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Computed Tomography Pelvimetry at the Yaoundé Central Hospital from 2018 to 2020: Practices and Obstetrical Outcome

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Abstract

Objective: Indications for computed tomography (CT) pelvimetry and its ability to predict obstetric outcomes remain controversial. The increasing use of this examination in the African context and the paucity of studies conducted in Cameroon and sub-Saharan countries motivated this study. Our objective was to assess CT pelvimetry practices at the Yaoundé Central Hospital and evaluate obstetrical outcomes. **Method:** We conducted a cross-sectional study with retrospective and prospective data collection in the Radiology Department of the Yaoundé Central Hospital from January 2018 to April 2020. All patients who underwent CT pelvimetry with an available report were included. Data collected included socio-demographic characteristics, indications, radiation doses, pelvic measurements, and delivery outcomes. Statistical analyses included descriptive statistics, Fisher's exact test, and binary logistic regression. **Results:** Of 267 women identified, 252 had CT pelvimetry reports, and 162 were followed until delivery. Mean maternal age was 28 ± 4 years, and mean height was 1.61 ± 0.06 m. The most frequent indication was scarred uterus (50.4%). Median dose-length product (DLP) was 34 mGy.cm (IQR: 28 - 41). Borderline pelvis accounted for 52% of cases, contracted pelvis 18.3%, and normal pelvis 29.8%. Caesarean section rate was 61.9%, higher in women with contracted pelvis (100%) and borderline pelvis (66.2%) than in those with normal pelvis (30.6%). Maternal height <1.55 m was predictive of caesarean delivery (OR 2.9, 95% CI 1.3 - 6.2, p = 0.01). **Conclusion:** CT pelvimetry was mainly indicated for scarred uterus and clinical pelvic stricture. Irradiation levels were within recommendations limits. The high proportion of borderline and con-

tracted pelvis (70.3%) was associated with increased caesarean section rates. Maternal short stature was predictive of caesarean delivery. These results highlight the need for standardized criteria in interpreting CT pelvimetry in obstetric management.

Keywords

CT Pelvimetry, Magnin Index, Obstetric Outcomes, Childbirth Mode, Caesarean Section

1. Introduction

During delivery, the passage of the fetus can be made difficult by the shape and size of the pelvis or his presentation [1]. It is therefore necessary to estimate the pelvic dimensions before the end of the pregnancy. This estimation is made by clinical evaluation and by medical imaging. CT pelvimetry is a medical imaging work up that allows accurate assessment of pelvic dimensions in order to predict mechanical dystocia for a reduction in maternal fetal morbidity and mortality [2]. The measurements obtained allow the obstetrician to decide on the mode of delivery in certain obstetric situations such as scarred uterus, breech presentation, macrosomia, acquired or congenital deformations of the pelvis. It has been used for several years. The precision of the measurements obtained the speed of acquisition of the sections and the reduction of the feto-maternal irradiation contributed to substitute this technique with radiopelvimetry [3].

There is no consensus on CT pelvimetry indications, and its ability to predict the outcome of labor is questioned [4]-[6]. The indications for its realization have become limited [7] and some authors do not recommend it before the delivery of a woman with a scarred uterus [8]. For other authors, performing CT pelvimetry increases the likelihood of cesarean delivery [7] [9]. It also poses a problem of maternal-fetal irradiation which remains significant despite a significant decrease in X-ray exposure compared to radiopelvimetry. The use of CT pelvimetry in the African context is increasing due to a greater availability of scanners. Many studies have been done on radiopelvimetry but very few have focused on the CT pelvimetry in Africa in particular.

In this work, we first examine the characteristics CT pelvimetry practice in terms of technical realization, recourse, indications, and secondarily the obstetric outcome after the realization of a CT pelvimetry at Yaoundé Central Hospital. The African literature review found 05 studies on the practice and obstetric outcome of women with CT pelvimetry. The scarcity of data on this subject in Cameroon and Africa is one element that motivated the realization of this work.

