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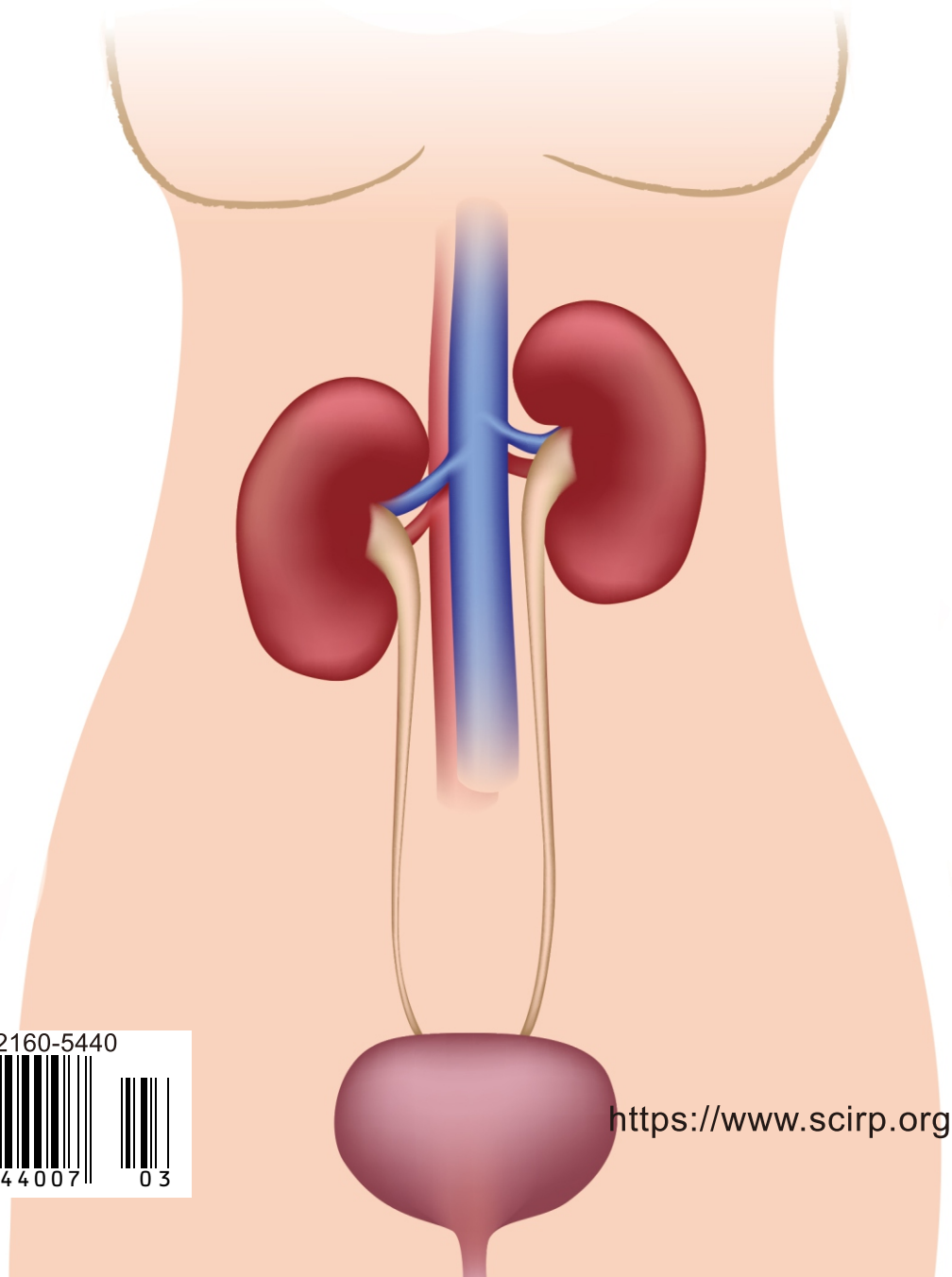

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Comparative Analysis of Kidney Stone Composition in Patients from Ghana and South Africa: Case Study of Kidney Stones from Accra and Cape Town

Evans A. Akpakli[1], Lisa Kaestner[2], John Lazarus[2], Kwame S. Norvixoxo[3]

[1]Department of Surgery, Korle-Bu Teaching Hospital, Accra, Ghana
[2]School of Medicine, University of Cape Town, Cape Town, South Africa
[3]Faculty of Global Challenges, African Leadership University, Kigali, Rwanda
Email: aaevansus25@gmail.com

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Abstract

Background: Kidney stone disease, also termed nephrolithiasis is associated with significant morbidities such as severe colicky flank pain, haematuria, urinary tract infection and kidney failure. Kidney stone disease was perceived as uncommon in developing countries; however, the global prevalence has been rising over the past two decades due to lifestyle changes. There is very limited literature on kidney stone composition in Africa, including Ghana and South Africa. It was based on this evidence that this study was undertaken. **Aim:** The primary aim of this study was to describe and compare the composition of kidney stone in patients receiving treatment at the Korle-Bu Teaching Hospital (KBTH), Accra (Ghana) and Groote Schuur Hospital (GSH), Cape Town (South Africa). **Methods:** The study was a retrospective folder review of patients treated for nephrolithiasis at the Korle-Bu Teaching Hospital in Accra (Ghana) and Groote Schuur Hospital in Cape Town (South Africa). Patients who were treated for kidney stone disease between 1st June 2016 and 31st May 2018 were recruited, and their folder numbers were retrieved from theatre logbooks. A total of hundred and sixty-three (n = 163) folders (n = 30 KBTH; n = 133 GSH) were subsequently retrieved from the two facilities' records department. Demographic data and kidney stone analysis results were analyzed using the *R* statistical software. **Results:** The age of KBTH patients ranged from 24 to 75 years and age of 45 years, while that of GSH ranged 19 to 77 years and median age 48 years respectively. Males were the majority stone formers for both hospitals [56.7% KBTH; 59.4% GSH]. There was no statistical difference in gender ($p = 0.9447$) and age ($p = 0.2612$)

between the two groups. Calcium oxalate (86.7%) and uric acid (90.0%) were the commonest components of the kidney stones analyzed from the KBTH. Calcium oxalate (66.2%) and carbonate apatite (40.6%) were the most common components stones from GSH. Brushite (3.0%), cystine (3.8%) and struvite (19.6%) stones were only found in GSH patients. All kidney stones from the KBTH were mixed stones. Pure kidney stones were only found among the GSH dataset constituting 48.9%, also female patients from GSH formed more mixed stones than their male counterparts (M:F = 40.5%:66.67%) and infection kidney stones were also predominantly found among female patients. **Conclusion:** The findings indicate that the two facilities' participants are not different in terms of gender and age. However, the composition of stones was found to be different between participants from both hospitals. This suggests that kidney stone composition may be influenced by patients' geographical location and or cultural background.

Keywords

Kidney Stones, Comparative Analysis, Korle-Bu, Groote Schuur

1. Introduction

Stone disease of the urinary tract, also termed urolithiasis, is a debilitating, chronic condition, which has affected people (perhaps) since antiquity. It results in great morbidity like severe colicky flank pain; infection and loss of kidney function may occur when the kidney is obstructed by a stone. It may result in loss of working hours and productivity due to repeated patient visits to the emergency unit or urologist, especially during those acute episodes requiring admission and intervention [1].

Kidney stones have been shown to be associated with other chronic diseases like coronary artery disease, hypertension and chronic kidney disease [2]-[7]. This had led to other investigators referring to kidney stone disease as a metabolic disorder beyond the obstructive symptoms caused by these stones.

Kidney stone analysis is essential in assessing stone patients, not only in determining stone composition, but also in providing a guide as to metabolic anomalies that might be involved in stone formation [8] [9]. The knowledge of stone composition is very important in further investigating and treating patients with kidney stone disease due to the high recurrence of this condition [10].

Kidney stone disease was perceived as uncommon in developing countries until recently [11], but they are now a health concern in many developing nations as it is in developed countries. Presently, there is insufficient data in the current literature on the incidence and prevalence of kidney stone disease in Africa and other developing countries [12]. The prevalence of kidney stones has been rising globally over the past two decades due to dietary and lifestyle

changes [11] [13] [14]. Although studies have reported a low incidence of kidney stone disease in people of African descent compared with, for example, Caucasians, there is also the paucity of information regarding kidney stones and stone composition among Africans [15] [16].

Evidently, stone disease incidence varies with race, ethnicity, occupation, geographic location, climate and diet [1]. These factors and variations in cultural practices and diet also affect the chemical composition of kidney stones. For example, people from South-East Asia consume betel leaves, nuts and calcium hydroxide paste which have been associated with hypercalciuria and hypocitraturia. Individuals from Northern India lack intestinal *Oxalobacter formigenes;* hence they are unable to metabolize dietary oxalate which causes absorptive hyperoxaluria [1] [17].

Anecdotal evidence shows that physicians manage numerous cases of upper urinary tract stones in clinics across Africa. However, at present, no published study has compared the stone composition between two different African countries. On premise, this study was conducted to determine the composition of kidney stones in our sample (of patients from Korle-Bu Teaching Hospital and Groote Schuur Hospital) and compare the results of these two countries. The populace in Ghana is mainly of African descent, while South Africa includes people of African, European, Asian ancestry and Coloured people. This multi-race scenario in South Africa also presents an opportunity to understand stone composition beyond just a single race and if possible, identify the significance of stone composition and its impact on the nature of kidney stone disease in Africa.

2. Methods

This retrospective study involved patients' folder review from 1st June 2016 to 31st May 2018 at the Korle-Bu Teaching Hospital (Accra-Ghana) and Groote Schuur Hospital (Cape Town, South Africa). The study is purely a descriptive study of kidney stone composition of patients who were treated for kidney stone disease in the two hospitals over the study period. Patients with kidney stone disease who were treated at the Urology units of Korle-Bu Teaching hospital (KBTH) and Groote Schuur Hospital (GSH) over the study period and had their stones analyzed were included in this study. The study recruited consecutive patients who were treated for stone disease in the two hospitals.

Ethical approval had been sought and approved from the Surgical Divisional research committee of Groote Schuur and the Human Research Ethics Committee (HREC) of both institutions. Patients who had radiological images (X-ray and CT scan) confirmation of kidney stones and were surgically treated, either by minimally invasive (URS, PCNL, Laparoscopy) or open surgery were used for this study. Theatre logbooks between 1st June 2016 and 31st May 2018 were reviewed for folder numbers of patients who had stone surgeries. These were used to source names from HREC approved urology database of the two hospitals and variable data obtained. Stones collected from patients during surgical procedures

were labelled and sent to the laboratory for analysis. Two laboratories (*i.e.* MDS Lancet and Pathcare laboratories) were involved in the analysis of stones for this study. MDS lancet was involved in the analysis of stones from KBTH and Pathcare from GSH. Both laboratories used Fourier transform infrared spectrometer (FT-IR) to analyze the stones. MDS lancet used Thermo Scientific, Nicolet iS10 FT-IR spectrometer and Pathcare used Agilent Technologies, Cary 630 FT-IR spectrometer for stone analysis.

There was not a sufficient study population from which a statistics formula-based sample size calculation could be drawn. Thus, we did not calculate a sample size but used the available folder/data of consecutive patients who were treated for kidney stone disease and had their stones analyzed. A total of thirty (n = 30) and one hundred and thirty-three (n = 133) patient folders were obtained from KBTH and GSH respectively. Data on date of surgery and stone analysis, demography (country of origin, age and gender) and kidney stone composition after analysis were collected using a data sheet. The data was coded and captured into Excel spread sheets and then exported into the statistical package R where it was cleaned and analyzed [18].

Descriptive statistics such as mean, standard deviation, frequencies and percentages were used to summarize the data (e.g. age, gender and country of origin). A student t-test was used to compare differences on age variables between the South African and Ghanaian samples and a p-value of less than 0.05 is considered statistically significant. In cases where the variable count is more than 5%, Chi-Square goodness-of-fit tests of proportions were used to assess for significance (gender variable between KBTH and GSH). The demographic variables, kidney stone type and kidney stone chemical composition as function of demographic indicator was analysed and compared between the Korle-Bu Teaching Hospital and Groote Schuur Hospital.

3. Results

A total of hundred and sixty-three (n = 163) participants (n = 30 KBTH; n = 133 GSH) were recruited for this study. The age of participants at the KBTH ranged from 24 to 75 years with a median age of 45 years, while the ages of participants at the GSH ranged between 19 to 77 years with a median age of 48 years. Males were the majority stone formers for both hospitals [56.7% KBTH; 59.4% GSH] with ratio of M:F = 1.3:1 (KBTH) and M:F = 1.5:1 (GSH). However, there was no significant statistical difference in gender (p = 0.9447) and age (p = 0.2612) between the two groups as shown in **Table 1**.

Most of the kidney stones from the dataset were composed of multiple chemical components.

Calcium apatite was only prevalent among stones of KBTH patients but was not observed in any of GSH patients. Contrarily, Struvite was only recorded among patients treated in GSH while none of KBTH stones contained struvite. With regards to chemical composition of stones, most of the stones from

Table 1. Demographic characteristics of kidney stone patients treated at KBTH (Accra, Ghana) and GSH (Cape Town, South Africa).

