn

Sex of New-born	Number of cases	Percentage %
Female	25	50
Male	24	48
Undetermined	1	2

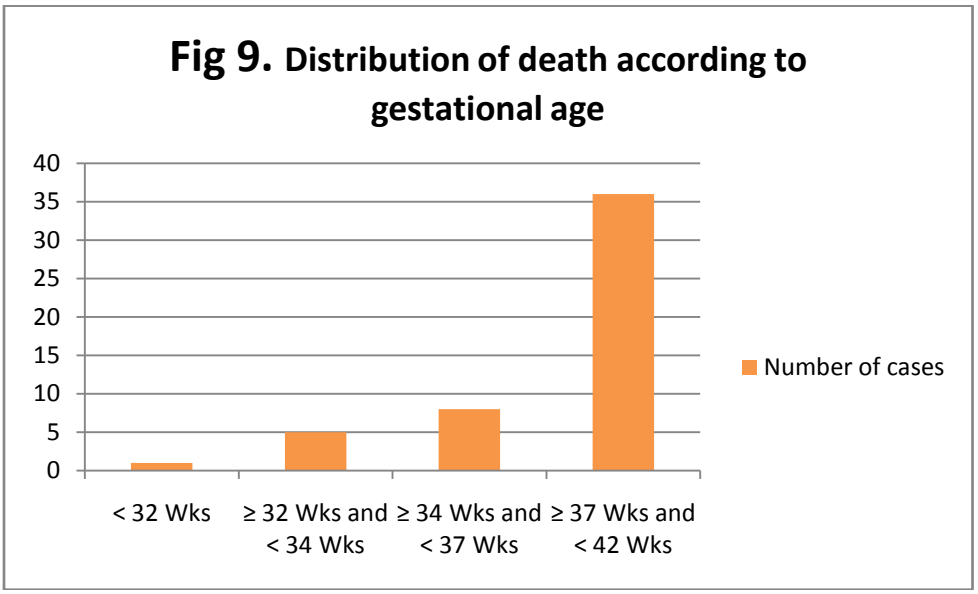


The new-borns were almost evenly distributed 25 females that is 50% and 24 males representing 48% of the population understudy. We had one case of anomaly of sexual differentiation.

2. Distribution of cardiac death according to newborns' gestational age

Table XVI: Distribution of cardiac death according to gestational age

Gestational age in Weeks	Number of cases	Percentage %
< 32 Wks	1	2
≥ 32 Wks and < 34 Wks	5	10
≥ 34 Wks and < 37 Wks	8	16
≥ 37 Wks and < 42 Wks	36	72



We observed that 36 newborns representing 72% had a gestational age between 37 and 42 weeks. The least number of deaths was for the gestational age less than 32 weeks which had only 1 death.

3. Distribution of cardiac death according to newborns' age of admission

Table XVII: Distribution of cardiac death according to age of admission

Age of Diagnosis	Number of cases	Percentage %
1– 7 days	43	86
7 – 14 days	1	2
14 – 21 days	4	8
21 – 28 days	2	4

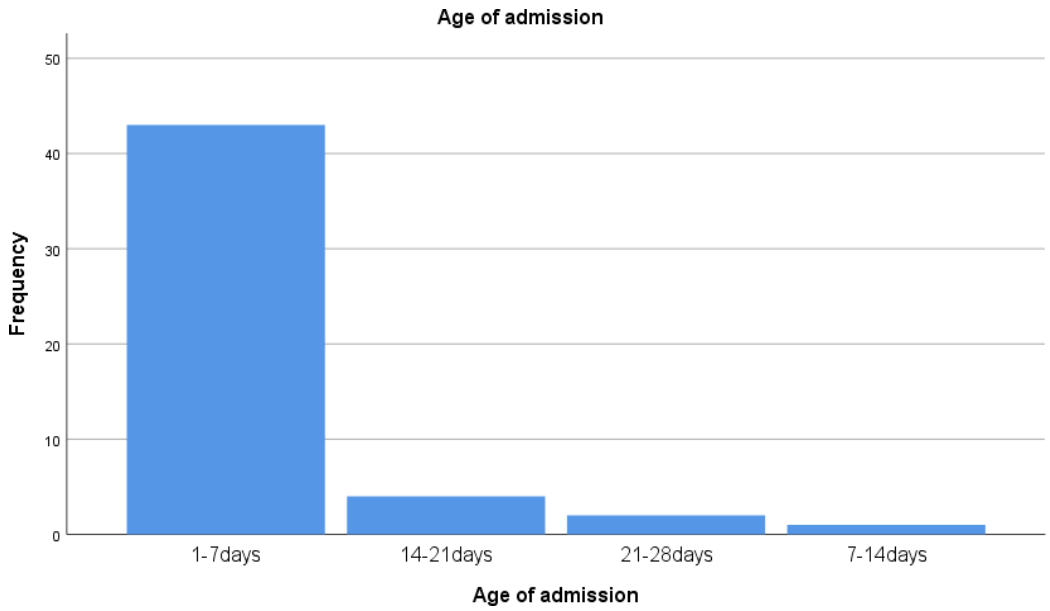


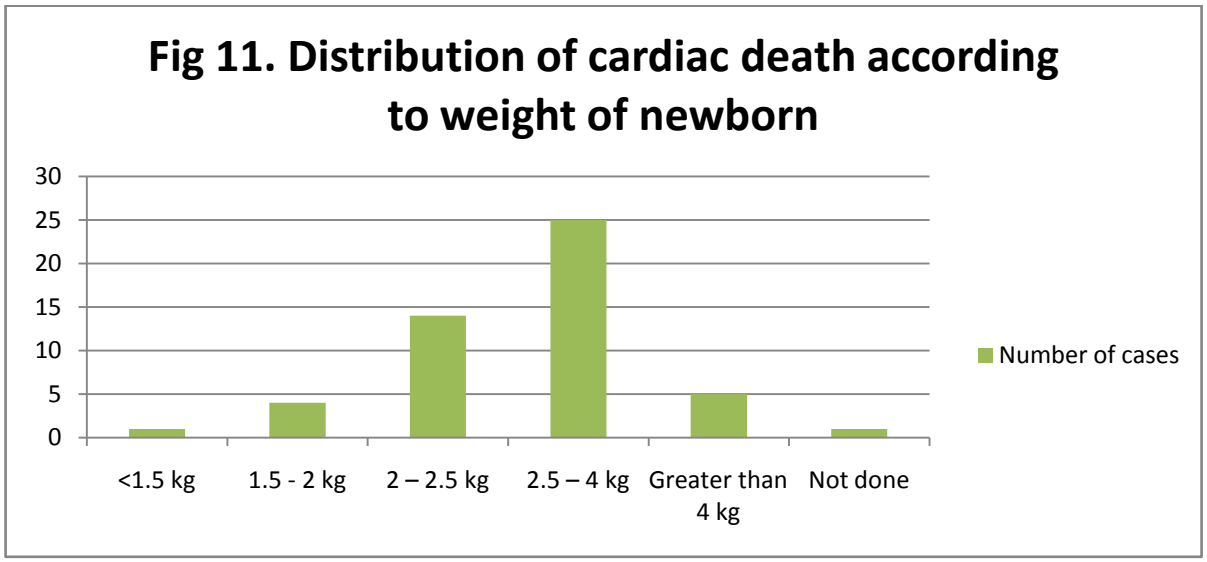
Figure 10: Distribution of cardiac death according to age of admission

Most of the newborns were admitted between day 1 and 7 of birth (86%) with the least amount of diagnosis done between the 7th and 14th day of life (2%).

4. Distribution of cardiac death according to newborns' Birth weight

Table XVIII: Distribution of cardiac death according to Newborn's birth weight

Weight of birth	Number of cases	Percentage %
<1.5 kg	1	2
1.5 – 2 kg	4	8
2 – 2.5 kg	14	28
2.5 – 4 kg	25	50
Greater than 4 kg	5	10
Not done	1	2



We observed that 18 (36%) newborns were of low birth weight (LBW) while 1 (2%) had a very low birth (VLBW) while the majority representing (50%) of the newborns weighed between 2.5 and 4 kgs. 5 weighed greater than 4 kgs while 1 birth weight wasn't documented.

5. Distribution of cardiac death according to newborns' condition at birth

Table XIX: Distribution of cardiac death according to condition of new-born at birth

Condition of new-born at birth	Number of cases
IUGR	8
Macrosomia	3
Prematurity	5
Prematurity + Hypotonia	1
Prematurity + IUGR	2

We had 8 cases of intra-uterine growth restriction, 3 cases of macrosomia, 5 prematurebirths plus 3 cases of prematurity + Hypotonia and prematurity + IUGR.

