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Predictive Factors of Mortality Due to Early Postoperative Complications at the University Clinics in Kisangani (DRC)

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Abstract

Background and Objectives: Postoperative complications (POCs) are new pathological phenomena occurring in the postoperative period and generally worsening the previous situation through their morbidity and mortality. We set ourselves the objective of determining overall mortality and prognostic factors associated with death due to early postoperative complications at the University Clinics of Kisanagani (CUKIS). **Methods:** This was an analytical cross-sectional study carried out in the CUKIS, Department of Surgery from 1 January 2014 to 31 December 2023. The target population consisted of all patients who had undergone full postoperative follow-up. A logistic regression model using software RStudio version 4.4.0 was used to determine factors predicting mortality due to early postoperative complications. **Results:** The prevalence of early POC was estimated at 35%, with surgical site infection being the most frequent POC at 45.3%. Of the 170 patients operated on who developed postoperative complications, 35 died, giving a mortality rate of 20.6%. After multivariate analysis using logistic regression, transfer as the mode of admission, previous laparotomy, preoperative diagnoses such as acute generalised peritonitis, intestinal occlusion, traumatic wound, diabetic foot and tumours were preoperative predictive factors associated with postoperative mortality, while surgery such as exploratory laparotomy and drug treatment with postoperative resuscitation were predictive factors of intraoperative and postoperative mortality. **Conclusion:** Certain factors can predict postoperative mortality. Knowledge of these factors can

help practitioners to take useful measures before each operation on a patient with these factors, with a view to preventing mortality due to postoperative complications.

Keywords

Early Postoperative Complications, Predictive Factors of Mortality

1. Introduction

Postoperative complications (POCs) are new pathological phenomena occurring in the postoperative period and generally worsening the previous situation through their morbidity and mortality [1] [2]. They may be immediate, early or late, depending on how soon they appear [3]. They are said to be early when they occur within thirty days following the surgical procedure. They are important indicators of the quality of surgical care [1]. Despite the use of increasingly effective and less invasive techniques to reduce postoperative morbidity, POC remains a major problem in surgery [2].

In the USA, the incidence of POC is estimated at 30.3%, according to a study carried out in 2002 by Healey [4].

In Europe, particularly in Switzerland, Renggli *et al.* reported a POC rate of 23.3% in 2003 [5]. In Germany, a study conducted by Markus *et al.* on postoperative care recorded a POC rate of 29.5% [6].

In Africa, a study carried out by Tonye *et al.* in 2015 in Cameroon, on early postoperative complications in Yaoundé, reported an overall rate of 14.3% [2]. Ugumba *et al.* in their study on postoperative complications in the General Surgery Department of the Commune I in the District of Bamako Reference Health Centre in Mali reported a postoperative of 6.67% complication rate [7].

In the Democratic Republic of the Congo, a study carried out by Mukakala *et al.* in 2021 on early postoperative complications in digestive surgery in Lubumbashi reported a frequency of 32.2% [8].

Morbidity and mortality caused by postoperative complications are higher in developing countries than in wealthier countries.

In industrialised countries, the rate of permanent disability or mortality is around 0.4% to 0.8% [9]. In the USA, Healey found a mortality rate of 1.83% [4]. In France, Gillion had found a mortality rate of 1% for patients operated on in digestive surgery [10].

In developing countries, some studies have shown mortality rates of 5% - 10% during major surgical procedures. For mortality from general anaesthesia alone, up to one case per 150 procedures has been reported in some parts of Sub-Saharan Africa [9].

Bang *et al.* in Yaoundé found morbidity and mortality rates of 33.3 and 10%, respectively [11].

In the DRC, Wasukama *et al.* found a mortality rate of 13% [12].

Regarding the prognostic factors associated with death due to postoperative complications, Assouto *et al.*, in their study of early postoperative evolution in digestive surgery in tropical environments, found that 89.2% of complicated cases were operated on as emergencies, and the risk of death was multiplied by 5.7 in the case of emergency surgery. Overall mortality was 13% and varied greatly according to the conditions of the operation: 85% in subjects operated on as emergencies and 15% in scheduled subjects [13].

In Kisangani, the prognostic factors associated with death due to early postoperative complications are not well documented, yet they are as common as in most developing countries.

The main objective of this study was to determine overall mortality and factors prognostic associated with death due to early postoperative complications at the CUKIS.