	Gender		Age							
			Count	Min.	Quantiles			Max.	Mean	Std. dev.
	Female	Male			25%	50%	75%			
Korle-Bu Counts	13	17	30	24.00	34.00	45.00	53.75	75.00	45.13	14.35
Proportion (%)	43.33	56.67								
Groote Schuur Counts	54	79	133	19.00	38.00	48.00	59.00	77.00	48.44	14.54
Proportion (%)	40.60	59.40								
Chi-Squared p-value: 0.9447			Student t-test p-value: 0.2612							

Korle-Bu patients (90%) contained uric acid, while only a few (about 20%) of the stones from Groote Schuur contained the chemical compound. Calcium oxalate (CaOx) formed 86.67% compared with 66.42% from Korle-Bu patients and Groote Schuur respectively. Carbonate apatite was more common among GSH kidney stones 40.30%, while only 16.67% of stones from KBTH contained Carbonate apatite. There was however, no apparent difference between stones from both hospitals with respect to the other kidney stone composition category (10% and 10.45% for KBTH and GSH respectively). Kidney stones such as Brushite (3.0%), cystine (3.8%) and struvite (19.6%) were only found in the stones of participants receiving treatment at the GSH while no patient from KBTH formed such stones as shown in Table 2 and Table 3.

More than 49% of the kidney stones from GSH patients were made up of only one chemical component (pure stones), none of the stones from Korle-Bu on the other hand were pure stones. The proportion of patients who formed stones made up of 3 chemical components are the same for the two hospitals but one patient from Korle-Bu formed a stone made up of four chemical components (see Figure 1 and Table 4).

The one component stones from GSH, Calcium oxalate was the most common forming 28.57% of the analysed stones. The other pure stones from GSH were uric acid (13.53%), struvite (5.26%) and cystine (1.50%) which was classified among other categories of stones. The majority of the stones examined from Korle-Bu patients were Calcium oxalate & Uric acid combination stones (73.33%), only a small fraction (5.26%) of Groote Schuur patients had this type of stone. Carbonate apatite & uric acid combinations stones (13.33%) were only observed among Korle-Bu patients. On the other hand, calcium oxalate & carbonate apatite (25.56%) and carbonate apatite & struvite (6.77%) component stones were only identified among stones from GSH as shown in Table 4.

Kidney stones were also analysed as a function of demographic indicators (*i.e.* gender and age). In this regard, the age variable was subclassified into two groups of patients (a) 45 or younger (≤45) and (b) older than 45 (>45) at the

Table 2. Chemical components present in kidney stones (number and proportion) in patients treated at KBTH and GSH.

		Kidney Stone Chemical Component									
		Ammonium urate	Brushite	Calcium apatite	Calcium oxalate	Carbonate Apatite	Cystine	Sodium urate monohydrate	Struvite	Uric acid	Unknown matrix
Korle-Bu	Count	1	0	**3**	**26**	**5**	0	1	**0**	**27**	1
	Proportion (%)	3.33	0.00	**10.00**	**86.67**	**16.67**	0.00	3.33	**0.00**	**90.00**	3.33
Groote Schuur	Count	5	4	**0**	**88**	**54**	5	0	**26**	**27**	0
	Proportion (%)	3.76	3.01	**0.00**	**66.17**	**40.60**	3.76	0.00	**19.55**	**20.30**	0.00

Table 3. Compressed kidney stone chemical composition: summary of patients treated at Korle-Bu and Groote Schuur Hospital.

		Kidney Stone Chemical Compound Constituent					
		Calcium Apatite	Calcium Oxalate	Carbonate Apatite	Struvite	Uric Acid	Other*
Korle-Bu	Count	3	26	5	0	27	3
	Proportion (%)	10.00	86.67	16.67	0.00	90.00	10.00
Groote Schuur	Count	0	88	54	26	27	14
	Proportion (%)	0.00	66.17	40.60	19.55	20.30	10.53

*Other: Ammonium urate, Brushite, Cystine, Sodium urate monohydrate and Unknown matrix. NB: This table is similar to Table 2, except for the new class named "Other".

time of examination (Table 5). Regarding demographic characteristics, females tend to have more multi-component (mixed stones) as evident in the three-component class among both Korle-Bu and GSH patients. While all the male stone formers from Korle-Bu had two components stones, more than 23% of the female stone formers had stones containing at least three chemical components and the only four-component stone observed was formed by a female from KBTH. Also, 60.8% of the male stone formers from Groote Schuur formed one component (pure) stones. However, more than 66% of the female stone formers from the same hospital formed stones composed of at least two chemical components (Figure 1).

All Calcium apatite stones, as well as the *Other* stone category, among Korle-Bu patients are from the females. The *Other* stone category is also evidently common among female patients at Groote Schuur. Carbonate apatite was absent in all the stones from younger patients of Korle-Bu. However, almost half 48.39% of stones from younger patients at Groote Schuur had kidney stones containing a carbonate apatite component. The prevalence of carbonate apatite kidney stones was similar for older patients (>45 years) at both hospitals.

Table 4. Classification of kidney stone as observed among patients treated at KBTH and GSH.

Chemical Combinations	Stone	Korle-Bu	Groote Schuur
		(n = 30)	(n = 133)
Calcium oxalate	Count	**0**	**38**
	Proportion (%)	**0.00**	**28.57**
Struvite	Count	**0**	**7**
	Proportion (%)	**0.00**	**5.26**
Uric acid	Count	**0**	**18**
	Proportion (%)	**0.00**	**13.53**
Other*	Count	0	2
	Proportion (%)	0.00	1.50
Calcium oxalate & Carbonate apatite	Count	**0**	**34**
	Proportion (%)	**0.00**	**25.56**
Calcium oxalate & Uric acid	Count	**22**	**7**
	Proportion (%)	**73.33**	**5.26**
Calcium oxalate & Other*	Count	1	3
	Proportion (%)	3.33	2.26
Carbonate apatite & Struvite	Count	**0**	**9**
	Proportion (%)	**0.00**	**6.77**
Carbonate apatite & Uric acid	Count	**4**	**0**
	Proportion (%)	**13.33**	**0.00**
Carbonate apatite & Other*	Count	0	3
	Proportion (%)	0.00	2.26
Struvite & Other*	Count	0	4
	Proportion (%)	0.00	3.01
Calcium apatite & Calcium oxalate & Uric acid	Count	1	0
	Proportion (%)	3.33	0.00
Calcium apatite & Calcium oxalate & Other*	Count	1	0
	Proportion (%)	3.33	0.00
Calcium oxalate & Carbonate apatite & Struvite	Count	0	4
	Proportion (%)	0.00	3.01
Calcium oxalate & Carbonate apatite & Uric acid	Count	0	2
	Proportion (%)	0.00	1.50
Carbonate apatite & Struvite & Other*	Count	0	2
	Proportion (%)	0.00	1.50
Calcium apatite & Calcium oxalate & Carbonate apatite & Other*	Count	1	0
	Proportion (%)	3.33	0.00

*Other: Ammonium urate, Brushite, Cystine, Sodium urate monohydrate and Unknown matrix.

Table 5. Number of chemical components per kidney stone of patients treated at KBTH and GSH as a function of age and gender.

				Renal Stone Constituent Chemical Count			
				1	**2**	**3**	**4**
Korle-Bu	**Age (year)**	**≤45**	Count	0	15	1	0
		n = 16	Proportion (%)	0.00	93.75	6.25	0.00
		>45	Count	0	12	1	1
		n = 14	Proportion (%)	0.00	85.71	7.14	7.14
	Gender	**Female**	Count	0	10	**2**	1
			Proportion (%)	0.00	76.92	**15.38**	7.69
		Male	Count	0	17	**0**	0
			Proportion (%)	0.00	100.00	**0.00**	0.00
Groote Schuur	**Age (year)**	**≤45**	Count	22	36	3	0
		n = 61	Proportion (%)	36.07	59.02	4.92	0.00
		>45	Count	43	24	5	0
		n = 72	Proportion (%)	59.72	33.33	6.94	0.00
	Gender	**Female**	Count	18	29	**7**	0
			Proportion (%)	33.33	53.70	**12.96**	0.00
		Male	Count	47	31	**1**	0
			Proportion (%)	59.49	39.24	**1.27**	0.00

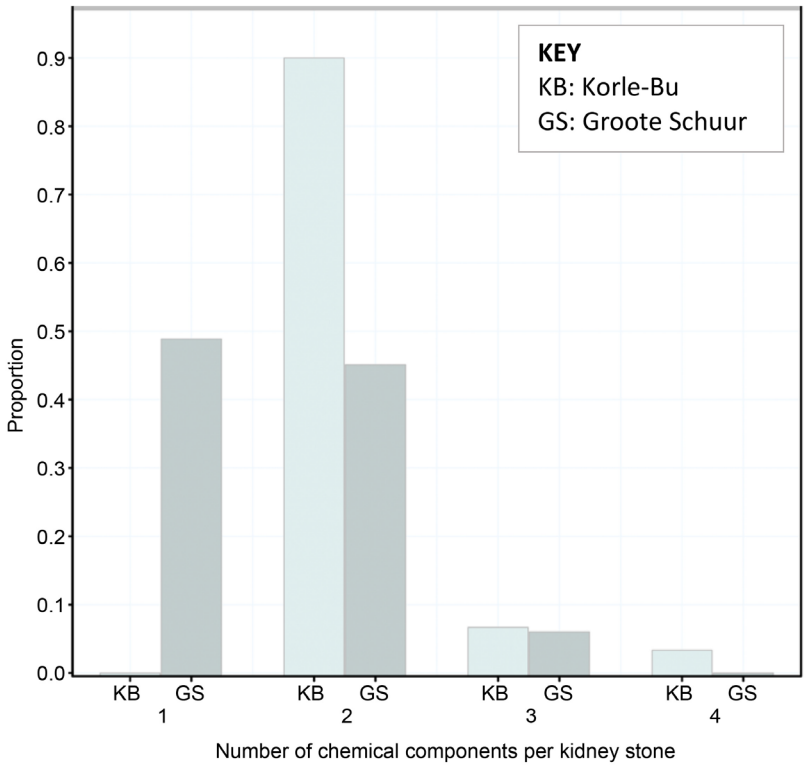

Figure 1. Number of chemical components per kidney stone as a function of the geographic location of patients.

The participants were diagnosed with kidney stone with abdominopelvic CT scan or X-ray. Blood investigations (full blood count, blood urea, electrolytes and creatinine) and urine studies (urinalysis, culture and sensitivity) were done. Those with evidence of urinary tract infection (UTI) were treated to render the urine sterile before stone extraction. The patients were counselled and consented for surgical stone extraction (retrograde ureterorenoscopy, PCNL, laparoscopy and open surgery). All the participants received prophylactic intravenous antibiotics preoperatively after induction of anaesthesia. Postoperatively the patients were reviewed at 2 weeks, 6 weeks and 12 weeks post-discharge. At first review, abdominopelvic CT scan or X-rays were done to assess for stone clearance. Those found with residual fragments were then scheduled for a second procedure to achieve clearance (stone clearance rate and complications data were not captured, because that did not fall within the scope of this study). To avoid kidney stone recurrence, the patients were offered diet sheet counselling on low-risk stone regimen and liberal oral fluid intake.

4. Discussion

Our study demonstrated that the male to female ratio from KBTH was 1.3:1 and that of GSH 1.5:1. This study shows a higher prevalence of kidney stone disease in males than females in both hospitals. However, there is no gender diversity among patients treated for urolithiasis in both hospitals. Various epidemiological studies showed male preponderance [14] [19] [20] which is also confirmed by this study as per the gender characteristics. Some studies have, however, reported a higher M:F ratio: 3.5:1 in Nigeria [11], 2.7:1 in Japan [21] and 3.8:1 in Kenya [22]. In this study, the low male-female ratio is not surprising: Scales *et al.* [23], in the United States, using in-patient discharges for kidney stone disease from 1997 to 2002 in their study, observed a dramatic rise in female discharges. This demonstrated an increase in the incidence of kidney stone disease in females and therefore, a change in the prevalence of kidney stone disease among men and women from a ratio of 1.7:1 to 1.3:1. This change was attributed to lifestyle changes associated with risk factors such as obesity which is increasing globally due to dietary and behavioural changes [24].

The median age of patients from the Korle-Bu was 45 years (range 24 to 75) and 48 years (range 19 to 77) for GSH patients respectively. The age distribution for both hospitals was similar, according to the student t-test ($p = 0.2612$) (**Table 1**). Kidney stone disease can affect all age groups from as young as 6 months to older than 90 years, as Alaya *et al.* [25] observed in their retrospective study in Tunisia. Even though kidney stone disease affects patients of all age groups, it is evident from epidemiological studies that the peak incidence for this condition occurs between the ages of 20 and 60 years, the most productive age bracket [20], [26] [27] [28]. In this study, the median age of patients is in the 4th decade, with mean ages of 45.13 (±14.35 SD) and 48.44 (±14.54 SD) for KBTH and GSH respectively. Studies of kidney stone disease in other African countries observed

mean ages of 45 years in Nigeria [11], and 43.5 years in Kenya [22] suggesting a similar age distribution of kidney stone patients in other African countries considered in this study.

Calcium oxalate (CaOx) is the most prevalent component of all kidney stones from both hospitals. This is not unexpected as calcium oxalate has been found to be the most predominant component, forming 60% to 80%, of all kidney stones globally [29] [30] [31]. In an Iceland study conducted by Edvardsson *et al.* [32], they examined recent trends in the incidence of kidney stone disease in adults over 24 years: 81% of stones in the study population were CaOx. Ansari *et al.* [33], reported pure calcium oxalate stones in 93% of their cohort, of which 80% were comprised of Calcium oxalate monohydrate (COM) and 20% Calcium oxalate dihydrate (COD). The high prevalence of CaOx component of stones in our study is in keeping with a predominance of CaOx stones globally.