6. Distribution of cardiac death according to circumstances of diagnosis

Table XX: Distribution of cardiac death according to circumstances of diagnosis

Circumstances of diagnosis	Number of cases	Percentage %
Antenatal	2	4
Fortuitous	2	4
NRDS	43	86
Systematic	3	6

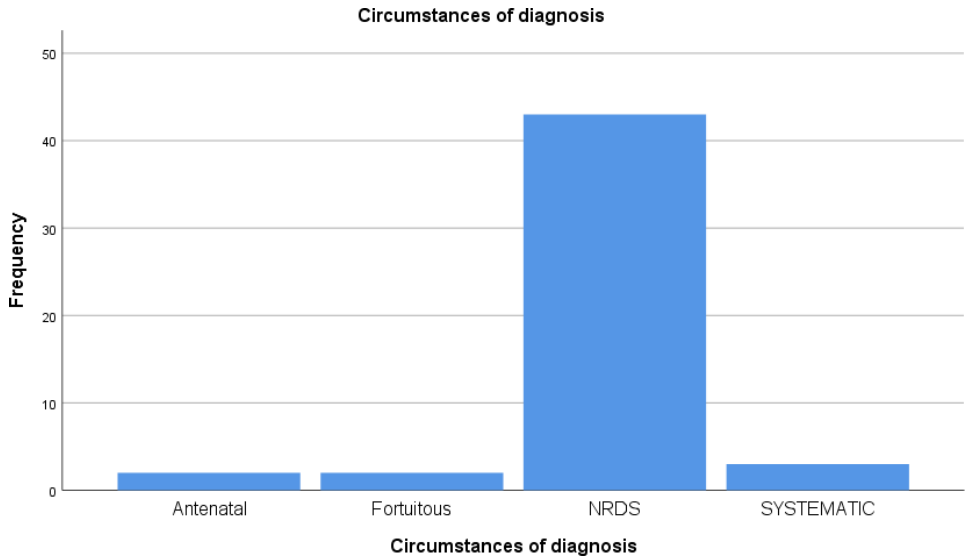


Figure 12: Distribution of cardiac death according to circumstances of diagnosis of new-born at birth

The majority of the newborns presented with newborn respiratory distress syndrome (86%). 4% were antenatal diagnosis while 6% were diagnosed during systematic or routine examination after birth. The rest (4%) were diagnosed fortuitously.

7. Distribution of cardiac death according to presence of critical signs due to NRDS

Table XXI: Distribution of cardiac death according to presence of critical signs

Presence of critical signs	Number of cases	Percentage %
YES	34	68
NO	16	32

We observe that 34 (68%) of the 50 newborns had the presence of critical signs due to NRDS. The said critical signs include; Nose flaring, Audible grunting, Costal retractions, subcostal retraction and Xiphoid retraction.

Table XXI;I SATURATION

Saturation	Number of cases	Percentage %
Done	32	64
Not Done	18	36

TABLE XXI.II Saturation

Saturation	Number of cases	Percentage %
< 69	19	59.4
70-90	7	21.8
Greater than 90	6	18.8

Only 32 newborns had their saturation measured that's 64% of the population under study. Of those 59.4% had a saturation lower than 69, 21.8% had a saturation between 70 and 90 while 18.8% had a saturation greater than 90.

8. Distribution of cardiac death according to suggestive clinical signs

Table XXII: Distribution of cardiac death according to suggestive clinical signs

Suggestive signs	Number of cases
Cyanosis	36
Heart Murmur	9
Tachycardia	3
Edema of limbs	4
Facial Puffiness	1
Refusing to feed	2
Convulsions	1
Bradycardia	1
Jaundice	1
Urinary infection	1
Diarrhea, Dehydration	1
Fatigue during feeding	1
Sclerema of lower limbs	1
Umbilical hemorrhage	1

We observed that 36 newborns of the cases under study had cyanosis as part of their suggestive signs. 6 newborns had a combination of both cyanosis with heart murmur. Other combinations included; Cyanosis and tachycardia, Polypnia and edema of lower limbs, Cyanosis and reduction in feeding, cyanosis + diarrhea + urinary infection + dehydration just to mention a few.

9. Distribution of cardiac death according to associated malformations

Table XXIII: Distribution of death according to presence of associated malformations.

Associated Malformations	Number of cases	Percentage %
YES	14	28
NO	36	72

Table XXIV: Different types of malformations found

Malformations	
Fente vélo-palatine	1
Choanal atresia	1
Clinodactylies of toes and fingers	1
Bilateral genu recurvatum	1
Congenital cubitus valgus	1
Pterygium colli	1
Dorsal cyphosis	1
Club foot	1
Hyperterolism	1
Sexual differentiation anomaly	1
Congenital adrenal hyperplasia	1
Microphtalmia	1
Polydactylitis	1
Isolated clitoris	1
Ulna hypertrophy	1
Facial dysmorphia	2
Choanal permeability	1
Cranio-facial dysmorphia	1
Arhinia	1
Suspected glaucoma	1

We observed that only 14 newborns representing 28% of the population under study had other malformations associated. The majority of these had an association of 2 or more malformations. The different types of malformations are listed in figure XXIV above.

Table XXV: Distribution of cardiac death according to the presence of T21 Down Syndrome facies

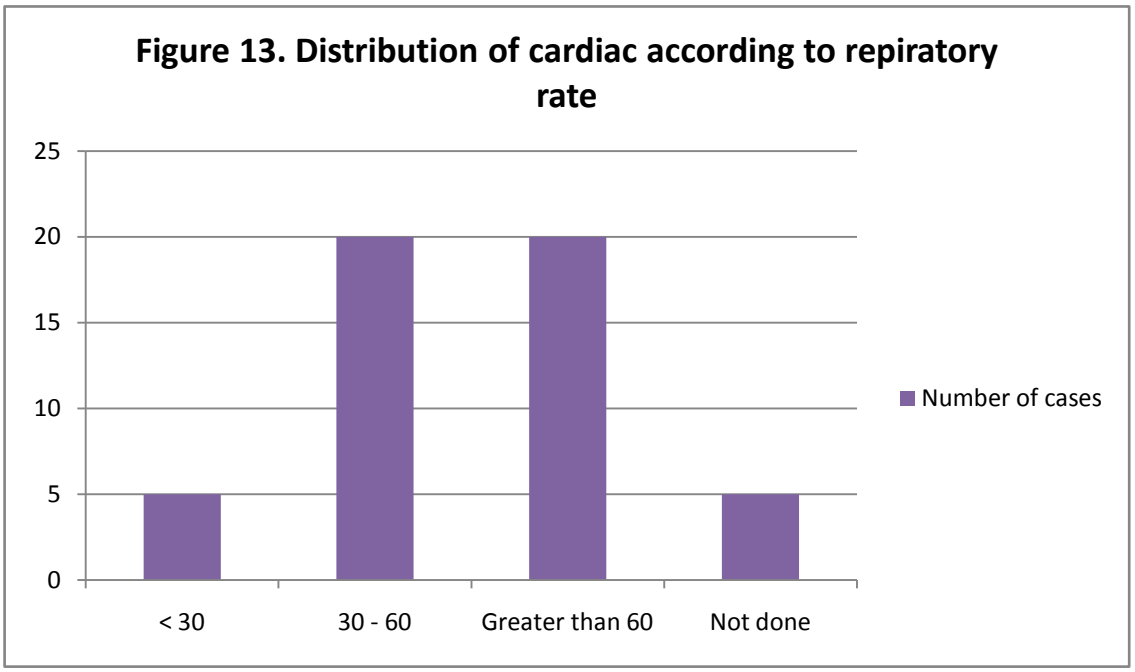
Presence of T21 Facies	Number of cases	Percentage %
Not Present	45	90
Present	5	10

5 newborns presented with Down syndrome facies that is 10% of all deaths. All of these newborns other malformations associated.

10. Distribution of cardiac death according to respiratory rate

Table XXVI: Distribution of cardiac death according to respiratory rate

Respiratory rate	Number of cases	Percentage %
< 30	5	10
30 – 60	20	40
Greater than 60	20	40
Not done	5	10

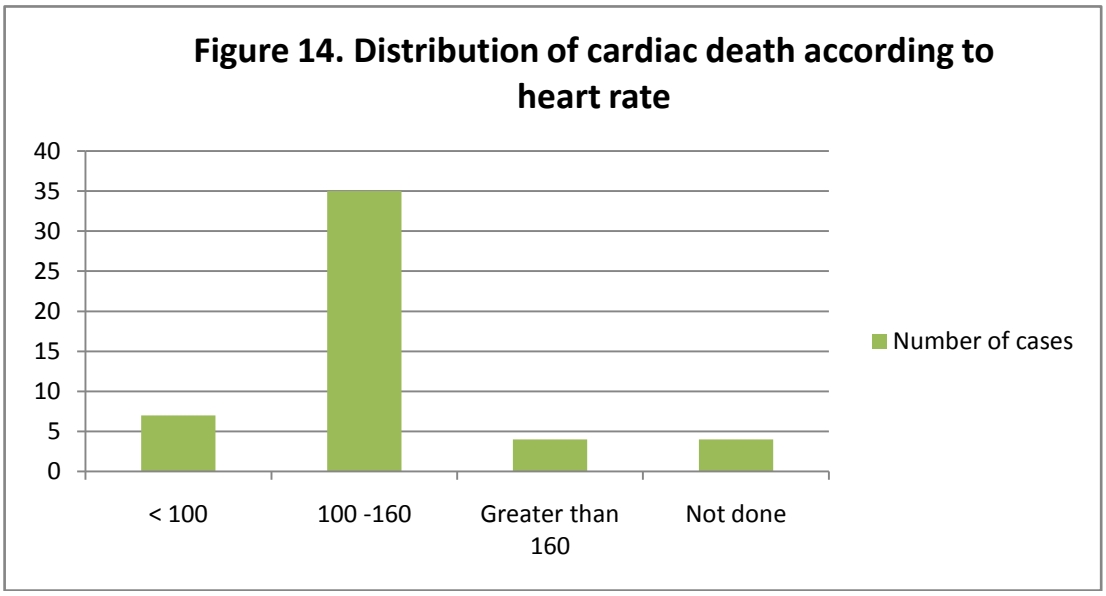


We note that only 5 newborns (10%) had their respiratory rate below 30 while 20 (40%) were ranging between 30 and 60. The other 20 (40%) had a respiratory rate exceeding 60. The rest of the newborns' rates weren't documented.

