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RESEARCH ARTICLE

Predictors of the Mortality of Patients Under Anesthesia for Postoperative Peritonitis in Kinshasa

Raissa Assani[1], Wilfrid Mbombo[2], Christian Nantulu[1], Gibency Mfulani[1], Philomene Diyoyo[1], Didier Kandongo[1], Fiston Nganga[1], Marcel Kamwanga[1], Von Joslin Miteo[1], Judith Mbimbi[1], Laurence Bamporiki[1], Jerry Muluma[1], Denis Mutombo[1], Berthe Barhayiga[1]

[1]*Department of Anesthesia-Resuscitation, University Clinics of Kinshasa, Democratic Republic of Congo.*
[2]*Monkole Mother and Child Hospital Center, Democratic Republic of Congo.*

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Corresponding Author: Raissa Assani-Laini, MD, Department of Anesthesia-Resuscitation, University Clinics of Kinshasa, Democratic Republic of Congo.

Abstract

Background: Anesthesia for postoperative peritonitis is associated with significant mortality due to the risk of multiorgan failure. This study was conducted to find predictors of this mortality.

Methods: This is a multicenter documentary analytical study conducted from 01/01/2017 to 12/31/2021 in patients anesthetized for postoperative peritonitis. Sociodemographic, clinical, and evolutionary data were collected and analyzed with SPSS 23.0 using, depending on the type of data; t Student, chi-square and Fischer's exact tests, logistic regression and Kaplan Meir curves for $p<0.05$.

Results: Two hundred and one patients were included in the study, the average age was 30 years (SD: 19); there were more or less as many men as women (sex ratio 0.97); 28.4% had comorbidities; 62.7% were transferred from peripheral structures, of which 57.7% were operated on urgently with appendicitis as the main indication (30.8%); surgery performed by a junior in 59.2%. The mean recovery time was 10.25 days; consciousness was altered perioperatively in 30.3%; 58.2% were classified as ASA III; 33.8% ASA IV; all the patients were operated under general anesthesia with tracheal intubation using the association propofol-ketamine, suxamethonium, halogenated and fentanyl. Antibiotic therapy was empirical using the combination of C_3G-Metronidazole (44.3%) and Piperacillin/tazobactam-aminoside (30.3%), complications were present intraoperatively in 55.2% and postoperatively in 41.8%; 5.5% irreversible cardiorespiratory arrest on induction. The overall mortality was 37.7%. Age > 65 years, ASA class > 3, impaired consciousness and the occurrence of intraoperative complications have proven to be predictors of mortality.

Conclusion: Mortality in this series, although significant, is low compared to previous studies and its predictors depend more on the patient's condition and are relatively independent of anesthesia.

Keywords: Predictors, Mortality, Anesthesia, Postoperative peritonitis.

1. Introduction

Postoperative peritonitis are serious infectious complications occurring after surgery of the abdominopelvic cavity, generally digestive and sometimes gynecological-obstetrical or urological[1]. Anesthesia for postoperative peritonitis (PPO) is particularly difficult because these patients are most often fragile, undernourished, with sepsis, candidates for multi-organ failure and presenting a very high risk of mortality [2]. Like any nosocomial infection, their prognosis is often severe, marked by high morbidity, mortality ranging from 12% to 80% depending on the

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series, an extension of the length of stay in intensive care and hospital and potentially serious sequelae [3,4,5].

Indeed, Montravers in France in 2015 had reported a mortality of 4% for community peritonitis and 12% for PPO while Launay Y. had found a mortality of 35% [5, 6]. Raetiborn in Germany, in 2001, had found a mortality of 9% for community infections and 39% for PPO [7].

Some factors are described as associated with mortality: extreme ages, time between first and second surgery, number of organ failures, hemodynamic instability, poor preoperative resuscitation, inappropriate antibiotic therapy, ASA class greater than III, the incorrect surgical procedure and the surgeon's inexperience [8]. Thus, Bohenen had reported 35% of deaths in the event of early reoperation, ie within 24 hours of diagnosis, versus 65% in the event of later reoperation [9].

In Africa, the incidence of morbidity and mortality varies according to the authors from 1.5 to 6% for morbidity and from 35 to 85% for mortality [10, 11, 12]. This heavy mortality in Africa could have several explanations: delay in care, lack of technical platforms and qualified personnel, etc. all in a context of poverty and non-optimal organization [10]. The pillars of the management of peritonitis in general and PPO in particular are: early management, effective pre, per and postoperative resuscitation, correct surgery and appropriate antibiotic therapy [13].