Uric acid (UA) kidney stones account for about 5% to 10% of all urinary tract stones. However, the incidence varies globally ranging from 5% to 40% depending on the geographic location [34]. It is startling that uric acid was found in 90% of all kidney stones from Korle-Bu. This result should, however, be interpreted with caution due to the small sample size from Korle-Bu. Uric acid stone formation is attributable to low urinary pH (pH < 5.5), low urine volume and hyperuricosuria which may be associated with metabolic defect or increased ingestion of purine diet. Korle-Bu Hospital (Ghana) is located in the tropics with high daily temperatures and humidity. These conditions obviously will induce profuse sweating with ensuing dehydration and low urine volumes in the absence of adequate fluid intake. These hot and humid weather conditions in tropical countries favour UA stone formation as described by some researchers [27] [34]. The mechanism by which UA and CaOx mixed stones are formed is not absolutely clear; however, the effect of UA on CaOx stone formation is due to UA reducing the solubility of CaOx in urine; a process referred to as salting-out [34] [35]. A study from Nigeria (a country with similar climatic condition to Ghana) did not identify UA stone among their sample [11]. This might be because Ekeke *et al* used a qualitative chemical analysis approach to determine stone composition instead of FT-IR spectroscopy. Qualitative chemical analysis of kidney stone has been shown to be beset with many errors in the determining kidney stone composition. Although the proportion of UA stones in the GSH dataset is 20.2%, it evident from (**Table 4**) that two-thirds of these stones (13.4%) were of pure uric acid. Pure UA stones are often formed in urine with persistently low pH (pH < 5.5) which is the significant risk factor for their formation even in the presence of normouricosuria. Pure UA kidney stones are strongly associated with metabolic conditions such as prediabetes, type 2 diabetes and obesity [36] [37]. These individuals have renal tubular insulin resistance and a defect in renal tubular ammonia genesis from glutamine with reduced excretion of ammonium to buffer hydrogen ions. Some researchers such as Torricelli *et al.* [38], have demonstrated that UA stone formers excrete urine with higher sodium content, lower calcium and lower oxalate contents than

CaOx stone formers. The GSH cohort of patients who formed pure UA stones might have conditions associated with persistent acidic urine production, or excrete urine with higher sodium, lower calcium and lower oxalate content.

From Table 2, cystine kidney stones constituted about 3.76% of stones from the GSH sample; of these, 2 patients formed 100% cystine stones. None of the stones analyzed from Korle-Bu contained cystine. Cystine stones are relatively rare, constituting about 1% to 2% of all kidney stones [39] [40]. Cystine stones are associated with cystinuria; they are usually an autosomal recessive hereditary disorder but sometimes heterozygous gene carriers may be autosomal dominant. The rarity of this condition and the small study population from Korle-Bu, might explain the lack of cystine stones in the KBTH cohort. In Nigeria, another West African country, of the eighty-nine stones analyzed in the study by Ekeke *et al.* (2018) none were cystine stones. It is plausible that this type of stone might not be found among West African patients. In a kidney stone composition study involving over 1000 stones from northern India, none of the analyzed stones were cystine [33]. This also confirms the rarity of cystine stones. Patients with cystinuria are often predisposed to the development of high blood pressure and chronic kidney disease (CKD); hence these patients should be screened for these diseases and treated accordingly.

As per Table 2, brushite stones were only found among the GSH dataset and constituted 3.01% of all analyzed stones, but none of the stones from Korle-Bu were brushite. Calcium phosphate stones exist in three forms: Hydroxyapatite, Brushite and Carbonate apatite. Approximately 15% of all kidney stones are calcium phosphate, of which a quarter are brushite stones. Brushite stones are usually the precursor to the formation of Calcium phosphate stones. In the absence of the conversion of Brushite to Hydroxyapatite, brushite stones are formed [41] [42]. The most important risk factors associated with brushite stone formation are hypercalciuria, elevated urine pH and higher urine supersaturation with calcium phosphate [41] [42]. Brushite stone formation has been strongly linked to the use of Extracorporeal shock wave lithotripsy (ESWL) to treat kidney stone disease [41]. ESWL is common in Cape Town and widely used as a treatment modality for small kidney stones. In Accra, this treatment option is limited or nonexistent. We are unable to tell whether this might explain the zero brushite stones among patients from Korle-Bu. Another likely explanation for the lack of brushite stones is that at the very extremes of urine pH (*i.e.* pH < 4 or >8) brushite can spontaneously be converted to Hydroxyapatite stone. Since Hydroxyapatite stones existed among the Korle-Bu dataset, it is possible that conditions (urine pH) might have favoured the conversion of brushite to Hydroxyapatite in the patients from Korle-Bu. Brushite stone formers have a higher risk of developing CKD than CaOx patients with prolonged follow up [43]. Therefore, brushite stone formers should be monitored closely for CKD to avert progression to end-stage renal disease (ESRD).

Urate kidney stone (ammonium urate and sodium urate monohydrate) components were only found among Korle-Bu patients. These stones are usually en-

demic bladder stones. Beukes *et al.* [44], reported a higher prevalence of urate kidney stones among patients of African descent in their study (from South Africa). On the contrary and quite remarkably, our study did not observe any urate component stones among GSH patients.

Struvite, also known as magnesium ammonium phosphate stones, were only found among the stones from GSH constituting 19.55% of all analyzed stone samples. Globally, struvite stones constitute 10% to 15% of all renal stones. The hallmark of these stones is recurrent urinary tract infections associated with urea splitting organisms. Patients with conditions which predispose them to urinary stasis (urinary tract obstruction, calyceal diverticulum and neurogenic bladder), urinary diversion procedures (continent urinary diversion or ileal conduit), neurologic disorders (spinal injury or pathology), prolonged indwelling urethral catheter and foreign bodies, are prone to developing recurrent UTI and therefore form struvite stones [45]. Over the past decades, the incidence of struvite stones has been observed to be on the decline in developed countries [46]. This had been attributed to the use of effective antibiotics in the treatment of UTIs. Of the 228 renal stones analyzed from the Iceland study, only one of the stones was struvite [32]. Durgawale *et al.* (2010), however, reported a very high incidence of struvite stones in their series, of which 71.2% of the analyzed stones contained struvite. This is not surprising since they included stones of the lower urinary tract in their work; stones of the lower urinary tract are often associated with infection. Astoundingly, none of the renal stones analyzed from Korle-Bu were struvite, this might be due to the unregulated antibiotic usage in Ghana this might have kept the urine of stone-predisposed patients from Korle-Bu sterile, hence preventing recurrent UTIs and struvite stone formation. Stone patients from Korle-Bu do not have indwelling double J (DJ) stent for prolonged periods before surgery as in GSH patients. This could also be the reason for the lack of struvite stones from Korle-Bu. Intriguingly, Ansari *et al.* (2005) reported 180 (20%) of 1050 observed stones as staghorn calculi in their study of stone composition in northern India. 90% of these staghorn stones were of oxalate composition (COM and COD) while only 4% were composed of struvite. This contravenes the evidence that majority of staghorn kidney stones are of struvite composition.

Carbonate apatite stones constitute about 40.60% of stones from GSH while in Korle-Bu only 16.67% of the stone were of carbonate apatite. This is not surprising as carbonate apatite stones are formed as an extension of the cascade of events that lead to struvite stones formation. The majority of carbonate apatite stones are formed in patients with recurrent UTI and persistently high urine pH. Phosphate is insoluble at high urine pH, and under such conditions, it easily precipitates out and combines with calcium and carbonate to form carbonate apatite stones. By extension, carbonate apatite stones are considered infection stones and are often associated with struvite stones.

From **Figure 1**, stones analyzed from Korle-Bu were heterogeneous or mixed stones made up of at least two or more components. It is therefore not surpris-

ing that the only 4 component stone came from Korle-Bu. Of the stones from GSH, 48.87% of the kidney stones were pure stones, and of the mixed stones, the majority of them were of two components (45.11%). The presence of only mixed kidney stones from Korle-Bu may probably be associated with ethnicity, dietary habits and or climatic conditions prevailing in Ghana. The pure stones in the GSH suggest a possible associated metabolic abnormality in patients who formed such stones.

As illustrated in **Table 4**, none of the kidney stones analyzed from the two hospitals were of pure carbonate apatite. This is not extraordinary as carbonate apatite seldomly forms pure stones. A carbonated apatite mixed CaOx stone is often associated with hypercalciuria and relatively alkaline urine in most cases. It may, however, also be related to conditions such as medullary sponge kidney or hyperparathyroidism [9] [47]. Thus, individuals who present with such stones should be screened to exclude the aforementioned disease entities. Carbonate apatite stones formed in combination with struvite are often associated with urea splitting organisms; nonetheless, in the absence of struvite, non-urease producing organisms such as *Escherichia coli* are usually the causative organism.

Table 5 shows a noticeable difference between gender and stone composition *(i.e.* pure or mixed). Although all males from the Korle-Bu formed mixed stones made up of two chemical components, females from both hospitals were predisposed to forming mixed stones with complex heterogeneity (two or more component). Struvite stones were only found among the GSH patients and also showed a high prevalence among females as illustrated in **Figure 2**. This is not unexpected as females are more prone to developing UTI compared with males and hence are more likely to form infection stones [45] [48] [49]. According to Jayaraman *et al.* (2018), globally, the female to male ratio for struvite stone formers is 2:1. Our study contrarily revealed a much higher ratio of 3.3:1 (F:M) among GSH patients than that observed globally. Notwithstanding this difference of no struvite stones in Korle-Bu cohort of patients, this study also confirmed the predominance of struvite stones in female stone formers. Carbonate apatite stones from this study were predominantly found in female stone formers in both hospitals. Other authors have also reported a greater prevalence of carbonate apatite kidney stones in females than men [49] [50].

The category of stones labelled as *Other* were mostly stones formed by females from both hospitals. A study from Mayor Clinic Metal Laboratory in the USA reported that over 43,500 of the kidney stones analyzed showed gender variations in stone composition. Females were found to form more apatite (calcium phosphate) and struvite stones while men were prone to forming CaOx and UA stones [51]. In the same study, Lieske *et al.* (2014), also observed that females, particularly younger than 40 years, predominantly formed apatite kidney stones. Our study also confirmed that apatite stones were largely found among female stone formers as illustrated in **Figure 2**. On the contrary, Wathigo *et al.* (2017) in Kenya and Ansari *et al.* (2005) in India did not observe any gender disparity of stone composition in their studies.

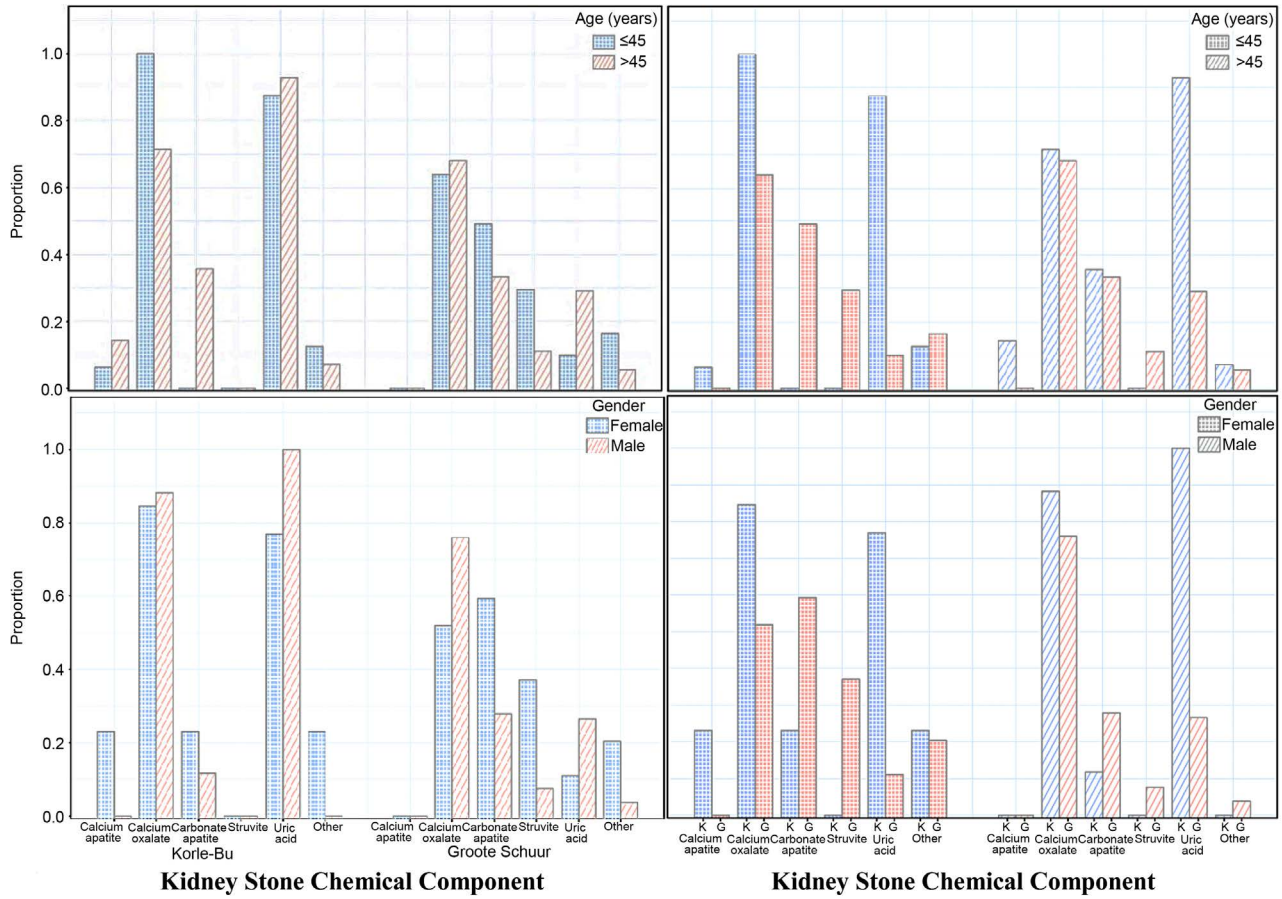

Figure 2. Prevalence of chemical component in the kidney stone of patients treated in KBTH(K) and GSH(G) as a function of Age and Gender.