11. Distribution of cardiac death according to heart rate

Table XXVII: Distribution of cardiac death according to heart rate

Heart rate	Number of cases	Percentage %
< 100	7	14
100 –160	35	70
Greater than 160	4	8
Not done	4	8



We note that 35 newborns (70%) had a heart rate ranging between 100 and 160. 7 newborns (14%) had a breathing rate which was below 100 beats per minute.

IV. Para-clinical study

1. Biological findings

- Complete blood counts were done in 31 cases this represents 62% of all the caseswith an absence of results in 19 cases (38%).
- C reactive protein was done in 28 cases that is (56%), It was positive (≥20mg/l) in 5of the 28 cases (17.86%).

Table XXVIII: Distribution of cardiac death according to biological findings

Biological findings		Number of cases	Percentage %
CBC	NO	19	38
	YES	31	62
CRP	NO	22	32
	YES	28	56

2. Radiological Exams

- Chest X-rays were done in 32 newborns that is 64% of the cases. The majority of the chest X rays showed cardiomegaly. The different presentations found are detailed in the table XXVII provided below.
- Heart echocardiography was done in only 21 cases this represents 42% of the population under study. Out of the 21 cases only 2 (9.5%) were done during antenatal. The different presentations found are tabulated in table XXVIII below.

2.1. Distribution of cardiac death according to chest X-ray

Table XXIX: Distribution of cardiac death according to Chest X-ray

Chest X-ray done	Number of cases	Percentage %
YES	32	64
NO	18	36

Table XXX: Different types of chest X-ray findings

Chest X-ray findings
Alveolar syndrome
Pleural effusion
Cardiomegaly
Boot shaped heart
Pulmonary atresia
Pulmonary infiltrates

Example of Chest X-ray which shows a boot shaped heart

2.2. Distribution of cardiac death according to heart echography

Table XXXI: Distribution of cardiac death according echocardiography

Heart echo done	Number of cases	Percentage %
YES	21	42
NO	29	58

Echocardiography was only done 21 newborns that is only 42% of all cases.

2.3. Distribution of cardiac death according to cardiopathy types

Table XXXII: Distribution of cardiopathy

Heart echo	Number of cases	Percentage %
Suspected cardiopathy	31	62
Complex Cardiopathy	19	38

Table XXXIII: Distribution of different types of cardiopathy and individual anomalies

Cardiopathy Type	Number of cases
TGA	7
CoA	2
Interrupted arch	1
VSD	7
ASD	11
PDA	9
Tricuspid insufficiency	4
Mitral insufficiency	2
Perforated foramen ovalis	3
Restrictive cardiomyopathy	2
Aorta Hypoplasia	1
Large pulmonary artery	1
Unique Atria	1
Ebstein anomaly	1
Severe Pulmonary stenosis	2
Suspected cardiopathy	31
Pulmonary atresia	1

31 newborns (62%) were documented as suspected cardiopathy because their death occurred before echocardiography was done.

With exception of 1 newborn that only had an atrial septal defect, all newborns in whom echocardiography was done presented with 2 or more types of cardiopathies and thus I have classed them all into complex cardiopathy.

The distribution above merely shows the number of times each cardiopathy presented itself and not necessarily the number of newborns that died from it.

Example of echography parasternal view short axis showing a pulmonary atresia with a patent ductus arteriosus.

2.4. Distribution of cardiac death according complicated linked to cardiopathy

Table XXXIV: Distribution of cardiac death according to complications

Complications	Number of cases	Percentage %
Heart Failure	2	22.2
LVH	1	11.1
PAH	6	66.7

Pulmonary hypertension was the most prevalent complication with 6 cases (66.7%)

V. Paraclinical study

1. Management

1.1. Symptomatic treatment

Symptomatic treatment was given according to clinical presentation of each individual ne- born. (Antibiotic therapy, Oxygen therapy, blood transfusion, diuretics, caffeine, invasive or non- invasive ventilation).

a. Oxygen therapy;

About 41 Newborns received oxygen therapy that represents (82%) of the population under study.

b. Antibiotic therapy:

Table XXXV: Distribution of cardiac death according to antibiotic therapy

Antibiotic Therapy	Nombre de cas	Percentage %
YES	41	82
NO	9	18

- 41 new-borns (82%) received antibiotic therapy as either symptomatic treatment or etiological treatment.

c. Non invasive ventilation :

Table XXXVI: Distribution of cardiac death according to NIV

NIV	Number of cases	Percentage %
YES	27	54
NO	23	46

- 27 new-borns (54%) benefitted from non-invasive ventilation.

d. Mechanical/Invasive ventilation (intubation):

Table XXXVII: Distribution of cardiac death according to intubation of newborns

Intubation	Number of cases	Percentage %
YES	19	38
NO	31	62

- Only 19 new-borns (38%) were intubated. The majority 62% were not.

e. others:

Table XXXVIII: Distribution of cardiac death according to the other drugs used

Other drugs
Digoxin
Lasix
Caffeine
Prostin
Atropine
Adrenaline
Dobutamin
Noradrenalin

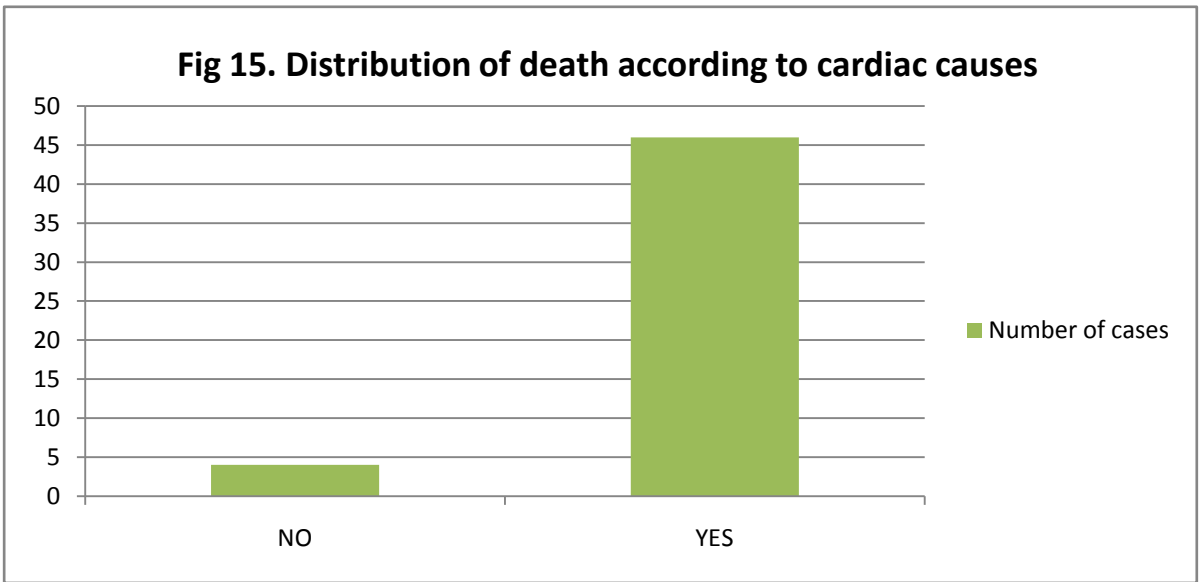
- 24 newborns 48% received either 1 or more vaso-active drugs such as Atropine, adrenaline, dobutamin or Noradrenalin. 1(2%) newborn received a blood tranfusion; 1(2%) was transfused with platelets while another with albumin. 2 (4%) new-borns were given Prostine while 3 receieved corticotherapy. An anti-diuretic was administered to 1 newborn.
- Vitamin therapy was given to 4 newborns this represents 8% of the cases.
- 38 newborns (76%) received eye and umbilical nursing

VI. Death

1. Causes of cardiac death

Table XXXIX: Distribution of cardiac death according to cardiac causes

Cardiac causes	Number of cases	Percentage %
NO	4	8
YES	46	92



We observed that 46 of the newborns (92%) had cardiac causes among the causes of death; that's either as a direct cause or as a complication of an underlying cause. Only 4 newborns (8%) had other causes of death. The specific cardiac causes are shown in table XXXVII below

2. Cardiac causes

Tableau XL: Distribution of cardiac death according to cardiac causes

Cardiac causes	Number of cases
Asystole	4
Desaturation	9
Bradycardia	13
Cardiac arrest	25
Cardiogenic shock	2

25 newborns died due to cardiac arrest this is followed by 13 who died due to bradycardia. We had newborns who presented with asystole, desaturation and cardiogenic shock which accounted for 4, 9 and 2 cases respectively.