Anesthesia for PPO particularly in Africa is therefore perilous with a very high risk of death. Indeed, these conditions of good resuscitation, optimal treatment time and appropriate antibiotic therapy, etc. are rarely met in sub-Saharan Africa and in the Democratic Republic of Congo (DRC) in particular. In the DRC, numerous studies carried out on peritonitis revealed heavy mortality, in particular: Mbala R. in 2008, had assessed the prognostic value of malnutrition on the morbidity and mortality of all peritonitis and had found a mortality of 44% for peritonitis secondary [14]. For Mbuyi F. (2012) who was interested in the Mannheim Peritonitis Index (MPI) and its applicability to University Clinics of Kinshasa (CUK); mortality for all peritonitis combined was 40.6% [15]. However, in the Mwembia A. (2012) series, PPO mortality reached 74% [16]. Despite progress in treatment, the prognosis of PPO still remains gloomy with a mortality rate ranging from 12% to 80% [3,4,5]. Several studies [6, 9] have been carried out in order to identify these different prognostic factors influencing the mortality rate of peritonitis. But few have assessed the predictors of this mortality in patients with PPO. Most of them involved both patients admitted to the intensive care unit and to surgery wards, or they included both PPO and nosocomial peritonitis (including non-postoperative peritonitis). They did not focus on the anesthetic management of patients with PPO.

In our environment, these studies date back ten years or more, but since then, vasopressors, in particular norepinephrine, which was rare, have become relatively accessible, new halogenated compounds such as sevoflurane and isoflurane have appeared on the market and the number of doctors anesthesiologists and resuscitation services have increased. It is thus, it seemed useful to us, to redo a study on the mortality of the PPO and to seek the predictors of this mortality, in the current state of the structures and the equipment of the services of anesthesia-resuscitation of the city of Kinshasa.

2. Methods

This is an analytical, documentary and multicenter study, focusing on patients who received anesthesia for postoperative peritonitis (PPO) during the period from January 1, 2017 to December 31, 2021, i.e. a duration of 5 years. It took place in five hospitals in the city of Kinshasa, namely: the University Clinics of Kinshasa (CUK), the Provincial General Reference Hospital of Kinshasa (HPGRK), the Ngaliema Clinic, the Monkole Hospital Center (CHM) and Kalembelembe Pediatric Hospital.

The choice of these hospitals was guided by logistics, the existence of at least one resuscitator anesthesiologist and the acceptance of the managers of the health structures. The present study opted for an exhaustive sampling with consecutive recruitment of the 168 patients who received anesthesia for PPO in the hospitals concerned during the study period.

2.1 Data Collection Technique

The present study used a literature review of the data. The collection was done by ourselves with the help of resuscitator anesthesiologists and resuscitation anesthesia assistants assigned to the hospitals concerned. A pre-established sheet was used to collect the information. For hospitals with a computer database, we simply extracted the data related to the anesthesia of patients operated for postoperative peritonitis. The data collected in relation to the evolution only concerned the period of hospitalization or follow-up in intensive care.

The following variables were retained: socio-demographic data (age, sex, safety of care). The parameters related to the initial surgery (urgent nature or not of the intervention, comorbidity, operative indication, operative act, qualification of the initial interveners, initial antibiotic therapy, level of the hospital where the first intervention took place). PPO-related parameters (ASA class before revision surgery, time between first surgery and revision, available biological data, generalized or localized nature of PPO, findings and action taken during revision, anesthetic techniques and drugs used, antibiotics used, use of catecholamines, intraoperative transfusion, qualification of workers). Parameters related to the evolution (other therapeutic supports, length of stay in acute care, complications, mortality at D10, causes of death)

2.2 Data Processing and Analysis

After data collection; an initial quality control was carried out to ensure the completeness, accuracy and reliability of the data. A second consistency check of each sheet was carried out to make corrections to certain inconsistencies noted in order to guarantee the validity of the results. The data processing was done in several stages: manual analysis of the forms; entry, purification and encoding on Excel 2013 finally the analysis was carried out on SPSS version 23; the presentation of the data was done in the form of tables and figures.