There is evidence that the incidence of kidney stone disease increases with increasing age and also varies with age stratification as observed in some epidemiological studies [24]. Although, our study stratified age of patients into ≤45 years and >45 years, we did not study the incidence of stone disease in these age groups. On the whole, the analysis of kidney stone composition among our cohort of patients did not vary between the age groups provided the patients came from the same geographic location. The observation of no difference in stone composition regardless of age has also been reported by other researchers in other countries where kidney stone compositional studies have been conducted [22] [33] [51].

A study conducted in the late 1980s by Beukes *et al.* [44], on composition and racial distribution of kidney stones from Bloemfontein, South Africa, observed the predominance of CaOx stones among the racial groups studied. This observation is confirmed by this current study that CaOx stones are the most common stone type as seen among patients from Ghana (mainly African descent) and South Africa (mixed race) although race was not directly a subject matter in our study. Beukes *et al.* (1987), observed a higher proportion of struvite and ammonium urate stones (infection stones) among the patients of African des-

cent in their patient population at the time. Contrary to their observation none of the patients from Ghana had struvite stones. We are unable to confirm in this study whether the infection stones among the South African cohort were more common in a particular race as race stratification was not considered in the study.

The limitation of this study was that: the study did not consider the metabolic abnormalities or the 24-hour urine studies, which are associated with stone formation. If it did, such consideration may have given insight as to why certain stones where formed. This was not an objective of this study but can however be the focus of future studies into comparative analysis of stone composition among different African countries. Furthermore, urinalysis and urine culture were not included in this study though they also affect stone formation and can also be used to assess treatment and follow up on patients with regards to urine pH and specific gravity.

Lastly, the study used results of stone analysis of patients who were treated in the two hospitals only. Though other institutions also treat patients with stone disease such patients have not been accounted for in this study. Hence the data used for the study might not be as representative of the entire population in Ghana and South Africa. Due to the small data size from Korle-Bu we were unable to stratify age into groups (decades) to determine the incidence of kidney stone disease among different age groups. Notwithstanding the aforementioned limitations, this study set the platform for future collaborative studies between hospitals and laboratories in Africa to determine the incidence of urolithiasis in Ghana and South Africa (and other countries on the continent) on a much broader scale.

5. Conclusion

The analyses discussed in this study are based on samples from KBTH and GSH. Both hospitals are open to the public and offer a variety of services to their patients. The study shows a similar gender distribution of kidney stone patients who were treated in Korle-Bu and GSH. There is also no significant difference in age distribution of patients treated for stone disease in both hospitals. Majority of the kidney stones from both countries were made up of CaOx stones; however, the stones from the Ghanaian cohort were mixed stones of which majority were an admixed calcium oxalate/uric acid composition. Pure kidney stones such as calcium oxalate, uric acid, struvite and cystine were only present among the South African patients. Although some patients from Ghana formed carbonate apatite stones, most stones with this component in this study were predominantly formed by South African patients. Certain kidney stone types, especially brushite, cystine and struvite were only found among the South African population. In contrast, calcium apatite and ammonium urate components stone were found in kidney stones from Ghanaian patients. Female patients predominantly formed carbonate apatite and stones with multiple components (mixed stones)

from both countries. Notwithstanding the small data especially from Ghana, it is noteworthy to infer from this study that kidney stone composition in Ghana is different from South Africa. Therefore, the composition of kidney stone is recognizably dependent on the demographic region from which the patient originates.

Authors' Contributions

EAA and JL conceived and formulated this study. All authors made significant inputs in drafting the manuscript, in terms of literature search, data analysis and interpretations, and the paper's final preparation for submission. All authors read and approved the final paper.

Availability of Data and Materials

The data supporting the conclusions of this manuscript is available in Figshare repository (https://figshare.com/articles/dataset/Data_for_Paper_Comparative_Analysis_of_kidney_stone_composition_among_patients_from_Ghana_and_South_Africa_/13519787).

Ethics Approval

Ethical approval was sought and granted by the human research committee of the faculty of health sciences, UCT (HREC REF:601/2018) and the Korle-Bu Teaching Hospital institutional review Board, Korle-Bu, Accra (KBTH-IRB/00002/2019).

Conflicts of Interest

All the authors declare no conflict of interest.

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Complete Cervico-Uretral Transections: A Vesicovaginal Fistula Not Like the Other

Dramane Cisse[1*], Abdoulaye Traore[2], Honoré Jean Gabriel Berthe[2], Mory Kone[1], Modibo Coulibaly[1], Diamilatou Thiam[3], Djibril Traoré[1], Bréhima Traoré[1], Mamadou Tidiani Coulibaly[2], Alkadri Diarra[2], Amadou Kassogue[3], Moussa Salifou Diallo[3], Oumar Guindo[3]

[1]Hôpital Sominé DOLO de Mopti, Mopti, Mali
[2]Université des Sciences des Techniques et des Technologies de Bamako (USTTB), Bamako, Mali
[3]Direction Régionale de la Santé de Mopti, Mopti, Mali
Email: *djennecisse@yahoo.fr, ngoaabdoulaye@yahoo.fr, berthonore@hotmail.com konemory@gmail.com, modibocoulibaly@yahoo.com, dralkadri@yahoo.fr, mamadoutc@yahoo.fr, mousalifon@gmail.com, barugdo@yahoo.fr

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Abstract

Introduction: Complete cervico-urethral transection is a vesicovaginal fistula characterized by total disinsertion of the urethra from the bladder. It is a fistula of the cervico-urethral intersection threatening the mechanism of continence. The aim of this study was to describe the epidemiological and therapeutic aspects of this type of fistula. **Patients and Methods:** This was a descriptive retrospective study on patients who have had surgery for cervico-urethral transection from June 01, 2012 to June 01, 2015. **Results:** Cervico-urethral transections (n = 76) accounted for 33.77% of all urogenital fistulas admitted to our department of surgery during the study period. The average age was 25.02 ± 8, 6 years. Married patients accounted for 85.58%, 72.36% had not received any classical education. Fistulas less than one year old made up 56.58% of cases, associated lesions were perineal tears 25.0%, vaginal sclerosis, 21.05%, vaginal straps, 13.15%, rectovaginal fistula, 2.63% and the shortness of the urethra less than 2.5 cm in 42.10% of cases. All surgeries were performed vaginally with a 98.68% fistula closure rate and an average of 1.68 surgeries per patient. After closure of the fistula, 10.67% of patients presented a residual urinary incontinence. **Conclusion:** Complete cervico-urethral transection is a frequent vesicovaginal fistula. She sometimes exposes to urinary incontinence after closing the fistula. The results of his surgery are often good at the cost of multiple intervention.

Keywords

Vesicovaginal Fistula, Cervico-Urethral Transection, Urinary Incontinence,

Urethra, Bladder

1. Background

Vesicovaginal fistula is an abnormal communication between the bladder and the vagina. It is an ancient pathology known since antiquity. In the Ebers papyrus, 2000BC, it is written "if a woman has urine constantly flowing, she will lose it all her life"; in addition, a vesicovaginal fistula and a perineal tear were found on the mummy of Henhenit dated 2050BC [1] [2]. It usually occurs after difficult and prolonged labor [3]. Once ubiquitous pathology, it has seen its incidence reduced to almost disappear in developed countries due to industrialization, the rise in living standards and progress in monitoring pregnancies and childbirth. However, it remains a public health problem in developing countries due to the weakness of the health system [4] [5] which must be added the low standard of living, illiteracy and harmful practices for women's health such as early marriages, early pregnancies and female genitalia mutilation. The prevalence of vesicovaginal fistula is not known, the WHO estimates that between 2 to 3 million women live with the fistula, the majority of which are in Africa [5] [6] and that the pathology has an annual incidence from 50,000 to 100,000 patients [6].

Several classifications of the pathology have been proposed without real consensus; however the majority of authors agree on the anatomical description of the lesions. Described as a severe vesicovaginal fistula by some authors [7] and complex by others [8] [9] [10], complete cervico-urethral transection is a total disinsertion of the urethra from the bladder. Its real particularity is linked to the fact that it concerns the urethro-cervical crossroads where the striated sphincters involved in the mechanism of voluntary continence, well individualized in the anatomical charts, are not apparent during the surgery. The destruction of the upper lip of the cervix sometimes goes so far back into the pelvis. In this case a dual approach, first, vaginal and pelvic, is necessary to reconstitute the neo-cervix to be anastomosed with the urethra. Sometimes the urethra amputated by the pathological process, even anastomosis to a cervix, does not allow continence because of its brevity. According to these difficulties, it is difficult to predict the outcome of the surgery.

The reestablishment of ureterovesical continuity associated with perfect continence is the expected result. Closure of the fistula, but accompanied by urinary incontinence of different severity, is qualified as a partial outcome to be improved by iterative interventions. This partial result is sometimes difficult to admit, especially in cases where urinary incontinence is total because the symptoms before and after the surgery remain the same. There may sometimes be residual lateralized fistulas in contact with the ischio-pubic and sub-symphyseal branches of difficult treatment. The objective of this study was to describe the epidemiological and therapeutic aspects of these fistulas in the surgical depart-

ment of the regional hospital called HôpitalSominé DOLO deMopti, Mali.

2. Patients and Methods

This was a descriptive retrospective study of patients who have had surgery for cervico-urethral transection between June 01, 2012 and June 01, 2015. Were included any patient operated on for vesico-vaginal fistula during the study period whose intraoperative diagnosis was a complete cervico-urethral transection. Vesico-vaginal fistulas with total destruction of the urethra which are part of another type and for which the treatment is different were not retained by our study. The patients were operated on in routine surgery and in mini campaign which drained a large crowd. The diagnoses were set during outpatient medical consultation and confirmed in the operating room under anesthesia. All of the surgeries were performed vaginally.

For the surgical technique, two situations were present:

A cervico-urethral transection with minimal cervical opening, it was about:

- release after incision of the vaginal mucosa, all around the neck of the bladder by low route;
- perform minimal dissection of the proximal urethra;
- perform a cervico-urethral anastomosis around a Foley CH 16 catheter at six threading points in total in 3/0 polyglycolic acid;
- check the tightness of the suture with a methylene blue test before inflating the balloon of the Foley catheter with 5 ml of physiological saline solution;
- perform the suture of the vaginal plane. The different times are illustrated in Figure 1.

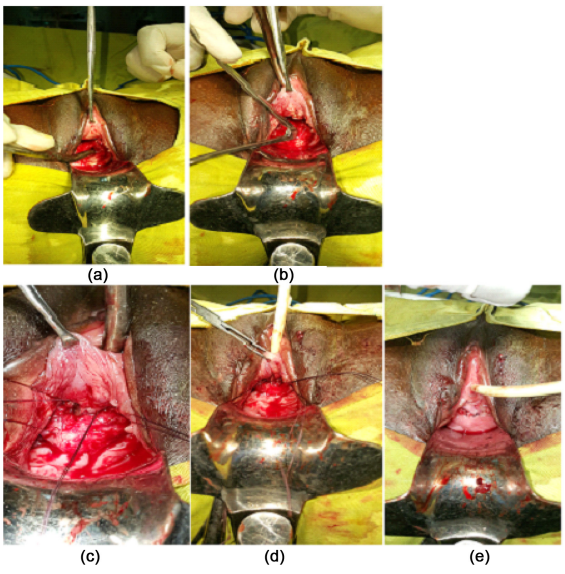

Figure 1. Cervico-urethral transection with minimal cervical opening. (a) Cervical release; (b) Urethral dissection; (c) Cervico-urethral anastomosis of the upper lip; (d) Cervico-urethral anastomosis of the lower lip; (e) Vaginal closure.

A large transection with sometimes prolapse of the bladder mucosa, we proceeded by:

- Find and probe the ureters, the ureteral meatus often located on the edges of the fistula, sometimes after good hydration or an intravenous injection of 20 mg of furosemide;
- Incision and dissection of the entire circumference of the bladder, the delicate parts being located near the uterine neck and in the sub-symphyseal region where the upper lip of the bladder can rise very high in the pelvis;
- Remodeling of the bladder with preparation of a neocervix;
- Minimal dissection of the proximal urethra;
- End-to-end cervico-urethral anastomosis with 6 points in total of 3/0 polyglycolic acid thread around a Ch 16 Foley catherter;
- Check the tightness of the suture by a test with methylene blue before inflating the balloon of the Foley catheter with 5 ml of physiological serum;
- Suture the vaginal plane. The different steps are illustrated in Figure 2.