3. Infectious causes associated to cardiac causes

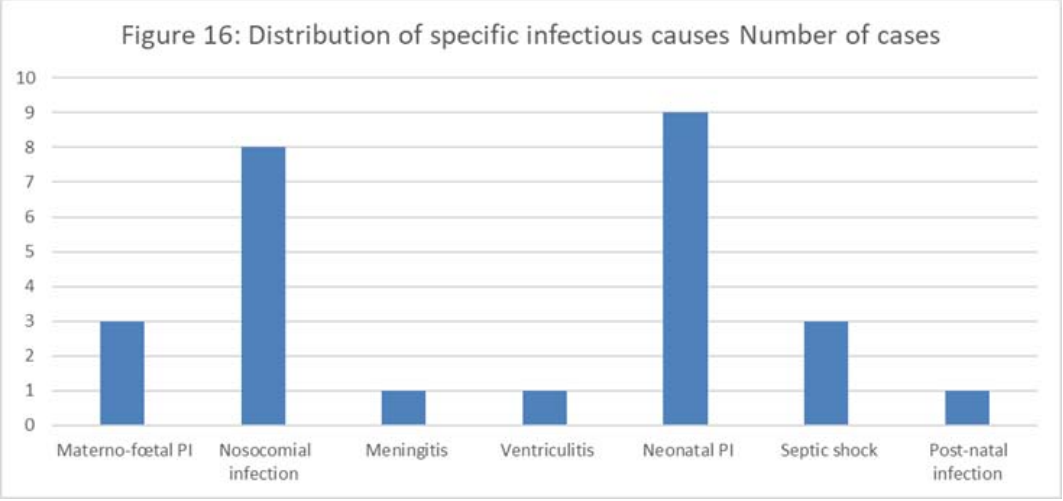
Table XLI: Distribution of cardiac death according to infectious causes associated to cardiac causes

Infectious causes	Number of cases	Percentage %
NO	27	54
YES	23	46

We observed that only 23 newborns (46%) had infectious causes on the list of causes. Thespecific infectious causes are listed in table XXXIX below.

Table XLII: Distribution of infectious causes associated to cardiac causes

Infection Type	Number of cases
Materno-fœtal PI	3
Nosocomial infection	8
Meningitis	1
Ventriculitis	1
Neonatal Pulmonary infection	9
Septic shock	3
Post-natal infection	1



- It is difficult to analyse the specific cause of death as most deaths are as a result of multiple causes.

- 23 New-borns representing 48% of cases died due to either having an infection as adirect cause of death or were in summation with cardiac causes. The majority of infectious causes are represented by Neonatal pulmonary infections which accounted for 36% of infectious causes while Nosocomial infections accounted for a close 32%. Other causes of death are tabulated below;

4. Other causes of death

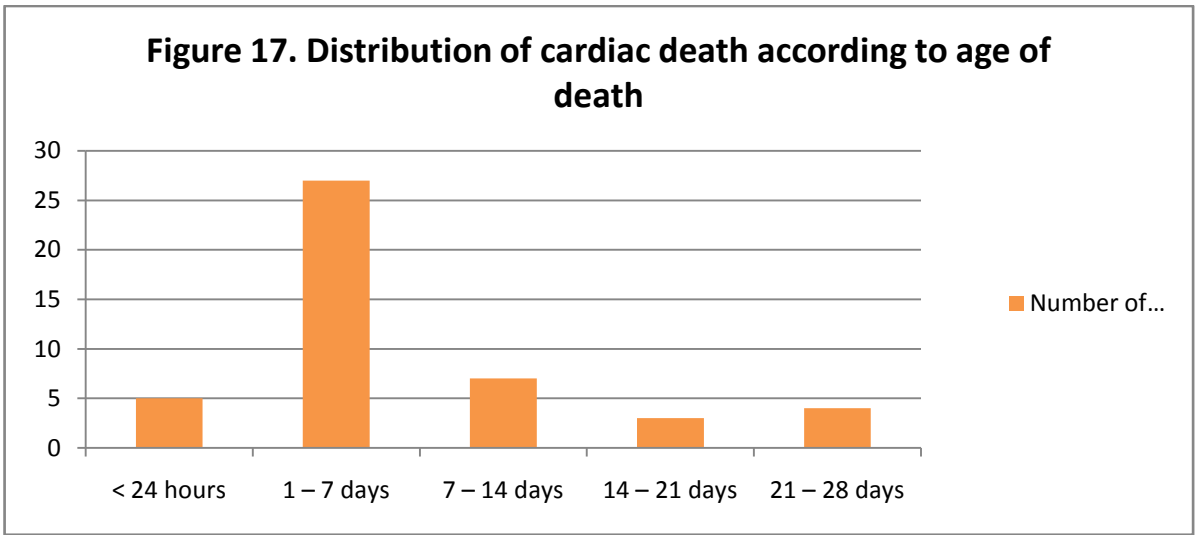
Table XLIII: Distribution according to other causes of death

Causes of death
Digestive Haemorrhage
Asphyxia
Polymalformative syndrome
Neutropenia

5. Distribution of cardiac death according to age of death

Table XLIV: Distribution of cardiac death according to age of death

Age of death	Number of cases	Percentage %
< 24 hours	5	10
1 – 7 days	27	54
7 – 14 days	7	14
14 – 21 days	3	6
21 – 28 days	4	8



The majority of the newborns 32(64%) died between the ages of 1 and 7; from those 5 (10%) died within 24 hours of birth. Only 4 newborns (8%) survived longer than 21 days.

6. Distribution of cardiac death according to period between admission

Table XLV: Distribution of cardiac death according to period between admission and death

Period	Number of cases	Percentage %
< 24 hours	27	54
1 – 7 days	14	28
7 – 14 days	9	18

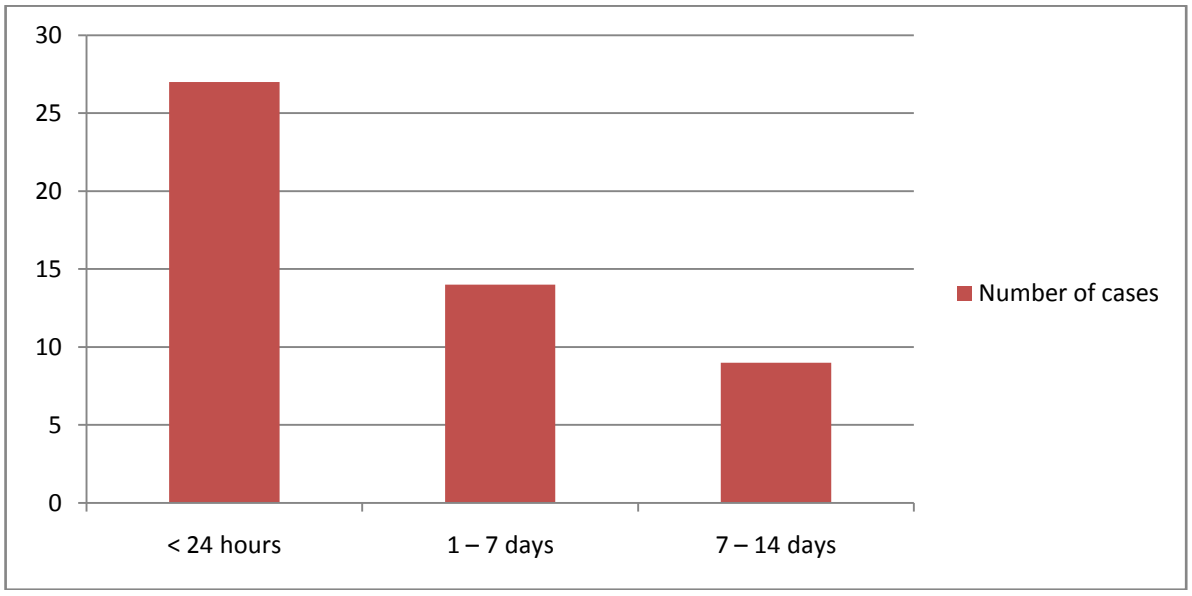


Figure 18: Distribution of cardiac death according period between admission and death

27 newborns (54%) died within 24 hours of admission while 14 (28%) were hospitalized for longer days ranging between 1 and 6 days.