2. Materials and Methods

This was a cross-sectional study with an analytical aim and retrospective collection. It was conducted in the Department of Surgery of the University Clinics of Kisangani in the Democratic Republic of the Congo. Data were collected from 1 January 2014 to 31 December 2023 (10 years). A total of 486 patients underwent complete postoperative follow-up, of whom 170 presented with POC and were the subject of our study. The various surgical procedures performed were: general and visceral surgery (hernia repair, appendectomy, exploratory laparotomy, surgical wound dressing, prostate adenectomy, orchidopexy/orchidectomy, hydrocele repair, cystectomy (Thyreoglossus), skin grafting, cystostomy, thyroidectomy, lumbotomy, mastectomy, flattening, fistulectomy, stone extraction and surgical tumour removal) and in traumato-orthopaedics (osteosynthesis of fractures, amputation of various limb segments, removal of stilts, swing hips, swing shoulders, bloody reduction, arthrotomy and removal of orthopaedic devices). All patients who underwent surgery during the period of our study, who presented one or more clinically diagnosed POCs, and whose records could be used, were included in this study. Patients who had undergone surgery but whose records could not be analysed were excluded. The following parameters were studied: age, sex, marital status, profession, patient admission mode, history, diagnosis preoperative, preoperative delay, type of patient according to ASA, surgeon quality, intraoperative diagnosis, nature of surgery, type of anaesthesia, type of surgery according to Altemeir and postoperative treatment. A pre-established data collection form helped us to collect the data from the patients' files. The data were entered using Microsoft Office 2021 Excel, then exported to R version 4.4.0.

All the variables in our study were included in an initial model logistic regression. The variables to be included in the final model were selected using a bottom-up stepwise method based on the Akaike information criterion (AIC). The lower the value of the Akaike information criterion (AIC), the better the final logistic regression model.

Crude and adjusted ORs were determined successively. The significance threshold of 95% ($\alpha = 0.05$) was therefore considered.

Ethical Considerations

The management of the CUKIS gave administrative approval for the study, and the Department of Surgery approved the protocol and the conduct of the study. All information obtained from patient files was kept completely anonymous.

3. Results

3.1. Epidemiological Data

Of the 1476 patients operated on during our study period, 486 were followed up postoperatively. We identified 170 patients with early postoperative complications, a prevalence of 35.0%. Of the 170 patients with postoperative complications, 35 died, giving a mortality rate of 20.6%. The mean age was 41.5 years, with a standard deviation of 24.2 years; the age group 60 - 79 was most affected by CPO, with 28.2%. Many patients were male (74.1%).

3.2. Clinical Data

The majority of POC cases were admitted via the emergency department 52.9%. The most common medical histories were arterial hypertension, gastritis and diabetes (respectively)12.9%, 10.0% and 7.1%, while surgical histories such as hernia repair and appendectomy were more prevalent (respectively) 6.5% and 5.9%. Acute generalised peritonitis and benign prostatic hypertrophy were the most frequent preoperative diagnoses in general and visceral surgery, with respectively 14.1% and 12.9%. Fractures were more frequent in orthopaedic trauma, at 17.6%. The preoperative period was less than 10 days in most cases (66.5%). Most patients operated on were classified as ASA 1 (66.5%). Benign prostatic hypertrophy and ileal perforation were intraoperative diagnoses the most frequent in general and visceral surgery, with respectively 12.4% and 4.1%. Fractures of two leg bones were more frequent in orthopaedic trauma, at 5.9%. Exploratory laparotomy was the most common surgical procedure in general and visceral surgery (30.0%), followed by adenomectomy (11.8%), and osteosynthesis was more common in orthopaedic trauma (12.4%), followed by amputation (5.9%). General anaesthesia was used most often (92.4%). The types of surgery according to Altemeier 4 were the most frequently performed. 72.9% of patients had received drug treatment without resuscitation, and surgical site infection was the most frequent CPO in 45.3% of cases.

3.3. Predictive Factors

3.3.1. Preoperative Predictive Factors

Transfer as a mode of admission, previous laparotomy, preoperative diagnoses such as acute generalised peritonitis, intestinal obstruction, traumatic wound, diabetic foot and tumours were predictive factors associated with postoperative mortality (**Tables 1-3**).