Early mobilization, daily vaginal toileting and daily oral hydration constituted the essential cares during postoperative time. The urethrovaginal catheters were removed 21 days after surgery. A survey sheet was drawn up and included the following data: age, marital status, level of education, concept of excision, circumstances of occurrence, mode of delivery, characteristic of fistula, age of fistula, associated lesions, surgical treatment, treatment results. The expected results were:

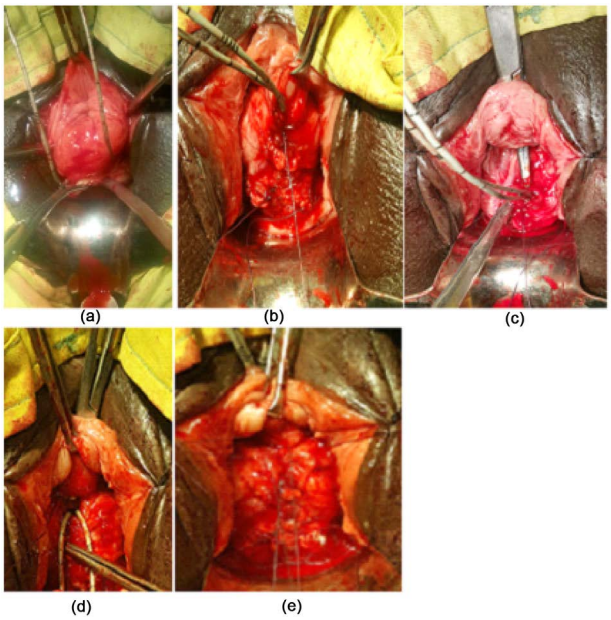

Figure 2. Large transection with prolapse of the bladder mucosa. (a) Catheterization of the ureters and dissection of the edges of the bladder; (b) Bladder suture with preparation of a neo-bladder neck; (c) Urethral exposure; (d) Cervico-urethral anastomosis of the upper lip; (e) Cervico-urethral anastomosis of the lower lip.

- Healing, the fistula is closed and continence is total;
- Improvement, the fistula is closed but there is persistent urine leakage through the urethral meatus;
- Treatment failure, there is still a fistula after surgery.

The data collected was analyzed using the epi Info 2005 software version 3.3.2.

3. Results

3.1. Epidemiological Aspects

Urogenital fistulas (n = 225) accounted for 4.73% of surgical interventions (n = 4752). Complete cervico-urethral transections (n = 76) accounted for 33.77% of these urogenital fistulas which were our study subjects. The mean age of the patients was 25.02 ± 8, 6 years with ranges of 14 years and 65 years. Patients under the age of 18 accounted for 19.74% (n = 15). Patients from the area covered by our hospital accounted for 59.21% (n = 45) of our subjects. Patients married and living with their husbands accounted for 81.58% (n = 62). The level of education was primary in 25% (n = 19) of patients. Type II excision was performed in 48.68% (n = 37) of patients. The minimum duration of postoperative follow-up was eight months. The socio-demographic data are highlighted in Table 1.

Table 1. Sociodemographic data of our subjects.

Variable		Frequency	%
Age groups	under 18 years	15	19.74
	18 - 41 years	53	69.74
	42 - 65 years	8	10,52
	Total	**76**	**100**
Origins	Mopti region	45	59.21
	Other regions	26	34.21
	Ivory Coast	4	5.26
	Burkina Faso	1	1.32
	Total	**76**	**100**
Marital status	Married	62	81.58
	Single	7	9.21
	Divorced	4	5.26
	Widow	3	3.95
	Total	**76**	**100**
Educational level	Koranic	38	50.00
	primary	19	25.00
	secondary	1	1.32
	literacy	1	1.32
	None	17	22.36
	Total	**76**	**100**
Excision	Noexcision	39	51.32
	Type 2	37	48.68
	Total	**76**	**100**

The fistula was obstetric in 98.68% (n = 75) of the cases and traumatic in 1.32% (n = 1) of the cases. During pregnancy, 64.31% (n = 46) of patients had no prenatal visits. About 62.67% (n = 47) of the patients had given birth at home with a labor duration greater than or equal to 3 days in 60% (n = 45) of the cases. The risk factors for fistulas are summarized in Table 2.

3.2. Therapeutic Aspects

3.2.1. Characteristics of Fistula

Young fistulas, less than one year old, constituted more than half of the cases,

Table 2. Risk factors for fistulas among our subjects.

Variable		Frequency	%
Etiology	Obstetrical fistula	75	98.68
	Traumatic fistula	01	1.32
	Total	**76**	**100**
Prenatal visit	No visit	46	61.34
	One visit	11	14.66
	Two visits	11	14..66
	Tree visits	7	9.34
	Total	**75**	**100**
Delivery	At home	47	62.67
	Assisted	28	37.33
	Total	**75**	**100**
Labor time	0 - 2 days	30	40.00
	3 days	32	42.67
	More than 3 days	13	17.33
	Total	**75**	**100**
Obstetric maneuver	Abdominal expression	26	34.67
	Forceps	21	28.00
	Others	4	05.33
	None	24	32.00
	Total	**75**	**100**
Delivery route	Vaginal birth	58	77.33
	Caesarean	17	22.67
	Total	**75**	**100**
Parity	Primiparous	43	57.34
	2 - 5 delivery	22	29.33
	6 and over	10	13.33
	Total	**75**	**100**
Newborn condition	Dead born	71	94.67
	Living	4	5.33
	Total	**75**	**100**

56.58% (n = 43). Type III perineal tears and vaginal sclerosis were the most frequent associated lesions with 22.37% (n = 17) and 21.05% (n = 16) respectively. The urethra was short, less than 2.5 cm in 42.10% (n = 32) of cases. It was one-eyed, closed at its proximal end near the bladder neck in 52.63% (n = 40) of cases. The fistula was very large in 35.53% of the cases. The characteristics of the fistula in our study are presented in Table 3.

3.2.2. Surgical Aspects

The patients were operated on under spinal anesthesia in 88.16% (n = 67) of cases and under general anesthesia in 11.84% (n = 9) of cases. The fistula was closed on the first attempt in 48.69% (n = 37) of the cases, on the second attempt in 38.16% (n = 29) of the cases. Urinary incontinence was observed in 10.67% (n = 8) of cases after fistula closure. It was observed in 5 patients with a short urethra less than 2.5 cm. Urethral lengthening by vaginal urethroplasty achieved total continence in 4 patients and partial urinary leakage in one patient when she kept urine for a long time. The other three patients had normal urethra and a very large fistula requiring bladder neck remodeling. They benefited from a colpo-suspension using the BURCH technique and continence upon removal of the

Table 3. Characteristics of fistula in our study.

Variable		Frequency	%
Age of fistula	Under one year	43	56.58
	1 - 3 years	16	21.05
	4 - 6 years	5	6.58
	7 - 10 years	12	15.79
	Total	**76**	**100**
Associated lesions	Perineal tear III	17	22.37
	Vaginal Sclerosis	16	21.06
	Vaginale strap	10	13.15
	Perineal tear II	2	2,63
	*RVF	2	2.63
	None	29	38.16
	Total	**76**	**100**
Urethral length	Short urethra < 2.5 cm	32	42.10
	Urethra ≥ 2.5 cm	44	57.90
	Total	**76**	**100**
Permeability urethra	Permeable urethra	36	47.37
	Blind urethra	40	52.63
	Total	**76**	**100**
Fistula size	**Minimal cervical orifice**	**49**	**64.47**
	Very wide cervical orifice	**27**	**35.53**
	Total	**76**	**100**

*RVF: Recto vaginal fistula.

probe one day after the surgery was effective. The surgical aspects data of our subjects are highlighted in Table 4.

4. Discussion

The Regional Hospital of Mopti called Hôpital Sominé DOLO of Mopti is closely linked to the history of vesico-vaginal fistula treatment in Mali. Indeed, since the creation of the "vesico-vaginal fistulas mission in Mali" within the framework of "Médecins du Monde" in 1993 by JA ROBEIN in collaboration with K. OUATTARA [7], several illustrious surgeons including K. OUATTARA, CAMEY M., MONSEUR J. and COLAS JM worked within this framework One of the objectives of this collaboration was to set up a local team with the technical ability to take care of the fistula patients. This dynamic has since been maintained, with the old ones initiating the new ones leading to a permanent team for the management of vesico-vaginal fistulas in routine surgery. The difficulties in assessing the results due to multiple classifications and the problems we faced with these anatomical types of fistulas led us to individualize them. Cervico-urethral transections are severe fistulas classified by CAMEY M [7], complex fistulas of BENCHEKROUN [8] [9] and GUEYE [10], Type IIAb fistulas of WAALDIJK [11] and OAUATTARA K. [12] and in part the group II fistulas of FALANDRY [13].

They made up 33.77% of our fistula cases. They constituted 22.6% of the series of DEMISEW *et al.* [14] in Ethiopia, 37% of MUSA *et al.* [15] in Uganda and 66% of the series by DIALLO *et al.* [16] in Guinea also including partial transections.

Table 4. Data of chirurgical aspects of our subject.

Variable		Frequency	%
Type of anesthesia	Spinal anesthesia	67	88.16
	General anesthesia	9	11.84
	Total	**76**	**100**
Chirurgical approach	Vaginal route	76	100
	Total	**76**	**100**
Closure of the fistula	1st attempt	37	48.69
	2sd attempt	29	38.16
	3rd attempt	6	7.90
	4th attempt	3	3.94
	Fail to close	1	1.31
	Total	**76**	**100**
Postoperative continence	Effective continence	67	89.33
	Urinary incontinence	8	10.67
	Total	**75**	**100**
Incontinence surgery	**Vaginal urethroplasty**	**5**	**62.5**
	BURCH	**3**	**37.5**
	Total	**8**	**100**

The mean age of our patients was 25.02 years and varied from 14 to 65 years. This mean age was close to the mean age of all types of fistula (n = 225), which was 24.73 years. The average age of our series is comparable to that obtained by DEMISEW *et al*. [14] in Ethiopia, MUSA *et al*. [15] Uganda and DIALLO *et al*. [16] in Guinea who reported 25 years, 24 years 25 years respectively. However, it remains lower than those obtained by MOUDOUNI *et al*. [17] in Morocco and TEKLE *et al*. [18] in Rwanda who reported 33 years and 34.6 years respectively. Patients under 18 constituted 19.74% (n = 15) of patients. All had an obstetric cause. This testifies to one of the causes of obstetric fistulas, namely early marriages and early pregnancies. In rural areas, certain marriages take place as soon as the girl sees her period and legally in our country, marriage is authorized from the age of 15 with the consent of the girl's parents. The majority of our patients, 59.21% were from the area covered by the hospital and 34.21% from the surrounding areas. The proportion of married patients in our series was 81.58% almost twice high than the proportion reported by DIALLO *et al*., 44.4%. [16]. This high rate of women remaining married despite the disability is believed to be due to the combined action of NGO partners carrying out awareness-raising trips and producing local radio spots accessible to the entire area. These actions have contributed to a greater understanding of the disease despite the low level of education of our patients. Indeed, 73.69% did not receive any formal education, 25% a primary level and only 1.32% a secondary level, on the other hand 75% had received a Koranic education. The image of the rejected patient living away from the village has become exceptional. The efforts made for social reintegration and especially the creation of income-generating activities have become rare with the patient still living in the family unit.

Cervico-urethral transection was of obstetric origin in 98.68% of cases. For MOUDOUNI *et al*. [17] the obstetric cause was found among 88.59% of patient and among 70% of patients for TEKLE *et al*. [18] in Rwanda. In sub-Saharan Africa, the vast majority of vesicovaginal fistulas are of obstetric origin and their prevalence has been estimated at 1.0 and 1.6 per thousand of women of reproductive age [19]. In one case, the fistula was of traumatic origin following the traditional incisional removal of a lithiasis embedded in the cervico-urethral level, which resulted in acute retention of urine. D'ELIA *et al*. [20] reported a case of a large urethro-vesicovaginal fistula following the surgical removal of a foreign body involuntarily introduced into the bladder. ICHIHARA *et al*. [21] in Japan also reported a case of cervico-urethral transection following pelvic fracture. The cervico-urethral area is difficult to access in pelvic surgery, iatrogenic etiologies by cesarean and hysterectomy are therefore rare. Primiparous constituted 57.34% and large multiparous 13.33% of our patients. DIALLO *et al*. [16] in Guinea, GUEYE *et al*. [10] in Senegal and DEMISEW *et al*. [14] in Ethiopia reported 40.4%, 46.0% and 39.3% of primiparous respectively. TEKLE *et al*. [18] in Rwanda reported 22.1% of primiparous. Beyond the primiparity, all events occurring during the pregnancy monitoring and delivery constitute the predominant risk factors. Indeed, 61.34% of our patients did not follow any prenatal

visit and 62.67% gave birth at home. Regarding assisted deliveries, 37.33%, none of them started in a center with sufficient technical facilities. Labor began in the village with the help of a traditional birth attendant, before they join in first time a health center without a surgical facility and finally ending in a referral center. This long circuit of the parturient associated with geographical obstacles, insufficient road infrastructure and the dysfunction of the referral-evacuation system partly explain the duration of labor of delivery greater than or equal to three days in 59.7% of cases. Abdominal expression, an unconventional obstetric maneuver, was used in 34.67% of patients and forceps delivery in 28.0% of parturients. The birth was carried out vaginally in 77.33% of parturients and by caesarean in 22.67%. Newborns resulting from these deliveries were lifeless in 94.67% of cases. This trend is found in the series by DIALLO *et al*. [16] in Guinea with a home birth rate of 37.3% and labor duration greater than or equal to three days in 74.2% of cases. DEMISEW *et al*. [14] in Ethiopia also reported a labor time greater than or equal to 2 days in 79.2% of cases and 85.7% of stillbirths. Excision, sometimes causing a resistant perineum interfering with the release of the presentation, could prolong the period of expulsion and thus constitute a risk factor. This dystocia is prevented by an episiotomy during the expulsion period in the case the delivery takes place in a health structure with qualified personnel. The proportions of patients excised or not were 48.68% and 51.32% respectively in our study, would rather imply the conditions of delivery in the occurrence of vesicovaginal fistula.