7. Distribution of cardiac death according to year of death

Table XLVI: Distribution according to the year of death

Year of death	Number of deaths due to CC	Total number of deaths	Percentage %
2016	15	211	7.1
2017	11	229	4.8
2018	12	250	4.8
2019	11	232	4.7

DISCUSSION

This study concerns neonatal mortality due to congenital heart defects at the Mohammed VI university hospital of Marrakech. As a retrospective study, the study is limited only to the information available in the files of patients.

Pre-natal mortality is a good measuring yardstick that can be used to evaluate the existing health systems and assess the necessary improvements that can be made in that regard (14).

This study is essential as it serves to improve the prevailing conditions in accordance with the present numbers as regards patients, materials, infrastructure and all the other needs of the department.

If we are going to improve the health systems with the current times; it is imperative that the data on which the improvements are based is updated regularly.

I. Definitions

The main definitions used in this study are based on recommendations of the world health organisation. Different regions and countries have varying definitions and so to maintain uniformity the WHO recommended definitions are most appropriate(6).

- Neonatal mortality is defined as the number of deaths during the first 28 completed days of life per 1000 live births in a given year or period ; it can be subdivided into;
    1. Early neonatal death: occurring during the first 7 days of life
    2. Late neonatal death: occurring after the 7th day of life but before the 28th completed day of life
- The total births: total number of births includes both live births and stillbirths
- Neonatal mortality rate : neonatal mortality per 1000 live births per year
- Congenital anomalies are defined by the World Health Organisation (WHO) as structural or functional abnormalities that occur prenatally and may be diagnosed prenatally or in early infancy (WHO, 2020b)

- Frequency: is defined as the number of occurrences of a repeating event per unit oftime
- Risk factor: a risk factor or determinant is a variable associated with an increased riskof disease or infection

II. Epidemiology

1. International data

According to the world health organisation (WHO); an estimated 240 000 new-borns die worldwide within 28 days of life of birth every year due to birth defects. Congenital heart defects are the leading cause of birth defect related mortality and account for approximately 40% of deaths in children with birth defects worldwide.

CHDs are the major cause of infant mortality, particularly in developing countries. They are reported to account for 20% of peri-natal deaths and their estimated prevalence is 8 per 1000 live births across the globe (BMJ jornal; Volume7, issue 2) (39).

The 2010 Global burden disease study found that congenital anomalies accounted for 6% of infant deaths (Lozano et al., 2012) (3).

Studies have suggested that around 19.3% of neonatal deaths and 20.6% of infant deaths are due to congenital anomalies in more developed countries (Almli et al., 2020; Roncancio et al., 2018) (22).

A study done in Spain for the period 2003-2012 revealed that 2970 (4.58%) infant deaths in a population of 64,831patients were due to congenital heart defects with 73.8% of deaths occurring in the first week of life. Infant mortality rate in patients with congenital heart defects was 6.23 per 10,000 live births (28).

A trends report released in Columbia for the period dating between 1999 and 2008 showed that out of 7,216,727 live births congenital anomalies were responsible for 7,321 foetal deaths

(3.4% of all foetal deaths) and 15,040 neonatal deaths (19.3%) of all neonatal deaths. The neonatal mortality rate due to congenital anomalies was 20.8 per 10,000 live births. It further revealed that mortality rates during this period were relatively stable (25).

In the United States of America; a CDC sponsored study on neonatal deaths showed that 4.2% of all neonatal deaths were due to congenital heart defects. The report showed that around 70% of infant deaths attributed to congenital heart defects occurred neonatally; that's to say in less than 28 days of life from birth (27)

2. National data

Morocco like other countries that are part of the United Nations; has targeted sustainable developed goal number 3 which aims to end preventable deaths of newborns and children under 5 years of age. Unfortunately; the efforts in this regard have largely being directed at combating communicable diseases and thus neglecting Non communicable diseases like CHDs. This is probably because of the cost that is required to combat CHDs; technology and infrastructure alike.

The Ministry of health's' annual « Health in numbers report » of 2020 put infant mortality at 18 per 1000 live births that's a considerable decrease from figures of 2015 in which it was reported to be at 28.8 per 1000 live births (58).

It is estimated that approximately 8000 newborns are born with cardiac malformations each year.

Even though the specific mortality figures due to congenital heart defects are hard to come by; the world health organisation has applauded the country for the strides that it has made to make significant improvements to the health care system and subsequently reducing both infant and neonatal mortality.

The ministry has undertaken a lot of health campaigns that are targeted at decreasing maternal, infant and neonatal mortality on a national scale. The minister has also encouraged

adequate documentation of births and mortality to enable proper and adaptable policy changes based on real figures.

A study done in 2020 in the intensive care unit of Mohammed VI university hospital during the period 2014-2017 revealed that congenital heart defects were responsible for 8.4% of all neonatal deaths. These figures show a considerable improvement in comparison with the figures that were released by the ministry of health « health in numbers 2016 » in which it was indicated that congenital anomalies accounted for 9.9% of all causes of death on the national scale (31).

In contrast to developed countries; for example the United states where congenital heart defects account for a meagre 4.2% of all Neonatal deaths, the country still has more work to do (27).

III. Discussion of factors which can be linked to neonatal mortality

1. Global frequency

In our series we found that the mortality rate of neonates due to congenital heart defects accounted for 5.4% of all deaths. This shows a significant reduction when contrasted with a similarstudy which was done during the period 2014-2017 in the same intensive care unit which reportedthat congenital heart defects accounted for 8.4% of all neonatal deaths.

It is also low when compared to a study done in Oujda in 2009 in which fœtal malformations were responsable for 14.54% of neonatal deaths; because cardiac causes are relatively the highest causes of death as regards malformations we can therefore speculate that the mortality specifically due to congenital heart defects was high.

Our figures are relatively close to the figures that were revealed by a study that was done in at CHU of Rabat in 2011 in which the neonatal mortality represented 5.8% of all neonatal deaths.

When compared to other countries however this figure is relatively high ; For example in the United states by 2016 their figures had dropped to as low as 4.3% of all neonatal deaths.

Table XLVII

Study	NMR
Our study	5.4%
CHU Rabat 2011(57)	5.8%
CHU Marrakech 2020(25)	8.4%
Carlos mortera et al (Spain) (30)	4.58%
Trends report Columbia 1999-2008 (25)	3 .4%
CDC report 2016 (United states) (27)	4.2%

Literaterature has suggested some risk factors that are a direct cause or can be linked as acause of neonatal mortality. These risk factors are classed as follows;

- Risk factors linked to the mother and the pregnancy;
- Risk factors linked to the new-born ;

2. Risk factors linked the mother and the pregnancy:

2.1. Maternal age

Maternal age has been a subject of scrutiny for many years; literature is dotted with so much data that dives deep into the outcomes of pregnancies for all age groups. The consensus by most authors is that both extremes of the reproductive age are considered at risk for adverse pregnancy outcomes.

In our study we observed significant statistical differences among the percentage of neonatal deaths according to maternal age. 58% of the mothers were below 30 years with the highest range being 25-29 years with 26% while the lowest was <20 years with 6%. These figures are consistent with a study by Yoo.Na-kim et al which suggested that maternal age lower than 29 years or higher than 40 years were associated with relatively high risk of neonatal mortality (1).

Another study however reported that both young and advanced maternal age has been associated with higher risks of neonatal mortality. It went further to say those neonates born to younger (<25years) mothers and older (≥ 30 years) mothers are at higher risk of neonatal death (5).

2.2. Maternal parity:

In our study we noted that mothers with a parity of III accounted for the highest number of Neonatal deaths at 32%; closely followed by mothers who had a parity of IV whose neonatal deaths Were at 30%. The least percentage points (16%) were for mothers with a parity of 2.

We observed that in mothers with a parity of 3, 68.75% of them had obstetrical history while 31.25% had no history. Some of the history includes; intra-uterine death, neonatal death, miscarriage and some cases an association of 2 more.

The case is similar with mothers who had a parity of 4 and more; 66.67% had obstetrical history while 33.33% had no history. The history is similar to that of parity 3 but in this case we even had a mother who had had 4 deaths.

These results are similar to a study that was done by faculty of public health of the university of Indonesia; in their study it was revealed that a parity ≥4; has a 1.9 higher risk of experiencing neonatal death than parity of 2 after controlling other variables; the more children born to mothers, the higher the risk of mortality (45).

Another study in Pakistan also supports these notions; the study done 2009 revealed that a lot of admissions in a hospital in Pakistan were from mothers who had at least 3 or more children, it put these mothers at high risk of malformations and thus high risk of mortality.