In order to learn about CT pelvimetry practice at Yaoundé Central Hospital, we documented the indications, described the technical aspects and finally we assessed the obstetrical outcomes.

2. Methods

This was a cross-sectional study with retrospective and prospective data collection conducted in the Radiology Department of the Yaounde Central Hospital (YCH) from January 1, 2018 to April 30, 2020. The Sampling was consecutive and exhaustive. We selected all patients who performed CT pelvimetry at the YCH from January 2018 to April 2020 and who had an available CT pelvimetry report. The descriptive analysis consisted in calculating the mean and the standard deviation for the quantitative variables (age, height, DLP, pelvic diameters) while the qualitative variables were represented in frequency tables (parity, grounds of appeal, DLP classes, type of pelvis, fetal presentation, mode of delivery, occurrence of obstetric complications, concept of immediate cry and caesarean section pattern). We calculated the relative risks by combining: the type of pelvis and the elements of obstetric outcome, the grounds for recourse and the elements of obstetric outcome. The exact Fisher test was used to calculate the p-value (p less than 0.05 was considered significant). A binary logistic regression was performed to bring up the predictors of delivery pattern.

Definitions [10]:

- Normal pelvis: obstetric conjugate ≥ 11.5 cm, transverse diameter ≥ 12 cm, Magnin index ≥ 23 cm.
- Borderline pelvis: values slightly below thresholds but not meeting criteria for contracted pelvis.
- Contracted pelvis: obstetric conjugate < 10.5 cm, transverse diameter < 11 cm, or Magnin index < 21 cm.

3. Results

A total of 267 women performed a CT pelvimetry from January 2018 to April 2020 at the Radiology and Medical Imaging Department of the Yaounde Central Hospital. We found 252 CT pelvimetry reports available. 15 women were excluded because of non-available CT pelvimetry reports and we were able to contact 162 women for description of the obstetric outcomes. The 90 women left could not be interviewed because of a lack of phone numbers, a refusal to participate in the study, or a maternal death. Two women were still waiting for delivery.

Comparison of women traced (n = 162) vs untraced (n = 90):

- Age and height distributions were similar.
- Indications were comparable (scarred uterus remained most frequent).
- Slightly higher proportion of borderline pelvis in traced women (54% vs 48%).

=> No significant differences, suggesting limited selection bias.

3.1. Characteristics of the Population

Age, height, parity and CT pelvimetry indications

The average age was 28 ± 4 years with extremes at 14 and 37 years. The average height was 1.61 ± 0.06 m. Multiparous represented 54% of the women and the remaining patients were at their first delivery. The scarred uterus was the most

frequent indication (50.4%) while clinical suspicion of pelvic stricture followed with 33.7% of CT pelvimetry requests (Table 1).

Table 1. Distribution according to CT pelvimetry indications.

Indications	Frequency	Percentage (%)
Scarred uterus	127	50.4
Clinical suspicion of pelvic stricture	85	33.7
Not mentioned	23	9.1
Fetal macrosomia	10	4.0
Breech presentation	4	1.6
Multiple pregnancy	2	0.8
Past history of dystocia	1	0.4
Total	**252**	**100**

3.2. Practice Evaluation

Protocol for the realisation of the CT pelvimetry

The Yaoundé Central Hospital (YCH) has a "Hitachi" computed tomography scan machine of 16 strips with which CT pelvimetry was performed. The parameter of acquisition varied from one patient to another. The voltage varied between 90 to 120 kV and the amperage between 50 and 80 mA.

Dosimetry

The Dose length product (DLP) average was 34.9 ± 11.99 mGy.cm. They were 37.3% of the women who had a DLP between 31 and 40 mGy.cm (Table 2).

Table 2. Distribution of women according to the DLP.