The mean duration of fistula at the time of treatment was 4.46 years, fistulas less than 1 year made up 56.58% of cases and 77.63% were less than 4 years old. A single case of fistula from a neighboring country was 10 years old. Our average duration of fistula is less than that reported by GOH *et al*. [22] which was 4.8 years old and that of MUSA *et al*. [15] in Uganda, and DIALLO *et al*. [16] in Guinea who reported 7.3 and 11 years respectively. We found no association between the duration of the fistula and the environment of the fistula. Some young fistulas were on a sclera vagina with sometimes straps interfering with access to the fistula while other very old fistulas were on a flexible and easily accessible vagina. The regional hospital of Mopti is the second center for the care of vesicovaginal fistulas in Mali after the teaching hospital "Point G", Bamako, Mali due to the number of cases operated on. In fact, from November 1993 to December 2007, 927 women victims of vesicovaginal fistula were treated there [23] and 225 women of all types during our study period. The awareness-raising actions of partner NGOs in the region and free healthcare services, food and accommodation for women victims of fistulas lead them to consult early in the event of urine leakage after childbirth. About 59.21% of our patients resided in the Mopti region. The vesicovaginal fistula was associated with a perineal tear in 25.0% of cases, including 22.37% of type III. These perineal tears, despite the extra time to repair them, allow good exposure of the fistula if they are isolated. Vaginal sclerosis, 21.06% and vaginal bridles, 13.15%, on the other hand make exposure and dissection difficult and require an additional section of bridle or

episiotomy. The rectovaginal fistula encountered in two cases (2.63%) was successfully repaired during the same procedure. Cervico-urethral transection was associated with a certain degree of urethral destruction, making it short less than 2.5 cm in 42.10% of cases. The length of the urethra is an important determinant of continence after fistula closure. The shorter the urethra, the greater the risk of incontinence after the fistula has closed. The large fistulas constituting 35.53% of cases require a remodeling of the cervix with the constitution of a new cervix, which despite its high fixation behind the pubic symphysis, exposes to urinary incontinence after the closure of the fistula.

Spinal anesthesia was attempted in all patients and was successful in 88.16% of them. The remainder, 11.84% received general anesthesia after failure of locoregional anesthesia. Spinal anesthesia allows early mobilization, rapid feeding and less postoperative morbidity associated with reduced anesthesia. It is the type of anesthesia most used for DEMISEW *et al.* [14] in Ethiopia with 70.8%. The vaginal route approach was used in all patients. MOUDOUNI *et al.* [17] used the vaginal route in 89% of cases for BENCHEKROUN type I and II fistulas (urethral and cervico-urethral). Indeed the vaginal route is the best indicated for the fistulas of the cervico-urethral crossroads. However, in certain situations where the upper lip of the cervix is inaccessible and tucked far behind the pubic symphysis, the mixed approach, upper and lower, may be necessary. This vaginal approach allowed us to close 75 of 76 fistulas (98.68%), with an average of 1.68 surgical operations per patient. This fistula closure rate was 68.1% for group II fistulas of DUMURGUIER and FALANDRY [13] with one repeatedly in 33% of cases for group II and III. MOUDOUNI *et al.* [17] had a 92% success rate after one to three interventions on average for BENCHEKROUN type II fistulas.

Urinary incontinence after closure of the fistula was observed in 10.67% of cases. GOH [22] in Ethiopia, out of 987 cases of all types of fistula obtained 24% urinary incontinence. For BROWNING [24], this urinary incontinence rate can reach 60% if the fistula reaches the neck or the urethra, which is the case in a complete cervico-urethral transection. For the prevention of this urinary incontinence, ARROSMITH [25] suggests the addition of a nearby pedicled and well vascularized tissue. This technique was chosen by MOUDOUNI *et al.* [17], DIALLO *et al.* [16] who used the MARTIUS process. TEBEU *et al.* [26], on the other hand, found that the observed results of urinary fistula treatment were similar whether or not MARTIUS graft interposition was performed. For our part, we have not made any contribution of neighborhood fabric. The urinary incontinence observed after closure of the fistula was subsequently treated based on the two anatomical requirements of continence mentioned by DUMURGUIER and FALANDRY [13], which are the length of the functional urethra and the angle of cervico-urethral closure. Thus, urinary incontinence with short urethra benefited from urethral lengthening by urethroplasty in vagina and urinary incontinence with normal urethral length benefited from a colpo-suspension via the suprapubic route using the BURCH technique.

The limits of our study come from the fact that most of the authors treat vesico-vaginal fistulas in general and that the transections are not individualized in particular in the literature. It was difficult to compare our results, we had to go into the classifications of each author to identify this type of fistula. The results of treating these often problematic fistulas are often not individualized. A larger sample would undoubtedly have enabled us to obtain results with a high level of proof. The study looked at the surgical aspect of cervico-urethral transection where the particularity lies in urinary incontinence which can persist after the closure of the fistula and even be complete. A healed cervico-urethral transection has no particularity compared to other healed vesico-vaginal fistulas, a study on the quality of life of cured patients should therefore be of interest to all types of fistulas without distinction.

5. Conclusion

Complete cervico-urethral transections are fairly frequent vesicovaginal fistulas. Their treatment is surgical and is mainly done through the vaginal route. Sometimes treatment results are good at the cost of multiple surgery interventions. Residual urinary incontinence can be corrected by lengthening urethroplasty when the shortness of the urethra is the cause or by colposuspension when the urethra is of normal length and the neck angle very open.

Conflicts of Interest

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

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Management of Priapism in Sickle Cell Patients: Experience of the Urology Department of the University Hospital Centre of Libreville

Adiren Mougougou[1*], Steevy Ndang Ngou Milama[1], Jean Félix Ngomas[2], Natacha Boumas[3], Francine Chimelle Mbana Boukoulou[1], Dimitri Mbethe[1], Izoudine Bissiriou[1], Jean Massande Mouyendi[1]

[1]Urology Department, University Hospital Center of Libreville, Libreville, Gabon
[2]Emergency and Anaesthesia Department, University Hospital Center of Libreville, Libreville, Gabon
[3]Paediatric Surgery Department, University Hospital Centre—Mother and Child—Jeanne Ebori Foundation, Libreville, Gabon
Email: *mougougouadrien@yahoo.fr

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Abstract

Introduction: Priapism is a rare pathology, known since antiquity. Sickle cell disease is the main aetiology in Africa. The aim of our work was to report our experience in its treatment. **Material and Methods:** This is a prospective, descriptive study carried out at the urology department of the Libreville University Hospital from January 2018 to December 2020. All sickle cell patients admitted to urology for priapism were included. The parameters studied were socio-demographic, clinical and therapeutic parameters as well as the evolution after treatment. **Result:** We collected 19 priapisms in sickle cell patients. The average age was 20.9 years with extremes of 4 and 53 years. Fifteen patients were homozygous SS. All patients had stasis priapism. The average consultation time was 22.4 hours. All patients had perioperative medical management combining hyperhydration, analgesia and antibiotic prophylaxis. A vasoactive drug was administered to 13 patients. Sixteen patients had a puncture of the corpus cavernosum. A distal cavernosal-spongiosum shunt under penile block was performed in 6 patients. The outcome was favorable from the outset in 12 cases, marked by complete detumescence of the corpus cavernosum. Partial detumescence was noted in 7 patients with the need for a new puncture of the cavernous body. A complication such as edema of the penis was in only one of our patients. A recurrence was noted in 2 patients. After an average follow-up of 6 months, no sequelae erectile dysfunction was observed. **Conclusion:** Priapism is a frequent complication among sickle cell patients in Libreville. Medical management associated with a cavernous puncture with administration of vasoactive drugs allows a favourable evolution without after-effects.

Keywords

Priapism, Sickle Cell Disease, Vasoactive Drug, Cavernous Puncture, Libreville

1. Introduction

Priapism is a rare condition, defined as an abnormally prolonged, often painful and irreducible erection occurring outside of sexual stimulation. It is a pathology known since ancient times. The term dates back to ancient Greece and derives from the god Priape [1]. Sickle cell disease is the major haematological cause of priapism in children and adults in Africa. It produces a picture of low-flow priapism linked to a slowing down of the cavernous circulation in connection with a cavernous drainage defect during the stiffening phase [2].

Indeed, the penis is an essentially vascular organ due to its penile corpus. Venous drainage takes place through the superficial and deep dorsal veins of the penis towards the pre-prostatic venous plexus [3]. During normal erection, there is a balance between the rigidity of the erectile bodies and venous drainage. Stasis priapism is thought to result from a blockage of the venous sinuses in the corpus cavernosum by pathological blockage of the detumescence mechanisms, thus prolonging the erection while the glans or spongy body remains flaccid [1].

The first-line treatment is medical, combining a puncture evacuating the cavernous blood and the intracavernous injection of alpha stimulants. The second-line treatment is surgical and consists of creating a cavernosal-spongiosum shunt. Among the various existing alpha-stimulating drugs, the use of etilefrin or phenylephrine is preferred because of their pure alpha-stimulating nature and better cardiovascular tolerance. The sometimes more readily available ephedrine can also be used. In the event of failure, of recurrence, or immediately in the event of suspicion of anoxia (pain, delay greater than 24 hours), the gas measurement of the cavernous blood is indicated to assess the intensity of the anoxic suffering and indicate the time of surgery [2]. Several authors [3] [4] [5] report the use of these drugs with varying results.

In addition to the treatment of priapism, it seems essential to us to insist on the classic treatment of a vaso-occlusive crisis in this sickle cell area.

The functional prognosis of the patient is related to the delay in the treatment of priapism with the fear of a definitive erectile dysfunction due to fibrosis of the corpus cavernosum. Priapism represents a major andrological emergency.

The aim of this work is to study strategies for the management of priapism in sickle cell patients in the urology department of the Libreville University Hospital Centre (CHUL) and to assess any complications.

2. Materials and Methods

This is a prospective study carried out in the urology department of the CHUL

from January 2018 to December 2020. All patients with sickle cell disease admitted to urology for the treatment of priapism were included. Four patients lost to follow-up after hospitalization were excluded from the study. Priapisms in non-sickle cell disease were not included. The data was collected from a survey form including the following parameters:

- Socio-demographic (surname, first names, age, profession).
- Diagnosis (presence of a prolonged, painful, irreducible erection, haemoglobin electrophoresis, number of episodes of priapism, delay in treatment, existence or not of associated factors).
- Therapeutic (medical, instrumental or surgical).

❖ **Drug treatment**

- Rehydration with crystalloids.
- Paracetamol analgesia—Nefopam—Tramadol for adults or Paracetamol—Morniflumate for children.
- Antibioprophylaxis with Cefuroxime.
- Oral alpha stimulants with close monitoring of blood pressure: etilefrine hydrochloride or heptaminol hydrochloride.

❖ **Instrumental treatment**

Usually unilateral because of the communication between the two corpus cavernosum, this was an evacuating puncture combined with a corpus cavernosum wash (PCC) under local anaesthesia (penile block) or general anaesthesia with laryngeal mask in children. We performed a longitudinal or lateral PCC using a large catheter (16 or 18 G). The evacuation continued until the result was bright red, fluid blood, then washed with a few millilitres of physiological saline combined with an intracavernous injection (IIC) of vasoactive substances (alpha stimulants which promote the contraction of the corpus cavernosum). We used epinephrine (Adrénaline®) with a dilution of 1 mg/l of saline, followed by a compressive dressing of the penis to avoid a haematoma.

❖ **Surgical treatment**

The principle consists of draining a high-pressure system (cavernous body) to a lowpressure system (spongy body). We used the distal cavernosal-songiosum shunt or T-shunt according to the Al Ghorab technique under local-regional anaesthesia (penile block) or general anaesthesia in the operating theatre.

Progressive monitoring noted detumescence, length of hospitalisation, possible complications.

The purely clinical diagnosis was made on an emergency basis by a resident doctor or intern. No further examination was required.

This care was gradual, depending on the consultation period and the evolving response after each stage.

❖ **Data processing**

The data collected was entered and analyzed using Excel software.

❖ **Ethical and legal aspects**

All the patients included in the study had given their informed consent (that

of the legal representative for minor patients). We also received authorization from the medical affairs department of the CHU to conduct this study.

However, the data sheets were secured within the department and only team members had access to the data. All members had signed a confidentiality clause.

3. Results

We received 19 priapisms in sickle cell patients out of 1183 patients hospitalised during the study period, i.e. a prevalence of 1.6%. The average age was 20.9 years with extremes of 4 and 53 years. Of these 19 patients, 15 (78.9%) were homozygous SS sickle cell patients, 3 were heterozygous AS and 1 patient was heterozygous SC. All patients had stasis priapism. The average consultation time was 22.4 hours with extremes of 5 and 76 hours. It should be noted that 9 patients had consulted after 24 hours. We noted that erectile tissue was taken in 4 cases, including 3 heterozygous AS patients. No intracavernous injection or penile trauma was observed.

Therapeutically, all the patients had benefited from perioperative medical care combining hyperhydration, analgesia and antibiotic prophylaxis. Only 13 patients had received oral administration of vasoactive substances (etilefrin hydrochloride in 10 cases at a dose of 25 to 100 mg/24hours and heptaminol hydrochloride in 3 cases). Due to the lack of availability of these drugs in pharmacies, 6 patients were not able to benefit from them. A corpus cavernosumpuncture was carried out in 16 patients. Intracavernosal injection of adrenaline diluted with saline was only performed in 7 cases. A posthectomy was associated in 2 cases. We performed a distal cavernosal-spongiosum shunt according to the Al Ghorab technique under penile block in 6 patients, 3 of which were directly before a very late consultation.