Recently the advance in prenatal genetic testing has been an important tool in preventing some of the repercussions that come with undetected genetic disorders. It helps families and health care providers make decisions about the pregnancy or the foetus

2.3. Social-economic status:

Our study revealed that 72% of the parents of deceased neonates had a low social status while 12% were from medium earning households. Only 1 farmer was considered a high income earner. Without a doubt the social-economic status of parents has a considerable role on the health of their new-borns as it has an impact on so many other factors such as : Nutrition for the expecting mother, habitation, regular pregnancy check-ups, accessibility to important pregnancy supplements like iron just to mention but a few.

These figures are close to those reported in a study done at the Mohammed VI university hospital of Marrakech in 2009 (75.7%), and another one in 2020 (76%) (49, 25).

A health survey conducted in Nepal on the social-economic determinants of infant mortality in 2011, demonstrated that socio-economic determinants are associated with infant mortality specifically in poorer and middle class people (8).

A mixed-method study of Bangladesh and 20 other developing countries based on demographic and health survey data concluded that mother's and father's lower education level, poor wealth status was found to be statistically significant influencing factors in neonatal death in developing countries (9).

2.4. Obstetrical history :

Our study revealed that only 38% of the mothers had a documented obstetrical history. Miscarriages represented the highest rate at 12% closely followed by intra-uterine foetal death at 8%. 3 mothers had history of neonatal death while 1 presented with an extra-uterine pregnancy.

These findings are consistent with literature with most authors concluding that the heavier the obstetrical history the higher the risk of neonatal death.

Janine Y. Khan et al in an article titled maternal history of neonatal death as an emerging risk factor of subsequent neonatal mortality in low-income and middle-income

countries reported that maternal history of neonatal death warrants recognition as an important risk factor of high neonatal mortality rate (12).

They further suggest that the association was stronger when there was multiple neonatal deaths or when a previous death occurred within 48 hours of death.

2.5. Chronic disease-Diabetes mellitus :

In our study we found that only 12 mothers representing 24% of cases had diabetes, of these 2 had type 1 diabetes, 4 had gestational diabetes while 6 were unprecised.

Among the many complications of new-borns born from diabetic mothers congenital heart defects make the cut.

Delphine Mitanchez et al reported that pre-gestational type 2 diabetes and maternal obesity significantly increased the risk of perinatal death and birth defects. They further suggest that gestational diabetes mellitus carries a small but significantly increased risk of congenital defects (ORs between 1.1 and 1.3). These risks mainly depend on maternal health condition (10). A study into a special care baby unit in Port Harcourt, Nigeria revealed that neonatal mortality rate is over five times that of infants of non-diabetic mothers and is higher at all gestational ages and birth weight for gestational categories. The study showed that 59.6% of the

diabetic mothers had had previous foetal or early neonatal deaths (11).

Needless to mention, diabetes still contributes highly to neonatal and infant death in our society today.

2.6. Disease during preganancy :

We found that 56% of mothers had had a disease during pregnancy. The majority of thesecases are represented by genital infection (11 cases). Our study revealed that only 54% of the mothers had follow-ups during pregnancy. This was done either by a general doctor or

a gynaecologist.

We also had mothers that presented with urinary infection, premature rupture of membranes, amniotic fluid abnormalities, anaemia, fever or threatened preterm labor.

Maternal morbidity undeniably has a huge impact on neonatal mortality. Many scholars have emphasized the need for pregnant mothers to undergo regular screening and do regular check-ups.

A study in Ethiopia showed that mothers that presented with a disease during pregnancy and did not have regular check-ups had a higher risk of neonatal mortality. This was mostly in low income populations in which access to maternity services was low. Others were discouraged by the distance they had to cover to access the nearest health center (63).

2.7. Consanguinity with husband:

In our study we had 22% of consanguinity of mothers with their husbands; 18% was 1st degree consanguinity while 4% was 2nd degree consanguinity.

Consanguinity is still prevalent today because most of these consangenous marriages are based on religious, cultural and/ or traditional beliefs. Some cultures believe in strengthening family ties by marrying blood-related spouses. Some cultures do this to keep wealth within the family.

Different studies have shown the devastating effects linked to consanguineous marriages. Reza Chaman et al in a research in Pakistan found that first cousin marriages were more prone to experience a child's death, compared to not-related-by-blood couples (16).

This is consistent with a study done by C Stoltenberg et al; a study which was aimed at estimating the recurrence risk for stillbirth and infant death in which they demonstrated that the risk of recurrence of stillbirth and infant death was higher for offspring of first-cousin parents compared to offspring of unrelated parents (13).

3. Risk factors linked to the new-born:

3.1. Sex of new-born :

In our study the sex ratio was almost evenly distributed; 50% were female deaths while 48% were male deaths. We also had 1 case of sexual ambiguity.

When it comes to distribution of CHDs by sex a study done in saudi arabia and published by the world health organisation in the eastern Mediterranean health journal revealed that distribution according to sex, male :female ratio for congenital heart disease in general; the frequency was almost the same for males and females. Female predominance was seen in patent ductus arteriosus while a significant male predominance was clear in left-sided obstructive lesions, coarctation of aorta and dextro-transposition of great arteries (14).

As regards distribution of mortality by sex, Wu Weiliang et al in a report dubbed incidence and mortality trend of congenital heart disease at the global, regional, and national level, 1990- 2017 reported that the mortality rate was slightly higher among males than females. But it is important to mention that it was only higher by 0.2 points; the male mortality was 6.4 while that of females was 6.2 and thus we can speculate that mortality in CHDs is evenly distributed (17).

3.2. Weight of new-born:

We observed in our study that 36% of the newborns were of low birth weight; 1 newborn had a very low birth weight (VLBW) while the majority of the newborns (50%) weighed between

and 4 kgs.

Low birth weight on its own is a huge morbidity in neonates but when it's coupled with a congenital malformation, more so a heart malformation, the risk of mortality is expected to increase exponentially.

Woo sun song et al demonstrated that infants with congenital heart disease and very low birth weight (CHD-VLBW) had a higher mortality rate (14). This conclusion is consistent with

another study that was done in Brazil by Selma et al. In this study, they showed that preterm infants with low birth weight and comorbidities presented higher risk of mortality related to CHDs (18).

3.3. Age of death:

A little more than half (54%) of the newborns died in their first week of life. Only a meagre 8% of all the babies survived longer than 21 days. In 54% of cases the new-borns died less than 24 hours after admission while 28% were hospitalised for periods ranging between 24 hours and 6 days.

According to world health organisation most neonatal deaths (75%) occur in the first week of life and in 2019, about 1 million newborns died within the first 24 hours.

UNICEF data reported that three-quarters of all neonatal deaths occurred within the first the first week of life (42).

This is supported by a retrospective study conducted in Spain to determine CHD mortality rate in Spain; in this study there were 2,970 (4.58%) of infant death in a population of 64, 831 patients with CHD; with 73.8% of the deaths occurring during the first week of life (30).

4. Causes of death

According to a study published by BMJ done in Norway mortality among the live-born children with severe CHDs was 10%, of whom 58% died before surgery (86).

These figures are almost consistent with the figures in our study in which the majority that is almost 90% died not only before surgery but some of these newborns died before they

could even be seen by a specialized pediatric cardiac surgeon.

The same study revealed that by 2016 prenatal detection was at 58% in Norway this is very far from our findings in which only a 4% of the of all the newborns had prenatal detection, this is an undeniable contributing factor to the high levels of death. This is due to the lack of specialized pediatric cardiac surgeons, neonatologists and basic pediatrics in centers in both urban and rural areas.

A study published in the Iranian journal of neonatology conducted in the department of neonatology of the regional hospital center in Agadir listed; distance travelled to health facility, multi-parity, low birthweight and number of prenatal visits as some of the factors that increase the occurrence of neonatal deaths (87).

Our study revealed that 72% of the newborns had parents from urban dwellings and only 28% were from rural areas this should speak to the problems this sector is facing. If these levels of deaths, lack of early detection were experienced in urban areas what about rural areas. We can assume that the 28% rural populations were the only ones who could afford to travel to get specialized care; this would mean the majority cannot afford. The onus is on the government to invest more in regional and provincial neonatology intensive care units so that the rural population can have access to this very important care.

A report carried by a news blog LE360 reported that the president of the society of neonatology intensive care, urgency and pediatrics said that at a national scale he estimates 350 bed spaces meant to cater for 50 000 to 70 000 neonates each year(88). These numbers are alarming and require immediate attention from the ministry of health.

During our study it was also noted that there is an acute shortage of medications which are essential in helping the newborns. For example in one of the files under study a newborn who was prescribed prostin wasn't able to be given because it wasn't available at the time. What this entails is that all newborns awaiting corrective and/or corrective surgery will not be able to survive.

RECOMMENDATIONS

The long term sustainable development goal worldwide as regards neonates is to attain a mortality rate of 1.1. Some countries, especially high income countries are well on the road to achieving this goal. For other countries however, specifically low-income countries or developing countries as they are normally referred to, this goal will remain a pipe dream as little progress has been made in this regard.