Dose length product (mGy.cm)	Frequency	Percentage (%)
Inf. to 10	2	0.8
10 - 20	18	7.1
20 - 30	88	34.9
30 - 40	94	37.3
40 - 50	28	11.1
50 - 60	14	5.6
60 - 70	4	1.6
70 - 80	1	0.4
80 - 90	2	0.8
90 - 100	1	0.4
Total	**252**	**100**

3.3. CT Pelvimetry Results

CT pelvimetry conclusions, pelvic biometry and fetal presentation

The borderline pelvis was the most frequent pelvic type found in CT pelvimetry conclusions (52%) while contracted pelvis accounted for 18.3% of the total population (Table 3).

Table 3. Distribution of patients according to the CT pelvimetry conclusion.

Type of pelvis	Frequency	Percentage (%)
Borderline pelvis	131	52.0
Normal pelvis	75	29.8
Contracted pelvis	46	18.3
Total	**252**	**100**

The different diameters explored with their mean and standard deviation are shown in Table 4 below. The bi-parietal diameter was measured in 252 women. The average was 9 +/− 0.7 cm. The cephalopelvic confrontation was performed using the Magnin diagram in the 4 patients whose bi-parietal foetal diameter was known. All were in the area for vaginal delivery.

Table 4. Characteristics of pelvic diameters of interest and Magnin Index.

n = 252	Min (cm)	Max (cm)	Mean (cm)	Standard deviation (cm)
Obstetric conjugate	9.0	13.5	11.3	1.0
Transverse diameter	9.1	13.7	11.5	0.8
Magnin index	18.8	26.9	22.8	1.4
Bispinous diameter	4.7	13.3	10.4	1.0

Concerning the foetal presentation, cephalic presentation was the most frequent with 94.4% of the women (Table 5).

Table 5. Distribution of women according to the fetal presentation.

Fetal presentation	Frequency	Percentage (%)
Cephalic	239	94.8
Breech	12	4.8
Transverse	1	0.4
Total	**252**	**100**

Association between CT pelvimetry's indications and the type of pelvis

The women who had as indication a scarred uterus, were the most frequent to be diagnosed with a borderline pelvis (49.6%). Women with scarred uterus who had a contracted pelvis represented 13% of the women (Table 6).

Table 6. Association between CT pelvimetry's indications and the type of pelvis.

CT pelvimetry indications	CT pelvimetry conclusions							
	Normal pelvis		Borderline pelvis		Contracted pelvis		Total	
	n	(%)	n	(%)	n	(%)	n	(%)
Scarred uterus	47	37	63	49.6	17	13.4	127	100
Clinical suspicion of pelvic stricture	18	21.2	47	55.3	20	23.5	85	100
Not mentioned	7	30.4	11	47.8	5	21.7	23	100
Fetal macrosomia	-	-	7	70	3	30	10	100
Breech presentation	1	25	2	50	1	25	4	100
Multiple pregnancy	1	50	1	50	-	-	2	100
Past history of dystocia	1	100	-	-	-	-	1	100

Logistic regression analysis (predictors of caesarean section) (Table 7).

Table 7. Predictors of caesarean section.

Variable	OR	95% CI	p-value
Maternal height <1.55 m	2.9	1.3 - 6.2	0.01
Borderline pelvis	3.1	1.5 - 6.5	0.002
Contracted pelvis	8.5	3.4 - 21.4	<0.001
Multiparity	1.2	0.6 - 2.5	0.58
Scarred uterus	1.4	0.7 - 2.8	0.33

4. Obstetrical Outcomes

Delivery mode

Most of the women gave birth through a caesarean delivery (61.9%). We had only one instrumental delivery while the rest were vaginal deliveries.

Obstetrical complications

Women who presented obstetrical complications during delivery were 40 (24.4%). The most frequent complication was represented by perineal tears during delivery with about 48.7% (Table 8).

Table 8. Distribution of obstetric complications before, during and after delivery.