Table 1. Distribution of cases according to analysis of predictive factors linked to mode of admission

Variables	Number of employees[1]	cOR[2]	95% CI	p	aOR[2]	95% CI	p
Admission procedure							
External consultation	13.6% (6/44)	-	-		-	-	
Emergency	16.7% (15/90)	1.27	0.47 - 3.79	0.7	1.27	0.47 - 3.79	0.7
Transfer	38.9% (14/36)	4.03	1.40 - 12.8	**0.012**	4.03	1.40 - 12.8	**0.012**

[1]% (n/N); [2]cOR = crudde odds ratio; aOR = adjusted odds ratio; CI = confidence interval.

Table 2. Distribution of cases according to analysis of predictive factors linked to patient history.

Variables	Number of employees[1]	cOR[2]	95% CI	p	aOR[2]	95% CI	p
HTA							
No	18.9% (28/148)	-	-		-	-	
Yes	31.8% (7/22)	2.00	0.71 - 5.23	0.2	2.03	0.63 - 6.12	0.2
Diabetes							
No	20.3% (32/158)	-	-		-	-	
Yes	25.0% (3/12)	1.31	0.28 - 4.69	0.7	0.84	0.16 - 3.63	0.8
Exploratory laparotomy							
No	18.8% (30/160)	-	-		-	-	
Yes	50.0% (5/10)	4.33	1.14 - 16.5	**0.027**	4.20	1.09 - 16.2	**0.032**

[1]% (n/N); [2]cOR = crudde odds ratio; aOR = adjusted odds ratio; CI = confidence interval.

Table 3. Distribution of cases according to analysis of predictive factors linked to preoperative diagnoses.

Variables	Number of employees[1]	cOR[2]	95% IC[2]	p	aOR[2]	95% IC[2]	p
BPH							
No	20.8% (31/149)	-	-		-	-	
Yes	19.0% (4/21)	0.9	0.24 - 2.63	0.9	2.97	0.68 - 12.1	0.13
PAG							
No	19.2% (28/146)	-	-		-	-	
Yes	29.2% (7/24)	2.16	0.76 - 5.72	0.13	6.31	1.80 - 23.5	**0.004**
OIA							
No	18.1% (28/155)	-	-		-	-	
Yes	46.7% (7/15)	3.97	1.30 - 12.0	**0.014**	11.1	2.94 - 44.9	**<0.001**
Traumatic wound							
No	19.9% (32/161)	-	-		-	-	
Yes	33.3% (3/9)	2.02	0.41 - 8.08	0.3	6.77	1.20 - 33.9	**0.021**
Diabetic foot							
No	19.4% (32/165)	-	-		-	-	

Continued

Yes	60.0% (3/5)	6.23	0.99 - 48.8	0.05	18.9	2.63 - 171	**0.004**
Tumour							
No	18.4% (30/163)	-	-		-	-	
Yes	71.4% (5/7)	11.1	2.27 - 80.0	**0.005**	31.6	5.49 - 263	**<0.001**
Fracture							
No	23.0% (34/148)	-	-		-	-	
Yes	4.5% (1/22)	0.16	0.01 - 0.81	0.078	0.49	0.03 - 3.14	0.5

[1]% (n/N); [2]cOR = crudde odds ratio; aOR = adjusted odds ratio, CI = confidence interval.

3.3.2. Per- and Postoperative Predictive Factors

Surgical intervention such as exploratory laparotomy and drug treatment with post-operative resuscitation were predictive factors during and after the operation (Table 4 and Table 5).

Table 4. Distribution of cases according to analysis of prognostic factors linked to the nature of the surgical procedure.

Variables	Number of employees[1]	cOR[2]	95% IC[2]	p	aOR[2]	95% IC[2]	p
General and visceral surgery							
Exploratory laparotomy							
No	14.3% (17/119)	-	-		-	-	
Yes	35.3% (18/51)	3.27	1.52 - 7.14	**0.003**	5.82	1.93 - 21.9	**0.004**
Adenomectomy							
No	19.3% (29/150)	-	-		-	-	
Yes	30.0% (6/20)	1.79	0.59 - 4.88	0.3	4.06	1.01 - 18.0	0.051
Surgical trimming							
No	21.6% (33/153)	-	-		-	-	
Yes	11.8% (2/17)	0.48	0.07 - 1.84	0.4	1.26	0.16 - 7.21	0.8
Appendectomy							
No	21.3% (34/160)	-	-		-	-	
Yes	10.0% (1/10)	0.41	0.02 - 2.30	0.4	0.27	0.01 - 1.69	0.2
Skin grafting							
No	20.9% (34/163)	-	-		-	-	
Yes	14.3% (1/7)	0.63	0.03 - 3.87	0.7	1.78	0.08 - 15.2	0.6
Traumato-orthopaedics							
Osteosynthesis							
No	22.8% (34/149)	-	-		-	-	
Yes	4.8% (1/21)	0.17	0.01 - 0.86	0.088	0.47	0.02 - 3.47	0.5
Amputation							
No	20.0% (32/160)	-	-		-	-	
Yes	30.0% (3/10)	1.71	0.35 - 6.55	0.5	4.06	0.68 - 22.8	0.11