Morocco for example, has achieved SDG 3; over 2 decades they have managed to reduce neonatal mortality has reduced to 11.50 per 1000 live from 28.4 per 1000 live births and it is wellon track to maintaining this achievement.

This has been achieved because the country and in particular; the ministry of health has put in place deliberate programs to help improve both maternal and neonatal care. A lot of vaccination campaigns have been done to ensure that early on, at their most vulnerable stage, new-borns are taken care of.

Unfortunately, most of these programs are targeted at dealing mostly with communicable diseases and such non communicable disease like in this case congenital malformation and specifically congenital heart defects still remain a challenge.

More has to be done to address the existing limitations.

Some of the things that can be put in place include but are not limited to;

- Access to health care and in particular specialized neonatology centers and intensive care units are still scarce or even nonexistent this means still a huge chunk of the population still has to travel long distances to be seen by a specialized neonatologist. It is for this reason that I recommend for the decentralization of specialized centers. The government should invest in more regional and provincial neonatology intensive care units to increase access for populations in far flung areas.
- The government needs to invest more in training specialized neonates, pediatric surgeons and giving them good incentives so that they can work even in remote areas. These incentives range from salary increments, proper housing and good

general conditions of service.

- In the same vain I recommend that more neonatology units are constructed to especially in rural areas. These units must be provided with the necessary machinery and human resource. This will significantly reduce the distance that patients have to cover to access specialized neonatology services that are primordial for precarious babies.
- The government should subsidize or provide freely essential medications like prostaglandins that are very important pre-surgery. This can be done nationally in neonatology units around the country.
- The ministry of health should also need to invest more in educating the citizens about the importance of antenatal screening. Many of these malformations if detected early can be easily managed but antenatal screening and pregnancy follow-ups still remain a problem.
- The benefits of early echocardiography screening cannot be over-emphasized. But for this to be possible more neonatologist, pediatric cardiologists, pediatric cardiac intensivists, radiologists, pediatric cardiac surgeons and alike need to be trained. Echocardiography can also be a routine diagnostic tool especially in critically ill neonates.
- Even though not all congenital heart defects are sensitive to prostaglandin; its usefulness in the case in which it is responsive cannot be ignored. This is why it should be made accessible.
- Good management of files and documents of patients is essential; Most studies require the use of these files and as such, they showed be handled delicately. This management starts at the point of collection.
- Those entrusted with collecting data must ensure that the data is; accurate; they must ensure that all the necessary data is collected. This is very important because this data will at one point be used to make the necessary policy

changes; if the collected data is insufficient or inaccurate, the changes to be made will not meet the needs of the population and will consequently stifle the much needed improvements.

- It is also very important to have a national registry where all neonatal death are reported specifying cardiac causes, so that statistical data are more précised and will lead to a plan of action, regarding cardiac disease especially congenital ones, and improve their survival.

CONCLUSION

Neonatal mortality is a very viable indicator of the quality of neonatal care; and despite the many strides made over the years; it still remains high in certain countries, especially developing countries.

With the advent of better and improved machinery, infrastructure and new health protocols,congenital heart defects are no longer regarded as a death sentence as they can be managed if they are detected on time.

We conducted a retrospective study of 50 files of new-borns who died in the neonatologydepartment at the Mohammed VI university hospital of Marrakech from 1st January 2016 to 31 December 2019.

This study allowed us to evaluate the frequency of neonatal mortality due to congenital heart defects as well as identify or discuss some risk factors that could have contributed to the deaths in the neonatology unit of Mohammed VI university hospital of Marrakech. This study is important because it will help identify areas in the health system that require the attention of health actors ; it will help policy makers model policies that are based on concrete researched dataand consequently ; this will improve the status quo.

The global frequency in our study was 5.4% for the period under study. The results show asignificant reduction from figures found in previous studies.

Some of the suggested risk factors discussed include; mothers' age, parity, obstetrical history, chronic disease, disease during pregnancy, consanguinity with husband and pregnancy screening.

The other risk factors were linked to the new-born and include; new-borns' age, sex and the new-borns age of death.

We demonstrated in our study that most of these factors had a direct impact on the well- being of the new-borns. Fortunately, adequate education, good health systems and continued training of neonatologists can help with better management of these factors. This requires adequate funding and the constant update of data ; so that policy direction is based on current data.

APPENDIX

I. NEW BORN:

DATA COLLECTION FORM.

FORM NO :

- IP: ……
- Date of birth: ……../……/ 20……
- Date of admission: ……. /……/ 20……..
- Age of admission: ……
- Gestational age…… Weeks
- Sex: Male ☐ Female ☐ Undetermined ☐
- Origin: Urban ☐ Rural ☐
  specify……..

• Profession of parents: Fathers' profession ……
Mothers' profession ……
• Social status: Low ☐ Medium ☐ High ☐
• Family history of congenital cardiopathy: Yes ☐ No ☐ Specify
……
• Family history of a congenital pathology: Yes ☐ No ☐ Specify
……
• Condition of the patient: Prematurity ☐ Macrosomia ☐
IUGR ☐ Specify ……..
• Circumstances of Diagnosis: Antenatal ☐ NRDS ☐
Systematic ☐ Fortuitous ☐
• Suggestive clinical signs: Cyanosis ☐ Heart Murmur ☐ Heart failure ☐
Polypnia ☐ Poor feeding ☐ Tachycardia
Others……C
ritical clinical signs due to NRDS: Nose Flaring ☐ Audible grunting ☐
Costal retraction ☐ Subcostal retraction ☐
Xiphoid retraction ☐
• Associated malformations: NO ☐ Yes ☐
Specify
……
Facies of T21 Present ☐ Not Present ☐

• Vitals on admission: $SP0_2$ at room air……% SPO_2 after O2 ……%
BG: ……g/l RR: ……Weight: …… kg
HR: …… LUL: ……RUL: ……..
RLL: ……. LLL: ……
• Biological findings: HB: ……g/l CRP: ……
WBC: ……
• Chest X-ray: Normal ☐ Cardiomegaly ☐ Boot shaped heart ☐

Hyper vascularization ☐ Hypo vascularization ☐
Others…….

• Heart Echo:
……
……
……
Type of cardiopathy: Cyanotic ☐
ToF ☐ ToGA ☐ CoA ☐ DORV ☐ TAPVR ☐
CT (Common truncus) ☐ RVH ☐
Others……
Non Cyanotic ☐
VSD ☐ ASD ☐ PDA ☐ AVSD ☐ PAPVR
Others ……...
Obstructive: ☐ Interrupted aortic arch ☐
TA ☐ PA ☐ PS ☐ AS ☐ HLHS ☐ ToF ☐
Others …….
• Complications linked to the cardiopathy: PAH ☐ LVH ☐ RVHHeart failure ☐Blood clots ☐ Heart valve ☐ Sudden death ☐ Others
…….
• Treatment: Medical: Antibiotic therapy ☐ Oxygen therapy ☐ NVI ☐
Invasive ventilation/mechanical ☐ Intubation ☐
others……
Surgery: …….
• Prognosis: Favourable ☐ Not favourable ☐
•Cause of death: Cardiac causes No ☐ Yes ☐
Specify
……..
Infectious causes No ☐ Yes ☐
Specify …….
Nosocomial infection ☐ Post-operative infection ☐Place of death: Intensive care ☐
Neonatal DEP ☐ Age of death …….
Weight at death……..
Period between admission and death……
Death: Pre-surgery ☐ During surgery ☐Post -surgery ☐
•Surgery: Date of surgery …….
Delay between diagnosis of surgery……
Reasons for delay of surgery……

II. Mothers' clinical data

• Age : ……years Gravida: …… Para: ……

- Obstetrical history: Without history ☐ Stillbirth ☐
IUFD ☐ Miscarriage ☐
Details ……
- Chronic disease: Diabetes: No ☐ Yes ☐ Type 1 ☐ Type 2 ☐
Gestational ☐ Unprecised ☐High blood pressure No ☐ Yes ☐
- Disease during pregnancy: No ☐ Yes ☐
Specify ……
- Consanguinity with husband: No ☐ Yes ☐
1st degree ☐ 2nd degree ☐
3RD degree ☐ 4th degree ☐
- Pregnancy Screening: No ☐ Yes ☐
- Drug intake: No ☐ Yes ☐
- Intake of toxins: No ☐ Yes ☐ Specify..……
- Intake of traditional plants: No ☐ Yes ☐
- Exposition to radiation during pregnancy: No ☐ Yes ☐

RESUMES

ABSTRACT

Neonatal mortality is a very viable indicator of the quality of neonatal care; and despite the many strides made over the years; it still remains high in certain countries, especially developing countries.

The objective of our study was to determine the neonatal mortality rate due to congenital heart defects and identify some risk factors of neonatal mortality in the department of Neonatology of the University Hospital Mohammed VI of Marrakech. We conducted a retrospective, descriptive and analytical study for the period January 1st 2016 to December 31st 2019.