The majority of the patients had benefited from drug treatment combined with instrumental or surgical treatment. Only one 7-year-old patient who consulted within 6 hours had only benefited from medical treatment with a favourable evolution (complete detumescence).

The average length of hospitalisation for patients was 4.6 days with extremes of 1 and 13 days. The evolution of patients summarized in **Figure 1** was immediately favourable in 12 cases marked by a complete detumescence of the corpus cavernosum. We noted partial detumescence in 7 patients with the need for a new puncture of the corpus cavernosum associated with a reinjection of alpha stimulant in 4 cases. Three patients had benefited from a caverno-cancellous shunt due to an unfavourable evolution after the cavernous puncture.

The evolution was marked by the occurrence of complications such as edema of the penis in a patient whose anti-oedematous treatment allowed regression after 48 hours. A recurrence was noted in 2 patients one and 8 months after the previous episode. After an average follow-up of 6 months, no sequellaire erectile dysfunction was observed.

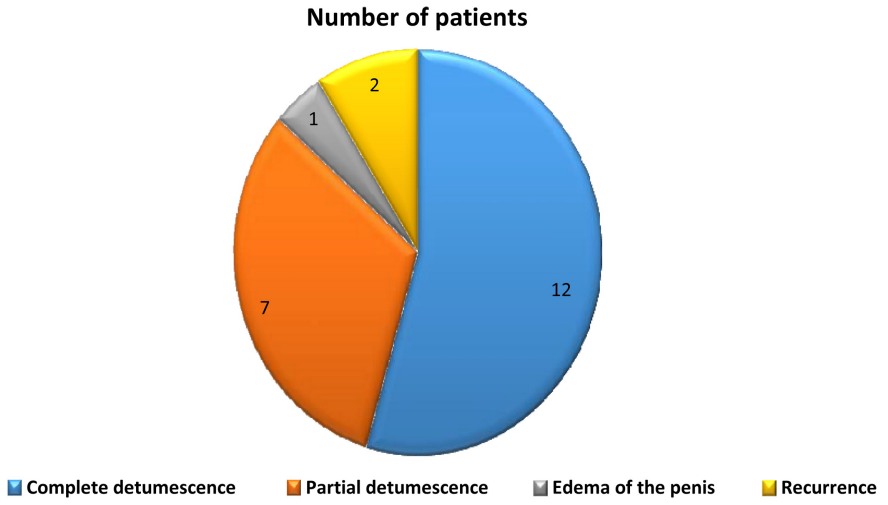

Figure 1. Progress data of patients treated for priapism and sickle cell disease at the university hospital of Libreville from 2018 to 2020.

4. Limitations of the Study

Although this prospective study has limitations, particularly in relation to:

- the sample: the number of patients does not reflect the reality of the problem. We believe that many patients are not well oriented;
- the difficulty of carrying out additional emergency examinations, in particular hemoglobin electrophoresis (due to lack of financial resources) in order to establish a definitive diagnosis and adequate management for the patient;
- the absence of blood gases and the frequent unavailability of certain drugs which could affect the results of the treatment;
- patients lost to follow-up after emergency treatment. Thus, the definitive diagnosis and treatment could not be evaluated in these patients;
- the lack of funding for the study, which would have made it possible to quickly carry out paraclinical examinations and the purchase of certain drugs.

Despite these limitations, the main epidemiological, clinical and therapeutic aspects allow us to make assessments compared to the data in the literature. The informations represent a first mapping of the specific management of this urgent pathology in this particular field in our country.

5. Discussion and Comments

Priapism is a very rare pathology. Sickle cell disease, an endemic pathology, plays a leading role among the aetiologies. Patients affected by this pathology are particularly exposed to the risk of priapism. At least 40% of sickle cell patients report episodes of priapism [4].

We have a fairly large number of cases over a short study period in a relatively young population. These results are the same on those of Moby Mpah *et al.* [5] in Cameroon, who report 33 cases of priapism, 19 of which were in sickle cell patients over a period of 36 months. In a prospective study conducted over 7

months in Congo, Okoko *et al*. [6] reported a larger sample of 68 cases of priapism in sickle cell patients, but in 79.4% of cases it was intermittent priapism which did not require hospital care. They are higher than those of Falandry *et al*. [1] in 4 black African countries, including Gabon, where 19 cases of priapism from all causes were reported in 18 years. They are more distant from those of the team in Tunisia [7] where the population is older (average age 43 years) and the aetiology of sickle cell disease is less frequent. Over a longer period (11 years), Bouya *et al*. [8] reported 32 cases of sickle cell priapism representing 62.5% of the priapisms treated in the urology department, with the age of the patients varying from 7 to 32 years, with an average of 15.5 years.

The low prevalence of our series could be justified by the fact that it relates to all patients hospitalised during the study period. It is thus similar to a broader reflection of the pathology in the general population, whereas it is calculated by several authors [4] [6] [7] [8] on a sample of sickle cell patients or priapisms, whatever the aetiology. This disparity is confirmed by Arduini *et al*. [9] in a compilation of 13 articles, including 6 African articles on the prevalence and characteristics of priapism in sickle-cell sufferers. These authors report an age ranging from 7 to 30 years and a prevalence of 0.67% to 48%. They believe that the prevalence of priapism is not real and explanations include under-reporting by patients, lack of awareness among doctors and lack of appropriate prospective studies.

In our series, the treatment time for sickle cell priapism was greater than or equal to 5 hours with an average of 22.4 hours. These data can be compared with those of Bouya *et al*. [8] in Congo, who report a consultation time of 6 to 48 hours. This is better than the 4-day delay reported by Falandry *et al*. [1] in their cross-border study as well as those of Fall *et al*. [10] in Senegal and Okoko *et al*. [6] in Congo who note that more than 80% of patients had consulted more than 24 hours. This could be explained by the multidisciplinary collaboration (paediatrics-haematology-urology) in the management of sickle cell disease and its complications. However, this consultation period is still long and improving it requires education and awareness raising actions for patients and their families as well as for health personnel, because according to Carnicelli and Akakpo [11], this is an emergency treatment whose aim is to prevent irreversible erectile dysfunction. The duration of the priapism and the delay in treatment are predictive factors for the recovery of erectile function. Histological changes are observed as early as the 12th hour and, in extreme cases, a necrosis of the smooth muscle after 48 hours [11].

All patients had stasis priapism. Among them, 15 patients (78.9%) were homozygous SS. This result is in line with the data in the literature, which shows a predominance of homozygous SS sickle cell disease in 70% to 100% of cases [8] [9] [10]. Sickle-cell anaemia is a frequent cause of priapism with more than a third of patients (homozygous SS) presenting at least one episode of priapism [11]. The mechanisms causing priapism in this group of patients are varied and incompletely elucidated, but are probably linked to a lack of regulation of nitric

oxide (NO) and phosphodiesterase type 5 enzyme activity [11].

The diagnosis of priapism is clinical (pain and rigidity of the penis). Additional examinations help to define the type of priapism and to support the etiological diagnosis. The diagnosis of ischaemic priapism can be made on the basis of an examination of the cavernous blood gases. This assessment is completed by a blood count and platelet count as well as a haemostasis assessment and, depending on the clinical context, by a chest X-ray and an abdomino-pelvic CT scan. Doppler ultrasound of the penis and the perineum is also performed in case of arterial priapism in order to highlight the site of the fistula. Finally, magnetic resonance imaging of the penis, which is not routinely required, can be discussed for predictive purposes to assess muscle viability [11]. In our series, the diagnosis was clinical because the majority of patients were known to have sickle cell disease.

Therapeutically, all the patients had received drug treatment. This medical treatment is poorly used by several authors [5] [8] [10] [12]. Our attitude is in line with that of Carniceli and Akakpo [11] who state that in the case of priapism in a sickle cell patient, local treatment of the priapism will be associated with general measures including hydration and intravenous analgesics, oxygen therapy and possibly plasma exchanges. In 16 cases (84.2%) a puncture of the corpus cavernosum and/or a distal cavernosal-spongiosum shunt according to Al Ghorab in 6 cases were associated with the treatment. Corpus cavernosum puncture is widely practised by Kassogue *et al*. [4] in Mali, Moby Mpah *et al*. [5] in Cameroon and Fall *et al*. [10] in Senegal in 89%, 67.9% and 52.4% of cases respectively. However, several series [3] [8] [12] reveal that surgical management was necessary in the majority of cases. This took place after failure of medical treatment or puncture of the corpus cavernosum. The lower use of surgery in our study could be explained by the relatively short average treatment time for priapism on the one hand, but also by the systematic combination of drug treatment before, during and after corpus cavernosum puncture on the other hand. Our practice is in line with the recommendations in the literature, which indicate that the first specialised therapeutic step consists of puncture-drainage of the corpus cavernosum with a 19 gauge needle (after local anaesthesia or penile block) at the lateral edge of the penis. A gentle suction can be performed until red blood is obtained. This treatment can be completed with an intracavernous injection of alpha-adrenergic agonists such as phenylephrine or etilephrine. Phenylephrine is usually diluted in physiological saline to obtain a concentration between 100 and 500 μg/mL. An injection of 1mL will be given every 3 to 5 minutes for 1 hour under tension control without exceeding 1 mg. A finer needle of 25 to 30 gauge may be used [11].

The evolution was favourable from the outset, marked by complete detumescence in 63.2% of cases and no fibrosis was observed after an average decline of 6 months. This development was better than that of several authors [3] [5] [10] [12] who report an absence of erection in 14% to 38% of cases. This result is cer-

tainly linked to the important role of medical treatment, which is indispensable in sickle cell crises.

6. Conclusion

Priapism is a frequent complication for sickle cell patients in Libreville. Medical management of a sickle cell crisis associated with a corpus cavernosum puncture with perioperative administration of vasoactive drugs allows a favourable evolution without sequelae. The consultation times remain long. Raising awareness of the population, sickle cell patients and health personnel about this pathology will help to limit its dramatic consequences.

Conflicts of Interest

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

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Management of Posterior Urethral Valves about 26 Cases

A. S. Ondziel Opara[1,2], L. I. P. Ondima[1,2,3], A. M. Ondongo Atipo[1,2], C. Boutol Mandavo[1,2,3], R. B. Banga Mouss[1,2], Dimi Nyanga[1,2], P. P. Avala[1,2], A. W. S. Odzébé[1,2*], P. A. Bouya[1,2]

[1]Faculty of Health Sciences, Marien Ngouabi University, Brazzaville, Republic of Congo
[2]Urology and Andrology Department, University Hospital Center, Brazzaville, Republic of Congo
[3]Pediatric Surgery Department, University Hospital Center, Brazzaville, Republic of Congo
Email: *odzebe_s@yahoo.fr

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Abstract

Aim: To improve management of the posterior urethral valve (PUV) in children in a hospital environment. **Patients and Methods:** This was a retrospective descriptive study that covered a sixteen (16) years period, from January 1, 2002 to December 31, 2017, In pediatric surgery and urology departments of our teaching hospital, 26 cases of posterior urethral valve (PUV) were involved. The diagnosis was made by retrograde urethrocystography and micturition, supplemented by ultrasound. **Results:** During this period, 26 patients (1.7%) had a PUV. The mean age of the patients was 73, 2 months with extremes ranging from 6 to 180 months. Fifteen patients consulted for dysuria, 8 for complete retention of urine. Only one patient had a history of rolling the valves to the benign ones. The main complications found were urinary tract infection in 15 children, urolithiasis in 3 children and renal failure in 2 children. Two children had serum creatinine values of 50 and 58 mg/L. The lamination of the posterior urethral valves was performed in all patients. In our series, we had one death from chronic renal failure in a 6-year-old child with a bilateral mute kidney at IVU. **Conclusion:** The valve diagnosis of the posterior urethra is made late because the diagnosis is still postnatal.

Keywords

Valves, Posterior Urethra, Congenital, CHU, Brazzaville

1. Introduction

The posterior urethral valves (PUV) are the most common obstructive uropathies in male children [1]. During the last decades, the diagnosis of PUV has

made a significant advance, in particular by the early detection of the disease during the prenatal period in western countries [2]. This detection is done by chemical analysis of fetal urine, ultrasound evaluation of fetal urinary tract and indication of uro-MRI [3]. Early diagnosis allows not only early management but also the prevention of deterioration of renal function. Despite these advances, long-term renal and bladder repercussions remain a problem in some children with PUV [4]. Indeed, it remains an important cause of infantile renal insufficiency [5]. In underdeveloped countries, PUV is most often postnatally diagnosed, delaying diagnosis and management, and increasing the risk of developing renal failure [6]. Nowadays, in Congo, there are still few publications on this malformation [7]. That's the reason we proposed to carry out this study in order to contribute to the improvement of PUV in the children's care at the University Hospital Center (CHU) of Brazzaville.