[1]% (n/N); [2]cOR = crudde odds ratio; aOR = adjusted odds ratio, CI = confidence interval.

Table 5. Distribution of cases according to analysis of predictive factors linked to postoperative treatment.

Postoperative treatment	Number of employees[1]	cOR[2]	95% IC[2]	p	aOR[2]	95% IC[2]	p
TM[3]	14.5% (18/124)	-	-		-	-	
TM + R[4]	37.0% (17/46)	3.45	1.58 - 7.58	**0.002**	3.45	1.58 - 7.58	**0.002**

[1]% (n/N); [2]cOR = crudde odds ratios; aOR = adjusted odds ratio; CI = confidence interval; [3]TM = Medicinal treatment; [4]TM + R = Medicinal treatment+ resuscitation.

4. Discussion

4.1. Epidemiological Data

The prevalence of postoperative complications in our study was 35.0%. Our prevalence is close to that found by Mukakala *et al.* [8] in Lubumbashi, which was 32.2%. It is higher than those of Tonye *et al.* [2] and Azabali *et al.* [14] who found a prevalence of 14.3% and 12.8% respectively. Our high prevalence of postoperative complications could be explained, on the one hand, by the difficult socio-economic conditions of our population, which are unable to take good care of itself in the event of illness and, on the other hand, by the precarious working conditions at CUKIS, which do not favour good patient care.

Of the 170 patients who had postoperative complications, 35 died, giving a mortality rate of 20.6%. These results are lower than those of Mukakala *et al.* [8], whose study found a mortality of rate 30.4%. This can be explained by the fact that the CUKIS surgery department where we carried out our study is staffed by specialists, doctors on specialisation and trainee doctors who are responsible for the daily follow-up of patients undergoing surgery, which means that POCs are detected early and managed. However, several authors have found mortality rates lower than ours in their series, including Assouto *et al.* [13], Coulibaly *et al.* [1], Gaudeuille *et al.* [15] and Wasukama *et al.* [12], who found mortality rates of 13%, 1.9%, 1.3% and 13% respectively. Our high mortality rate could be explained by the same reason; on the one hand, by the difficult socio-economic conditions of our population, which do not manage to well cope with care in the event of POC, and on the other hand, by the working conditions precarious at CUKIS, which do not favour good management of POC.

The mean age was 41.5 years, with a standard deviation of 24.2 years, and the majority were male (74.1%) or married (56.5%). Our results are like those of Bang *et al.* [11], who found that the mean age of patients was 37.6 ± 13 years and 66.7% were male. This age corresponds to that of a young adult during physical and social activity, who is likely to be exposed to many of life's hazards, particularly illness.

4.2. Clinical Data

The majority of POC cases were admitted by emergency departments, *i.e.* 52.9%. These results are like those of Assouto *et al.* [13], Mukakala *et al.* [8], Tonye *et al.* [2], Coulibaly *et al.* [1] and Ahmedou *et al.* [16], who found that respectively

83.2%, 80%, 71%, 65% and 51.2% of patients admitted by emergency departments. Our results can be explained by the fact that in our study, most of the pathologies found were surgical emergencies, which could explain most emergency admissions. In addition, patients admitted as emergencies are often those with serious conditions requiring urgent care or transfer to a specialist medical facility with qualified staff and appropriate technical facilities.