Data used was collected from hospital records of new-borns from 0 to 28 days using a data collection form that was pre-made.

We found a mortality rate of 5.4% of all hospitalized new-borns. The majority of these deaths occurred in the first week of life.

Some risk factors were identified and discussed. We divided these risk factors into those that were linked to the mother; mothers' age, parity, obstetrical history, chronic disease, disease during pregnancy, consanguinity with husband, pregnancy screening and those linked to the new-born; new-borns' age, sex and the new-borns age of death.

Our study revealed that despite the many efforts that have been put in place by the relevant authorities, more still has to be done in this regard. Both maternal and neonatal health care systems still require improvement.

The main recommendations are:

1. The decentralization of specialized neonatology centers.
2. Governments have to invest more in training specialized neonates and giving themgood incentives so that they can work even in remote areas.
3. Echocardiography should be made routine especially in critically ill neonates.
4. Increased access to prostaglandin
5. Eduacate mothers on the importance of antenatal screening
6. Good management of files and documents

RÉSUMÉ

La mortalité néonatale est un indicateur très fiable de la qualité des soins néonatals : et malgré les nombreux progrès réalisés au fil des ans ; il reste encore élevé dans certains pays, notamment les pays en voie de développement.

L'objectif de notre étude était de déterminer le taux de mortalité néonatale due aux malformations congénitales et d'identifier certains facteurs de risque de mortalité néonatale dansle service de néonatologie du CHU Mohammed VI de Marrakech.

Nous avons mené une étude rétrospective, descriptive et analytique sur la périod du 1er janvier 2016 au 31décembre 2019.

Les données utilisées ont été recueillies à partir des dossiers hospitaliers des nouveau-nés de 0 à 28 à l'aide d'un fiche d'exploitation.

Nous avons trouvé un taux de mortalité de 5.4% de tous les nouveau-nés hospitalisés. La majorité de ces décès sont survenus au cours de la première semaine de vie.

Certains facteurs de risque ont été identifiés et discutés. Nous avons divisé ces facteurs derisque en ceux qui étaient liés à la mère ; àge des mères, parité, antécédents obstétricaux, maladies chronniques, maladies pendant la grossesse, consanguinité avec le mari, dépistage de lagrossesse et celles liées au nouveau-né : l'àge, le sexe et l'age de décès du nouveau-né.

Notre étude a révélé que malgré les nombreux efforts qui ont été mis en place par les autorités compétentes, il reste encore beaucoup à faire à cet égard. Les systèmes de soins de santématernelle et néonatale doivent encore étre améliorés.

Les principales recommendations sont :

1. La decentralisation des centres spécialisés de néonatologie.
2. Les gouvernments doivent investir davantage dans la formation de specialist en néonatologie et leur donner de bonnes incitations pour qu'ils puissent travailler méme dans des zones rurales.
3. L'échogracardiographie doit ètre rendue systématique, en particulier chez les
4. nouveau-nés gravement malades
5. Facilité access aux prostaglandines
6. Eduquer les mères sur l'importance du dépistage prénatal
7. Bonne gestion des dossiers et des documents

موجز

تعد وفيات الأطفال حديثي الولادة مؤشرا موثوقا به للغاية على جودة رعاية الأطفال حديثي الولادة: وعلى الرغم من التطورات العديدة التي تحققت على مر السنين ؛ لا يزال مرتفعا في بعض البلدان ، وخاصة البلدان النامية.

كان الهدف من دراستنا هو تحديد معدل وفيات الولدان بسبب التشوهات الخلقية وتحديد بعض عوامل الخطر لوفيات الولدان في قسم طب الأطفال حديثي الولادة في مستشفى ***CHU*** محمد السادس في مراكش.

لقد أجرينا دراسة بأثر رجعي وصفية وتحليلية خلال الفترة من 1 يناير 2016 إلى 31 ديسمبر 2019.

تم جمع البيانات المستخدمة من سجلات المستشفى للمواليد الجدد من 0 إلى 28 باستخدام ورقة البيانات.

وجدنا معدل وفيات يبلغ 5.4٪ من جميع الولدان في المستشفى. حدثت غالبية هذه الوفيات خلال الأسبوع الأول من العمر.

تم تحديد بعض عوامل الخطر ومناقشتها. قسمنا عوامل الخطر هذه إلى تلك التي كانت مرتبطة بالأم ؛ عمر الأم ، التكافؤ ، تاريخ الولادة ، الأمراض المزمنة ، الأمراض أثناء الحمل ، القرابة مع الزوج ، فحص الحمل وتلك المتعلقة بالمولود: العمر والجنس والعمر للمواليد.

كشفت دراستنا أنه على الرغم من الجهود الكثيرة التي تبذلها الجهات المختصة ، لا يزال هناك الكثير الذي يتعين القيام به في هذا الصدد. تحتاج أنظمة الرعاية الصحية للأمهات والأطفال حديثي الولادة إلى مزيد من التحسين.

التوصيات الرئيسية هي:

1.لامركزية المراكز المتخصصة لطب حديثي الولادة.

2.يجب على الحكومات أن تستثمر أكثر في تدريب المتخصصين حديثي الولادة ومنحهم حوافز جيدة حتى يتمكنوا من العمل حتى في المناطق الريفية.

3.يجب أن يكون تخطيط صدى القلب روتينيًا ، خاصة عند الولدان المصابين بأمراض خطيرة

4.سهولة الحصول على البروستاجلاندين

5.توعية الأمهات بأهمية الفحص قبل الولادة

6.إدارة السجلات والوثائق الجيدة

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Epidèmiologie hospitalier cardiopathie congenitale en pèdiatrie
Thèse de medecine N33

بسم الله الرحمن الرحيم

قسم الطبيب

أُقْسِمُ بِاللَّهِ الْعَظِيمِ
أَنْ أُرَاقِبَ اللَّهَ فِي مِهْنَتِي
وَأَنْ أَصُونَ حَيَاةَ الإِنْسَانِ فِي كَافَّةِ أَطْوَارِهَا، فِي كُلِّ الظُّرُوفِ وَالأَحْوَالِ، بَاذِلاً وُسْعِي فِي اِسْتِنْقَاذِهَا مِنَ الْهَلاَكِ وَالْمَرَضِ وَالأَلَمِ وَالْقَلَقِ.
وَأَنْ أَحْفَظَ لِلنَّاسِ كَرَامَتَهُمْ، وَأَسْتُرَ عَوْرَتَهُمْ، وَأَكْتُمَ سِرَّهُمْ.
وَأَنْ أَكُونَ عَلَى الْدَّوَامِ مِنْ وَسَائِلِ رَحْمَةِ اللَّهِ، بَاذِلاً رِعَايَتِي الصِّحِّيَّةَ لِلْقَرِيبِ وَالْبَعِيدِ، لِلصَّالِحِ وَالطَّالِحِ، وَالصَّدِيقِ وَالْعَدُوِّ
وَأَنْ أُثَابِرَ عَلَى طَلَبِ الْعِلْمِ أُسَخِّرُهُ لِنَفْعِ الإِنْسَانِ لاَ لأَذَاهُ
وَأَنْ أُوَقِّرَ مَنْ عَلَّمَنِي، وَأُعَلِّمَ مَنْ يَصْغُرُنِي، وَأَكُونَ أَخًا لِكُلِّ زَمِيلٍ فِي الْمِهْنَةِ الصِّحِّيَّةِ، مُتَعَاوِنِينَ عَلَى الْبِرِّ وَالتَّقْوَى
وَأَنْ تَكُونَ حَيَاتِي مِصْدَاقَ إِيمَانِي فِي سِرِّي وَعَلاَنِيَتِي، نَقِيَّةً مِمَّا يَشِينُهَا تُجَاهَ اللَّهِ وَرَسُولِهِ وَالْمُؤْمِنِينَ
وَاللَّهُ عَلَى مَا أَقُولُ شَهِيدٌ

كليـــــــة الـطـب
و الصيدلة - مراكش
FACULTÉ DE MÉDECINE
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UNIVERSITÉ CADI AYYAD

سنة 2023 أطروحة رقم 116

دراسة الوفيات بين حديثي الولادة المصابين بعيوب خلقية في القلب بمستشفى محمد السادس الجامعي بمراكش

الأطروحة

قدمت ونوقشت علانية يوم **2023/03/28**

من طرف

السيد رفاييل موانسا كابوسوي

المزداد في 18 فبراير 1995 بلوساكا

لنيل شهادة الدكتوراه في الطب

الكلمات الأساسية:

وفيات الأطفال حديثي الولادة - عيوب القلب الخلقية - عوامل الخطر - مستشفى جامعة محمد السادس بمراكش

اللجنة

السيد	ف. م. ر. ماء العينين أستاذ في طب الأطفال	الرئيس
السيدة	ن. الادريسي السليطين أستاذة في طب الأطفال	المشرف
السيد	م. بو الروس أستاذ في طب الأطفال	الحكام
السيد	ن. راضى أستاذ في طب الأطفال	
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