Complications	Frequency (n)	Percentage (%)
Perineal tear	19	48.7
Dystocia	9	23.1
Postpartum hemorrhage	5	12.8
Acute fetal distress	3	7.7
Uterine rupture	2	5.1
Pre eclampsia	1	2.6
Total	**40**	**100**

Newborn status at birth

We recorded 1 neonatal death out of 160 deliveries, which gives a death rate of 6 deaths per 1000 births. Fifteen newborns did not immediately cry at birth. (9.4%). The average birth weight was 3275 +/− 378 g with a minimum weight of 2500g and a maximum of 4400 g.

Association between obstetric outcome and the type of pelvis

The proportion of women with borderline pelvis who gave birth by caesarean section was 66.2% meanwhile all the women with contracted pelvis delivered by caesarean section. A woman with a borderline pelvis was 3 times more likely to give birth by caesarean compared to a woman with a normal pelvis (Table 9).

Table 9. Association between the mode of delivery and the type of pelvis.

Type of pelvis	Cesarean delivery	%	Vaginal delivery	%	RR	IC 95%	p-value
Normal pelvis	15	30.6	34	69.4	Réf	-	-
Borderline pelvis	51	66.2	26	33.8	2.1	(1.4 - 3.4)	0.00005
Contracted pelvis	33	100	-	-	3.3	(2.1 - 5)	-

The women with borderline pelvis who experienced obstetric complications represented 23.1%. The relative risk of complication occurrence in women with a borderline pelvis was 0.6. The proportion of women with contracted pelvis who presented with complications was 3%. The relative risk of occurrence of obstetric complication in women with contracted pelvis compared to normal pelvis was 0.07.

Association between obstetrical outcome and CT pelvimetry indications

The proportion of women who came for clinical suspicion of pelvic stricture and who gave birth by caesarean section was 50.8%. We found a statistically significant link between the clinical suspicion of pelvic stricture and the occurrence of caesarean delivery. The latter seems to be a protective factor. Meanwhile the proportion of women with scarred uterus who gave birth by caesarean section was 64.6%. There was no statistically significance relationship between having the scarred uterus and the occurrence of caesarean delivery (Table 9).

Women who performed CT pelvimetry for suspicions of fetal macrosomia were 90 (60.4%) to benefit of a caesarean delivery. There was no significant relationship between the indication for fetal macrosomia and the occurrence of caesarean section (Table 9).

All the women who came for bridge presentation gave birth by caesarean section. There was no significant link between the presentation of the seat and the occurrence of caesarean delivery (Table 9).

5. Discussion

Our findings confirm the predominant use of CT pelvimetry in women with scarred uterus and suspected pelvic contraction. Radiation doses were acceptable com-

pared to published data. The strong association between abnormal pelvic types and caesarean section highlights the clinical weight given to imaging conclusions. However, the absence of standardized criteria for defining borderline pelvis complicates interpretation and may partly explain the high caesarean section rate. The comparison of traced versus untraced women suggests minimal selection bias, but this remains a limitation. Future studies should explore predictive models integrating clinical and imaging factors to refine decision-making.

5.1. Characteristics of the Population

The average age of women was similar to that obtained by Ngegue in 2011 in Cameroon and slightly greater to that obtained by Adjenou in Togo that same year [10] [11]. Meanwhile, the average size was slightly smaller than that found by Ngegue and Adjenou in their studies [10] [11]. This could be due to the fact that the height inferior to 1.55 m is a known risk factor for narrowed pelvis.

Multiparas were the most represented in the study of Ngegue *et al*., as is the case in our study. The latter had 70.4% of his total strength which was composed of multiparas [11]. The high frequency of multiparas could be due to the fact that, CT pelvimetry was mostly prescribed to women with scarred uterus. Indeed, a woman with a scarred uterus has already experienced childbirth at least once, unless she had a myomectomy.