The most prevalent medical histories were arterial hypertension, gastritis and diabetes with 12.9%, respectively10.0% and 7.1% of cases, and surgical histories such as hernia repair and appendectomy were more prevalent with 6.5% and 5.9% respectively. Ndayisaba *et al.* [17] in their study, found undernutrition, HIV, diabetes and obesity. Ugumba *et al.* [7] found arterial, hypertension, diabetes, haemorrhagic diathesis, HIV/AIDS and cancer in 46.43% of cases. The above-mentioned authors were not interested in surgical history. Our results can be explained by the fact that hypertension, gastritis and diabetes are three pathologies in our environment, linked to a lifestyle dominated by stress and an inappropriate diet due to poverty. Acute generalised peritonitis and benign prostatic hypertrophy were the most frequent preoperative diagnoses in general and visceral surgery, while fractures were more frequent in orthopaedic trauma. Mukakala *et al.* [8] found acute generalised peritonitis followed by acute intestinal obstruction to be the most frequent operative indications, which could be explained by the fact that this author's work concerned acute abdominal surgery whereas our data concerned all surgical pathologies whatever their severity. Regarding trauma and orthopaedic surgery, our results corroborate those of Gogoua *et al.* [18] in their study of early orthopaedic trauma revision at the University Hospital Treichville-Abidjan, found that the initial lesions were varied and dominated by open fractures. The high frequency of fractures observed in our series can be explained by the high rate of road traffic accidents in our environment, which constitute the main aetiology.

The time between hospitalisation and surgery was less than 10 days in most of our cases (66.5%). Our results are in line with those of Ndayisaba *et al.* [17], Bang *et al.* [11] and Soumah *et al.* [19] who found preoperative delays of 5 days, 4 days and 3 days respectively on average. Magagi *et al.* [20] found a very short preoperative delay of 9 hours with extremes of 1 - 48 hours. The short delay observed by the others can simply be explained by the fact that their work concerned surgical emergencies, which is not the case for our series.

ASA class 1 was more dominant in our study. Our result differs from that found by Gaudeuille *et al.* [15], in his study of postoperative complications in the paediatric surgery department in Bangui, who found a predominance of ASA class 2. Our result also differs from that of Mukakala *et al.* [8] who found that many patients were in ASA3 class. It agrees with Ndour *et al.* [21] who found that most patients were classified ASA1. The predominance of ASA1 patients observed in our series can be largely explained by the fact that many of our patients consulted for less serious pathologies of severity moderate such as hernias and appendicitis, pathologies which

have less impact on the general condition of patients.

Most surgical procedures were performed by specialists. Our results are like those of Mukakala *et al.* [8] who also found that most surgical interventions were performed by specialists. This result can be explained by the fact that the CUKIS surgery department has several specialists with skills in several areas of surgery.

Benign prostatic hypertrophy and ileal perforation were the most frequent intraoperative diagnoses in general and visceral surgery, while fracture of two leg bones was more frequent in orthopaedic trauma. Our results differ from those of Bang *et al.* [11] who found respectively gastric perforation, simple acute catarrhal appendicitis, intestinal occlusion due to tumour and ileal perforation, the latter not having worked simultaneously in orthopaedic trauma surgery. Adamou *et al.* [22] in their study on diagnostic delay and prognostic implications in an African setting; Case of digestive surgery emergencies at Zinder national hospital in Niger, found ileal perforation, appendicular perforation and strangulated hernias. Our results can be explained by the fact that acute generalised peritonitis and benign prostatic hypertrophy were the pathologies most frequently encountered preoperatively. Concerning trauma and orthopaedic surgery, our results concur with those of Gogoua *et al.* [18] in his study of early revision orthopaedic trauma at the Treichville-Abidjan University Hospital, who found that the initial lesions were varied and dominated by open fractures. The predominance of open fractures of 2 leg bones in our series can be explained by the poor muscular coverage of the leg bones, at least on their anteromedial aspect, which makes them vulnerable. Exploratory laparotomy was the most common surgical procedure in general and surgery visceral, followed by adenomectomy, and osteosynthesis was more common in orthopaedic trauma, followed amputation. Bang *et al.* [11] in his study, found laparotomy for resection/anastomosis, perforation suture, adhesiolysis, etc. followed by appendectomy. Tonye *et al.* [2] found caesarean sections: 159 cases (60%); salpingectomies, hernia repairs and appendectomies. This could be explained by the fact that Tonye had also worked in gynaecology obstetrics. Our results can be explained by the fact that the diagnoses most frequently found in our series were benign prostatic hypertrophy, ileal perforation and fracture of two legs, which are the indications for the above-mentioned operations. General anaesthesia was used in many cases. Our results corroborate those of Matsanga *et al.* and Gaye *et al.* [23] [24] who found that general anaesthesia was predominant in 100% and 95.6% of cases respectively. The fact that general anaesthesia was used in most surgical cases in the Department of Surgery at the CUKIS can be explained by the fact that these clinics have neither an organised anaesthesia and intensive care service, nor qualified staff in this field. In addition, material unavailability may also explain the predominance of general anaesthesia, but also, most surgical operations in our series require general anaesthesia.