The descriptive analyzes carried out are the mean ± the standard deviation for the quantitative data with a Gaussian distribution and the median with the interquartile space (IQS), for the data with a non-Gaussian distribution, the relative (%) and absolute (n) for categorical or qualitative data **.** Ficher's exact test was performed to compare the percentages. The Student's t test compared the means and the ANOVA test to compare the medians.The search for predictors of mortality was done by logistic regression. The strength of association between a factor and mortality was assessed by calculating the hazard ratio (HR) and odds ratio (OR) with 95% CI. The survival analysis was done with the Kaplan Meier curve and log rank. For all tests, the significance level was set at p 0.05.

2.3 Ethical Considerations

Adherence to the study was conditional on the voluntary signature of the consent form after clear explanations given to the patient. The research protocol was validated by the ethics committee of the school of public health of the University of Kinshasa under the number: ESP/CE/110/2022 . Confidentiality rules were respected during data processing and analysis.

3. Results

During the study period, 12,253 patients were operated for abdominal surgery, of which 272 were operated for PPO. (i.e. a frequency of 2.2%). We excluded 71 incomplete files, and therefore analyzed 201 patients.

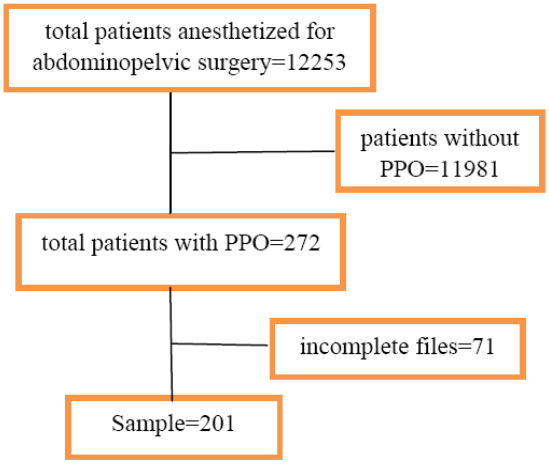

Figure 1. *Patient flow chart*

3.1 Sociodemographic Characteristics

The mean age of the patients was 30 years (SD: 19.054) with extremes ranging from 0 to 84 years. Patients between the ages of 18 and 64 predominated (67.2%), followed by those under 5 with 13.4%. The M/F sex ratio is 0.97 and 87.1% of patients had no safety of care.

The comorbidities present were: cardiovascular 31 patients; diabetes 22 patients, malnutrition 6 patients, HIV infection 2 patents, respiratory (asthma and COPD) 9 patients and obesity 2 patients, etc.

Comorbidities were present in 28.4% of patients. 62.7% of patients were referred from peripheral health structures, of which 42.3% were at primary level,

34.3% at secondary level and 23.3% at tertiary level. Surgery was performed urgently in 57.7%. The indications were represented by appendicitis (30.8%), perforation of the hail (26.4%), gyneco-obstetric pathology (16.9%) (in particular: caesarean section, adnexal masses, uterine myomas), gastroduodenal perforation (11.9%), colon pathology (10.4%) and others.

Table 1. *General profile of the study population*

Variables	Frequency (n=201)	%
Age (year) X±ET	30±19	
age range		
0 to 5	27	13.4
6 to 17	26	12.9
18 to 64	135	67.2
65 to 84	13	6.5
Sex		
M/F:	0.97	
Feminine	102	50.7
Male	99	49.3
Financing of care		
Secure	26	12.9
Insecure	175	87.1
Comorbidities		
Absent	144	71.6
Present	57	28.4
Alcohol and tobacco poisoning	23	11.4
Place of 1st surgery		
Referred from another hospital	126	62.7
Operated in the same hospital	75	37.3
Hospital level 1st surgery		
Primary	85	42.3
Secondary	69	34.3
Tertiary	47	23.4
Degree of urgency of the 1st surgery		
Emergency	116	57.7
Program	82	40.8
Unspecified	3	1.5
Indications for surgery		
Appendicitis	62	30.8
Ileojejunal perforation	53	26.4
Gyneco-obstetric pathology	33	16.4
Gastroduodenal perforation	24	11.9
Colon pathology	21	10.4
Others	8	4

3.2 Intraoperative Data

The surgical procedures performed were: appendectomy (36.8%), anastomosis or suture resection (23.4%), gyneco-obstetrical procedure (13.9%), stoma (7%) and cleaning and drainage (6.5%) and other 12.4%. In 59.8% of cases the act was performed by a junior and 40.2% by the senior. Antibiotic therapy was unspecified in 30.8%, triple therapy in 30.8%, C_3G + metronidazole (23.4%) and quinolone + metronidazole (14.9%).