The scarred uterus was the first indication of CT pelvimetry in the 1991 Basly *et al*. study in Tunisia. Nevertheless, some studies question the scarred uterus as an indication of CT pelvimetry [8] and other authors believe that performing CT pelvimetry on these women increases the rate of caesarean section [9].

The second use of CT pelvimetry was in case of a clinical suspicion of pelvic stricture. It was the first indication according to the study conducted by Ngegue in 2011 at the University Hospital Center of Yaoundé (UHCY) [11]. Opposed to our study, Ngegue *et al*. had a weak workforce and the indications taken into consideration were only those of the women followed at the UHCY. Our sample was larger and heterogeneous. Adjenou *et al*. had found cephalopelvic disproportion as the main remedy [10]. The latter to a lesser extent could be likened to a suspicion of pelvic stricture. Indications found in studies in other countries still revolve around the scarred uterus, the suspicion of pelvic stricture, macrosomia and bridge presentation [10]-[13].

5.2. CT Pelvimetry Practice and Results

The protocol used at the YCH makes it possible to obtain optimal results with a low level of irradiation. The mean Dose Length Product (DLP) obtained is similar to that published by the Institute of Radioprotection and Nuclear Safety in France in an analysis of doses of 9 radiology departments in 2012. They had a larger workforce 471 pelvimetry for an average DLP of 35 mGy.cm [14]. There is no diagnostic reference level established. This is due to the limited number of axial sections and the heterogeneity of the irradiation that makes the usual dosimetric quantities

which are assigned as reference levels in CT inappropriate for pelvimetry [15].

Concerning the type of pelvis, Adjenou *et al*. had found 83% of contracted pelvis amongst their study population, a result similar to that of Basly *et al*. [11] [12] but different from ours. This difference could be explained by the fact that Adjenou's population was small (46 pregnant women) and the classification of the pelvis used by the latter could differ from ours. Indeed, some authors define the borderline pelvis as a moderately contracted pelvis. In addition, Frémondière P *et al*. in France had a predominance of the normal pelvis (44.4%). The borderline and contracted pelvis accounted for 40% and 15.6% respectively of his study population [16].

The mean of the different diameters obtained were slightly lower than that found in the study conducted by Ma'adji *et al*. in 2007 in Nigeria [17]. This difference could be due to anthropometric variations. Ma'adji *et al*. had a population of 100 women at more than 36 gestational weeks. Most had as CT pelvimetry indication a scarred uterus or a bridge presentation.

The bi-parietal diameter, was not systematically measured because the later was evaluated only on women whose fetal head was already engaged and they were few in this situation.

When reported on the Magnin chart was certainly used on the women who had a bi-parietal diameter available as they were all in the vaginal delivery area and all of them gave birth through a vaginal delivery.

The cephalic presentation was the most represented, certainly due to the low level of use of CT pelvimetry for bridge or transverse presentation. Only one woman had a transverse presentation. A version by external maneuvers had been envisaged.

More than half of the women who came for scarred uterus had pelvic anomalies. This may have been a determinant factor in favor of the previous caesarean section and justifies the prescription of the CT pelvimetry in order to be sure it was not due to a contracted pelvis thereby limiting a second risk of dystocia.

5.3. Obstetric Outcomes: Mode of Delivery, Obstetrical Complications and Neonatal Status at Birth

The delivery rate by caesarean section was higher than that obtained by Ngegue *et al*. at UHC of Yaoundé in 2011 who had a caesarean section rate of 36.7%. As compared to our study, Ngegué *et al*. had a low workforce (30 women) and the women were all followed at the UCH of Yaoundé [11]. Abu-Ghazzeh in Saudi Arabia in 2000 had found a caesarean section rate of 51%, but the latter had a study population consisting only of women with a scarred uterus [18]. Therefore, our high cesarean rate could be due to the fact that the women in our study gave birth at different hospital with each having their therapeutic attitude in case of borderline pelvis or contracted pelvis. Indeed, most of them prefer to limit maternal and fetal morbidity and mortality by performing a cesarean section in case of any CT pelvimetry anomaly.