The types of surgery according to Altemeier 4 were more frequent in patients with CPO. Our results differ from those of Gaudeuille *et al.* [15] who found that majority of surgical procedures (36.43%) were classified as Altemeier 1. Our re-

sults can be explained by the fact that in our series, most intraoperative diagnoses are indications for contaminated or dirty surgical procedures, such as ileal perforation. Surgical site infection was the most frequent CPO in 45.3% of cases. Our results agree with those of Ndour *et al.* [21] who found that surgical site infection was the CPO most frequent with 64.1%.

This result can be explained by the fact that in countries with limited resources such as ours, the poor state of hospital infrastructures and equipment, the insufficient supply and unreliable quality of medicines, shortcomings in administrative management and infection control efforts, and chronic under-funding are all factors that explain the high frequency of surgical site infections.

4.3. Predictive Factors

4.3.1. Preoperative Predictive Factors

Transfer as the mode of admission, previous laparotomy, diagnoses preoperative such as acute generalised peritonitis, intestinal obstruction, wound traumatic, diabetic foot and tumours were predictive factors preoperative associated with postoperative mortality. Regarding the mode of admission, our results differ from those of Assouto *et al.* [13]. In his study, he pointed out that most deaths were reported in patients undergoing emergency surgery, and the risk of death was multiplied by 5.7 in the case of emergency surgery. Our results can be explained by the fact that most patients are transferred to the CUKIS in a very precarious clinical state, which means that their postoperative prognosis is very poor. In relation to surgical indications, Coulibaly *et al.* [1] found that the causes of death were acute generalised peritonitis, intestinal intussusception, hydrocephalus, meningocele, Hirschsprung and laparoschisis's disease. This can be explained by the fact that this author worked in paediatric surgery. Our results can be explained by the fact that the above pathologies are in the majority in our series.

4.3.2. Per- and Postoperative Predictive Factors

Surgical intervention such as exploratory laparotomy and treatment drug with postoperative resuscitation were predictive factors both intraoperatively and postoperatively. Our results are like those of Razafindraibe *et al.* [25] who found in their study that exploratory laparotomy was significantly associated with the occurrence of intraoperative death. These authors made no mention of postoperative treatment. Our results are in line with those of Gaudeuille *et al.* [15] found that postoperative may be influenced by the age mortality patient's, pathologies, type of POC and surgical procedures. Our results can be explained by the fact that preoperative such as acute generalised peritonitis and intestinal obstruction diagnoses are predictive factors of preoperative mortality and are managed by exploratory laparotomy. In addition, patients who have undergone exploratory laparotomy are normally treated with drugs and resuscitated postoperatively.

5. Conclusion

POC remains a major problem in surgery, despite the use of increasingly effective

and less invasive techniques to reduce postoperative morbidity. This study revealed that the predictive factors associated with mortality due to early POCs at CUKIS are: transfer as mode of admission, previous laparotomy, preoperative diagnoses such as acute generalised peritonitis, bowel obstruction, traumatic wound, diabetic foot and tumours, surgical intervention such as exploratory laparotomy and drug treatment with postoperative resuscitation. Knowledge of the latter may help practitioners to take useful measures before each surgical operation on a patient with these conditions with a view to preventing mortality due to postoperative complications. This work has limitations due to the lack of other important elements, given that it is a retrospective study. Consequently, we recommend more elaborate prospective studies with a view to producing more reliable results and genuine recommendations.

Authors' Contributions

Felly Kanyinda Ciamala: Substantial contribution to design and configuration, data acquisition, data analysis and interpretation. Asaph Bwini Dianaben: Revision and participation in the final approval of the version to be published. Claude Muamba Mubalamata: Revision and participation in the final approval of the version to be published. Tom Wami Tomo: Review and participation in the final approval of the version to be published. Périclès Lokangu Kalokola: Revision and participation in the final approval of the version to be published. Ralph Munsense Tshiyombo: Review and participation in the final approval of the version to be published. Roger Amisi Kitoko: Review and participation in the final approval of the version to be published. Freddy Wami W'Ifongo: Revision and participation in the final approval of the version to be published.

Conflicts of Interest

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

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