The mean time to treatment was 10.25 days (SD: 5.467 with the extremes 3 to 30 days), the majority (43%) of patients were reoperated between the sixth and tenth day. Patients with impaired consciousness accounted for 30.3% and 58.2% were classified as ASA III, 33.8% classified as ASA IV. Moderate anemia was present in 66.7% of patients, it was severe in 10.9%. Leukocyte count was performed in 54% of patients, among whom hyperleukocytosis was noted in 35.8% of cases. Neutrophils were counted in 46% of patients and pathological in 20%; 36.2% of patients had achieved platelet count; 3.5% had thrombocytopenia.

Table 2. *Intraoperative data at the first surgery*

Variables	Frequency (n=201)	%
Operative act		
Appendectomy	74	36.8
Anastomosis/suture resection	47	23.4
Gyneco-obstetric act	28	13.9
Resection + Ostomy	14	7
Cleaning and drainage	13	6.5
Others	25	12.4
Operator qualification		
Generalist (junior)	119	59.2
Specialist (senior)	82	40.8
Antibiotic therapy		
Triple therapy	62	30.8
Not specified	60	30.8
C_3G + metronidazole	47	23.4
Hemoglobin level (g/dl)		
Severe anemia (<7)	22	10.9
Moderate anemia (7 to 10.99)	134	66.7
Normal (11 and up)	45	22.4
Leukocyte count (/mm ^{3})		
Normal (4 to 12,000)	35	17.4
Hyperleukocytosis (>12000)	72	35.8
Not done	94	46.8
Neutrophils (%)		
Regular (<70)	50	24.9
Pathological (70 and over)	42	20.9
Not done	109	54.2
Platelet count (/mm ^{3})		
Hypoplatelettosis (<100,000)	7	3.5
Normal (>100,000 to 500,000)	66	32.8
Not done	128	63.7
Blood glucose (mg/dl)		
Not made	61	30.3
Normal (60 to 110)	87	43.3
Pathological (<60 or >110)	53	26.4
Creatinemia (mg/dl)		
Normal (<1.5)	18	9
Pathological (1.5 and above)	9	4.5
Not done	174	86.6
Natremia (mmol/l)		
Normal (135 to 145)	33	16.4
Pathological (<135 or >145)	29	14.4
Not done	139	69.2
Serum potassium (mmol/l)		
Normal (3.5 to 5)	28	13.9
Pathological (<3.5 or >5)	38	18.9
Not done	135	67.2
Chloremia (mmol/l)		
Normal (95 to 105)	20	10
Pathological (<95 or >105)	26	12.9
Not done	155	77.1

Less than 40% of the patients had carried out a biochemical assessment, of which the natremia was pathological in 14.4% of the cases, the potassium level in 18.9% of cases and the chloremia in 12.9%; serum creatinine was pathological in 4.5%.

3.3 Study Population Imaging Data

Abdominal ultrasound was performed in 22.4% while the abdomen without preparation was performed in 53.7%.

Table 3. *Performing preoperative imaging*

Variables	Frequency (n=201)	%
Abdominal ultrasound		
Achieved	45	22.4
Not done	156	77.6
Abdomen without preparation		
Accomplished	108	53.7
Unrealized	93	46.3

3.4 Anesthetic Data of Patients with PPO

All patients were operated under general anesthesia with tracheal intubation. Induction was performed with: either the propofol-ketamine combination (44.8%), ketamine alone (37.8%) or propofol alone (17.4%). Induction curare was: suxamethonium (93.5%) and atracurium (6.5%). Halothane, ketamine, sevoflurane and isoflurane were maintenance hypnotics in 30.8%, 21.9%, 20.4% and 7% of cases respectively. Fentanyl and sufentanil were used in 80.1% and 15.4% respectively. Maintenance curare was pancuronium in 66% of cases and atracurium in 15%. Anesthesia lasted more than two hours in 90% of cases.