2. Patients and Methods

This was a retrospective descriptive study that covered a sixteen (16) years period, from January 1, 2002 to December 31, 2017. It took place in the departments of Pediatric Surgery and Urology-Andrology of the University Hospital Center of Brazzaville. The study population consisted of children who had been cared in both services. Were included patients whom the clinical and paraclinical examinations had allowed to retain the diagnosis of PUV and benefited a management. The variables studied were clinical, paraclinical, therapeutic and evolutionary. Clinical variables were: age, consultation reason, temperature, general condition, abdominal distension; paraclinical variables were done for all patients concerned with: blood count, uroculture, urea and serum creatinine, ultrasound of the urinary tract, urethrocystography. The therapeutic variables were: iterative urethral dilation, vesicostomy, cystolithotomy followed by the pose of double "J" probes. The evolutionary variables were: regular checking up of patients in external consultation with the completion of an ultrasound of the urinary was assessed at 7 days postoperative, 1 month, 3 months, 6 months, and 12 months. We know the duration of hospitalization and the results obtained for each type of treatment. The favorable evolution was pronounced on the basis of the standardization of the Biological constants, the absence of the valves to the urethrocystography of control and the improvement of the clinical signs. The valve diagnosis of the urethra was done on the basis of clinical and paraclinical elements. We were able to collect 26 files during this period. The information was collected from a survey card using data from the service registers, inpatient medical records, operative reports and home visits that supplemented the information from the follow-up booklets.

3. Results

Between January 1, 2002 and December 31, 2017, 8113 patients were admitted to the pediatric surgery department and to the urology and andrology department

of the Brazzaville University Hospital Center. During this period, 26 patients had been treated for a PUV at a frequency of 0.3%. Its incidence was 1.7 cases/year.

The mean age of the patients was 73, 2 months with extremes ranging from 6 and 180 months. We divided the children according to the age group knowing that they come to paediatric surgery until the age of 15 (Figure 1). The oldest patient in our series was 15 years old and he was from the rural area.

In our study, we did not record any posterior urethral valve cases diagnosed as antenatal.

The reason for consultation was dysuria (n = 15), complete retention of urine (n = 8) and abdominal pain (n = 3).

In the physical examination a bladder globe was found in 8 children. The main complication found was urinary tract infection (n = 15), urolithiasis (n = 3) and renal failure (n = 2).

Two children had serum creatinine values > 58 mg/L. Cytobacteriological examination of the urine was performed in all children and revealed: *Escherichia coli* (n = 7), *Klebsiella* (n = 5) and *Pseudomonas aeruginosa* (n = 3). Ultrasound of the urinary shaft was indicated in all children. The results made it possible to objectify bilateral hydronephrosis and control bladder in 24 children (Figure 2).

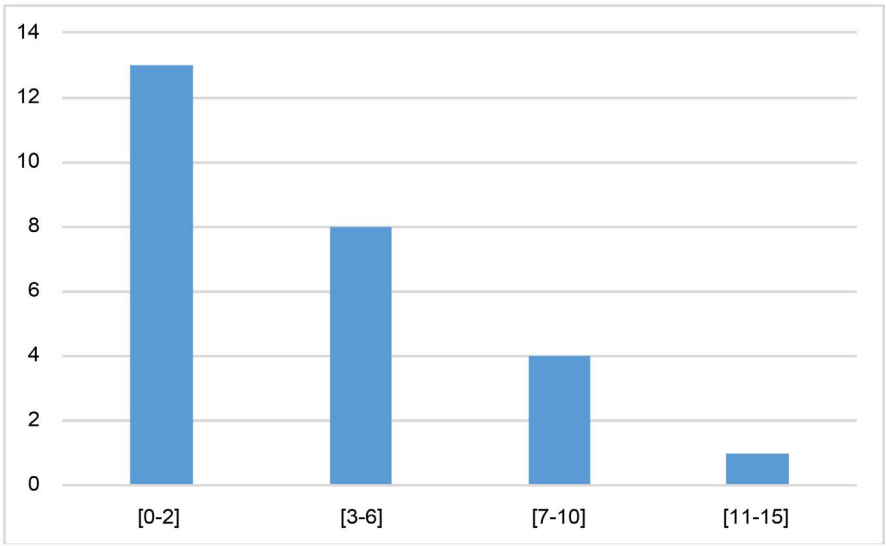

Figure 1. Distribution of patients by age group.

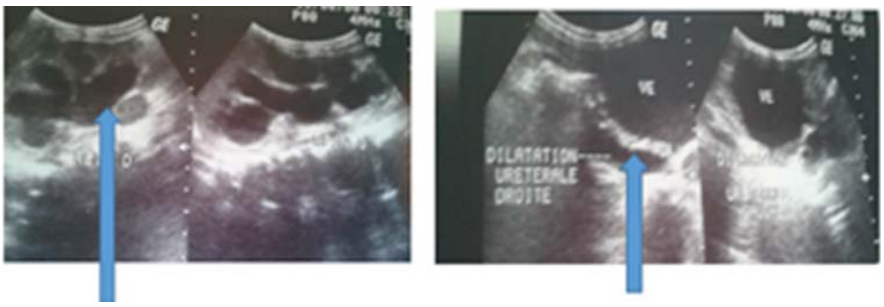

Figure 2. Image 1 and 2 of ultrasonography showing bilateral uretero-hydronephrosis.

Urethrocystograhy was performed in all children the results were found: a valve association bladder calculus in 14 patients (Figure 3). Urethrocystography shows an image of a bladder diverticula and VUP (Figure 4).

Medical treatment based on antibiotic therapy was indicated in 15 patients with urinary tract infection.

All patients underwent valve with progressive urethral iterative dilatation using probes of increasing caliber. Cysto-lithotomy was indicated in three patients. These were 2 patients with bladder stones and 1 patient with urethral lithiasis

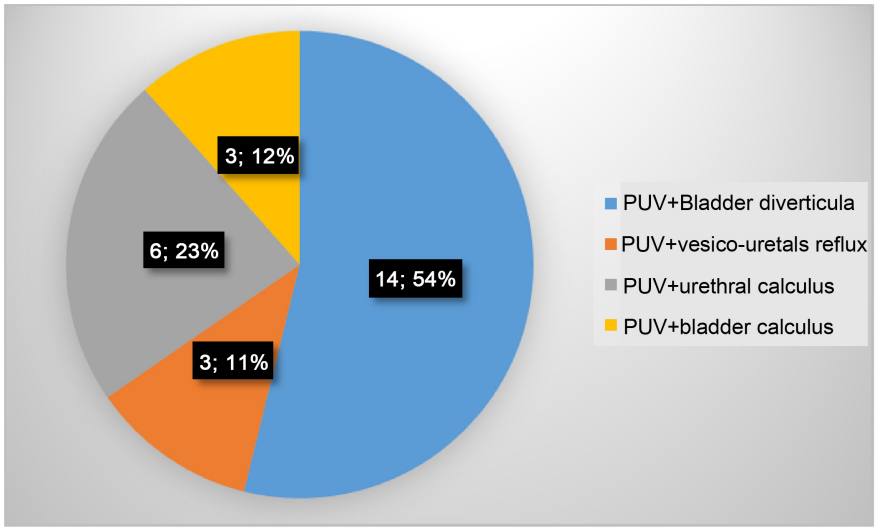

Figure 3. Distribution of children according to the results of the urethrocystography.

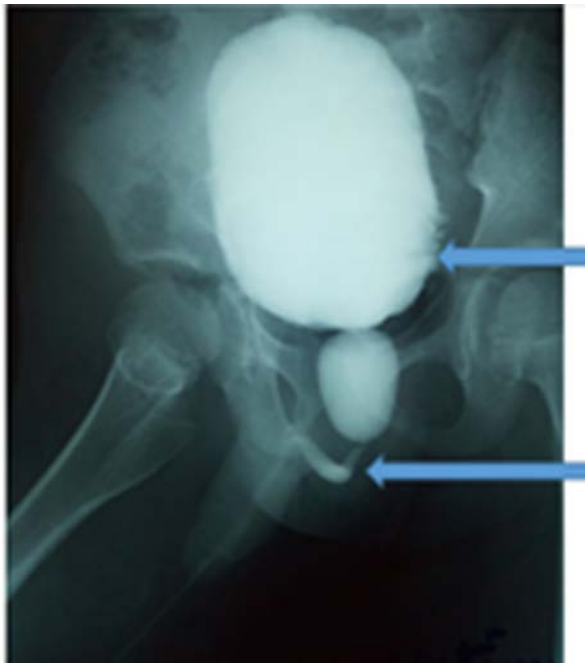

Figure 4. Micturating cystourethrogram showing characteristic "nail clipping" under the dilated prostatic urethra of VUP, Bladder diverticula at the arrow above.

located at the membranous level. The calculus had been pushed back into the bladder.

In our series, we had one death from chronic renal failure in a 6-year-old child with posterior urethral valves with a bilateral nonfunctional kidney at IVU.

4. Discussion

The incidence of PUV is variously reported in the literature; Its incidence is to 1/5000 - 8000 male infants births in the USA [8], 1/8000 births in England [9] and 4/10,000 births in Columbia [10]. Its frequency is unknown in Africa as an evidence to the scarcity of scientific publications [11] [12].

In our study we had 26 cases in 16 years, an incidence of 1.7 cases/year and a frequency of 0.3%. In Senegal [11] frequency to 7 cases/years is an infrequent pathology. They realize a very early onset of bladder obstruction, preventing the normal flow of urine into the posterior urethra and are often accompanied by a bladder control and a vesico-ureteral reflux. Dysuria and urine retention were the main clinical manifestations as in series [8] [10] with varying frequencies. The physical examination revealed a bladder globe in 8 cases/26 (compared to 12 cases/70 in the series presented by Schober in the USA [13]). Makosso *et al.* [7] in Congo found in 2 cases/3. The antenatal ultrasound not only allows recalling the diagnosis but also especially to carry out a care without prolonged delay after the birth. It has been practiced in the majority of patients of the series American [13], French [14] and Nigerian [6]. A study of North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) database identified the causes of neonatal end-stage renal disease in the modern era (2000 to 2012) among 98 neonates aged <31 days, PUV account for 21% of the causes of chronic kidney failure in neonatology [15]. Kidney damage can occur early, hence the value of early management.

Other causes in 46% in our series, no diagnosis was made in antenatal. Urethrocystography was performed in all patients. This is the postnatal reference examination for the detection of posterior urethral valves [16]. These examinations must imperatively include urination phase without probe, in order to highlight the typical image of "nail clipping" at the level of the posterior urethra [17].

The iterative lamination of the urethra by increasing urinary catheters (Fogarty probe, Foley probe) was widely used according to the authors. So Asinobi *et al.* [6] in Nigeria 15 cases out of 40, Claude *et al.* [14] in France had treated 32 cases out of 35, Angwofo *et al.* [18] in Cameroon 15 out of 22. The concern of this technique is that it is done blindly with a risk of false road. Other authors used the Fogarty probe by visualizing the valve with a cystoscopy. It is an alternative to endoscopic valve section. It maintains the minimally invasive transurethral visual standard, and avoids electrocautery and the difficult manipulation of wired electrodes in a constrained field. This hybrid technique is patient friendly, being devoid of radiation exposure, and has the advantage that it can be conducted safely under sedation [19].

Nowadays, the standard treatment of the valves of the posterior urethra is an

endoscopic section from birth [11] [14]. This technique brings good results. However, it is not yet part of our therapeutic arsenal. The technique with the Fogarty probesau Foley probe has the advantage of being perfectly accessible to practitioners who do not have modern endoscopic equipment. Its success rate is equivalent to the endoscopic route. However, it must be performed with much care attention to avoid urethra's rupture [17]. Our results are identical to those of the series [7] [15] [19].

The postoperative course was simple in all cases, compared to 5.6% of complications in the series presented by Warren in Canada [20].

We have a case of death in a patient with chronic renal failure. He had arrived very late at the hospital with abdominal pain. The destroying of the valves had been achieved without allowing a recovery of the renal function. Because at this stage the care is multidisciplinary. Il is necessary management involving nephrologists and resuscitators.

Other authors, including Gargah *et al*. [21] and R. Khemakhema *et al*. [22] in 46 cases and 71 cases of patients respectively, observed 3 and 6 deaths due to renal failure.

The evolution towards the renal insufficiency is seen in not insignificant proportions. Depending on the series, they can reach up to 45% of cases.

For these patients, who have reached the end-stage kidney disease, dialysis and/or renal transplantation are required, the cost of management is often expensive, especially when there is not a good system of medical assistance.

Most recent studies have shown that there is no significant difference in prognosis between kidney transplant in relation with PUV and other etiologies [21]. In our context where dialysis and especially renal transplantation are not accessible, prevention and early management remain the only way to avoid reaching the end-renal stage failure.

All these elements lead us to believe that earlier management while improving our technical plateau would allow us to improve our quality of care.

5. Conclusion

The PUV is one of the most common obstructive malformative uropathies but infrequent pathology. In our context, the diagnosis is postnatal, delaying its management. It is necessary to make an early diagnosis and to treat the patient precisely because we need to preserve the renal function of the patients. When this pathology is detected late, it can lead to a terminal renal failure. Despite many advances in its management, progressive urethral iterative dilatation using probes of increasing caliber (Fogarty probe or Foley probe) is still used. This technique certainly brings good results but the endoscopic section should be added to our therapeutic arsenal because it is actually the most used technic in the world; it's a gold standard technic.

Conflicts of Interest

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

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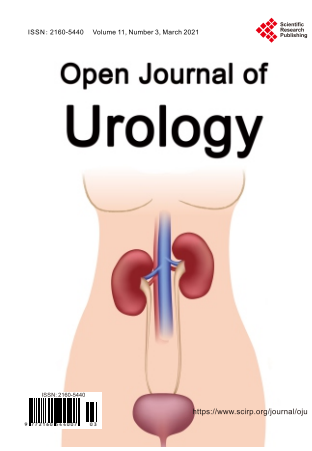

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