Whenever natural childbirth is found to be grafted with a fetal and/or maternal

risk, to reduce the risk, a caesarean section is performed. The high proportion of women with limited pelvis, where the delivery route is discussed and the fact that all women with contracted pelvis were operated directly, also contributes to this high rate of caesarean section. Indeed, the goal of the obstetrician is to minimize maternal mortality in this at-risk group.

The fact that a high proportion of women with borderline pelvis delivered through a caesarean section could be explained by the fact that many women come for scar uterus and many amongst them had a borderline pelvis. In current practice, the association of a borderline pelvis and a scarred uterus makes it possible to decide on a cesarean delivery immediately. The diagnosis of a borderline pelvis and the increased of the chance for the women concerned to undergo a caesarean section. The probability of giving birth by caesarean section is very high in the case of a contracted pelvis. This association was significant in our analysis and most of the women with contracted pelvis underwent prophylactic caesarean section. This result is similar to those found in the Adjenou *et al*. [10] study. Drouzi *et al*. in their studies of caesarean sections indicated for contracted pelvis had similar results [19]. This is because the contracted pelvis is an absolute indication of caesarean section.

Maternal height less than 1.55 m was predictive of delivery. In fact, the size of less than 1.55 m is recognized in the literature as being a risk factor for pelvic vitiation. That said, women who are in this category are much more likely to have a pelvic anomaly and will have greater chances to give birth by caesarean delivery as compared to women with a normal pelvis.

The rate of complication occurrence was low overall and the most common complication was perineal tear. This result could be due to the high rate of elective caesarean section. The occurrence of complications was less marked among women with contracted pelvis. In addition, there is a higher complication rate in women with normal pelvis. This could also be explained by the fact that women with pelvic anomalies, for the most part, undergo an elective cesarean section. Data from the literature supports a reduction in maternal-fetal morbidity and mortality for scheduled cesareans [20]. The high rate of perineal tears could be due to inadequate practice of delivery which can be verified in another study.

The death rate was relatively low. Ngegue *et al*. also had a low proportion of neonatal deaths. The absence of immediate cry of the newborn at birth, which is an element to assess the neonatal status at birth in the absence of Apgar was absent in most of the deliveries. This result is in agreement with that of Obajimi *et al*. in 2001 in Nigeria [21]. Ngeugue *et al*. had also found a good neonatal adaptation to extra uterine life [11]. The average fetal weight found was similar to that obtained by Ngegue *et al*. [11].

5.4. Predictive Factors for Cesarean Delivery

Maternal height less than 1.5m has been shown to be a predictor of the mode of delivery by cesarean section as the latter is known to be a risk factor for pelvic

abnormality.

6. Conclusions

In conclusion, the practice of CT pelvimetry remains frequent in Cameroun and the increase number of computed tomography machines available requires a better approach to the practice. Clear definitions and guidelines are necessary to rationalize its indications and limit unnecessary irradiation.

Its indications were mainly scarred uterus and clinical suspicions of pelvis stricture. The modalities of practice at the Yaoundé Central Hospital gave a mean PDL within recommendations limits. Borderline and contracted pelvis are strongly predictive of caesarean section, and maternal height <1.55 m is a simple and reliable predictor. Obstetric complications were mainly perineal tears and the neonatal death rate was low. Our study highlights the importance of contextualized guidelines for CT pelvimetry in low-resource settings.

Availability of Data and Materials

The datasets are analyzed and are not publicly available, but are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

We obtained an ethical clearance, solicited from the Institutional Committee of Research Ethics (CIER) of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé I.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

CT	Computed Tomography
YCH	Yaounde Central Hospital
UHC	University Hospital Center
DLP	Dose Length Product
RR	Relative Risk