Table 4. *Intraoperative anesthetic data of patients with PPO*

Variables	Frequency (n=201)	%
Induction narcotic		
Propofol + ketamine	90	44.8
Ketamine	76	37.8
Propofol	35	17.4
Induction curare		
Suxamethonium	188	93.5
Atracurium	13	6.5
Maintenance narcotic		
Halothane	62	30.8
Ketamine	44	21.9
Sevoflurane	41	20.4
Propofol + ketamine	25	12.4
Unspecified	15	7.5
Isoflurane	14	7
Morphinic		
Fentanyl	161	80.1
Sufentanil	31	15.4
Unspecified	9	4.5
Curare maintenance		
Pancuronium	131	65.2
Atracurium	39	19.4
Unspecified	31	15.4
Duration of anesthesia		
Less than 2 hours	9	4.5
2 hours or more	181	90
Not concerned	11	5.5

3.5 Surgical Data of Patients with PPO

For the majority of the patients, the PPO was generalized in 79.1%, localized in 15.4% and 5.5% of the patients were not operated on, because they died on induction. The intraoperative findings were: suture release (41.8%), residual peritonitis (23.9%), gastric or hail perforation (17.9%), colonic lesion 10% and bladder lesion 1%. . Acts performed, stoma (71%), cleaning and drainage (16.4%) and suture resuscitation (6.5%). The surgical procedure lasted more than two hours in 88.1% and less than two hours in 6.5% of cases.

Table 5. *Intraoperative surgical data of patients with PPO*

Variables	Frequency (n=201)	%
Features of the PPO		
Generalized	159	79.1
localized	31	15.4
Indeterminate	11	5.5
Discovery on recovery		
Release of suture threads	84	41.8
Residual peritonitis	48	23.9
Gastric or small intestine perforation	36	17.9
Colonic lesion	20	10
Bladder perforation	2	1
Indeterminate	11	5.5
Surgical act performed		
stoma	144	71.6
Cleaning and drainage	33	16.4
Suture refreshment	13	6.5
Not posed	11	5.5
Duration of surgery		
Two hours or more	177	88.1
Less than 2 hours	13	6.5
Not concerned	11	5.5
Intraoperative transfusion	134	66.7
Yes	67	33.3
No		
Antibiotics	89	44.3
C_3G + metronidazole	61	30.3
Piperacillin/tazobactam +aminoglycoside	51	25.4
C_3G + aminoglycoside		
Intraoperative use of catecholamines		
Noradrenaline	96	49.8
Ephedrine	14	7
Adrenaline	11	5.5
Dobutamine	3	1.5
No use	91	45.3
Postoperative mechanical ventilation		
No	171	85
Yes	19	9.5
Not concerned	11	5.5

Legend: C3G=third generation cephalosporin

The majority of patients were transfused intraoperatively, i.e. 66.7% of cases; 9.5% of patients had received mechanical ventilation postoperatively. Catecholamines were used in 49.8% for noradrenaline, 7% for ephedrine, 5.5% for adrenaline and 1.5% for dobutamine. C_3G in dual therapy with metronidazole were the most used antibiotics with 44.3%; Piperacillin/tazobactam + aminoside were used in 30.3% and C_3G + aminoside in 25.4% of cases.

3.6 Evolutionary Data of Patients with PPO

Postoperative complications were: septic shock 47 cases, multiple organ failure 35 cases, acute kidney injury: 9 cases, severe anemia: 4 cases, respiratory distress: 4 cases, septic encephalopathy 3 cases, persistent fever 3 cases.

Table 6. *Progression data of patients with PPO*

Variables	Frequency (n=201)	%
Intraoperative complications		
No complications	90	44.8
Septic shock	56	27.9
Low blood pressure	34	16.9
Tachycardia	4	2
Hyperglycemia	3	1.5
Hypoglycemia	2	1
Hypothermia	2	1
Bradycardia	2	1
High blood pressure	1	0.5
ACR at induction	11	5.5
Postoperative complications		
No	117	58.2
Yes	84	41.8
Vital outcome		
Alive	126	62.3
Deceased	75	37.7
Length of stay in intensive care		
Less than 5 days	85	42.2
5 days or more	20	10
Not admitted to intensive care	96	47.8
Causes of death		
Septic shock	23	11.4
Multi-organ failure	16	7.9
Respiratory distress	6	2.6
Uremic encephalopathy	6	2.6
Cancer	5	2.4
Septic encephalopathy	4	1.9
Diabetic ketoacidosis	4	1.9

Intraoperative complications were more marked by septic shock in 27.9%, arterial hypotension in 16.9% followed by intraoperative death in 5.5%. Postoperative complications were present in 41% of patients. Overall mortality was 37.7% and 52% of patients were admitted to acute care for less than 5 days in 42.5%. The average length of stay in acute care was 4.2 days (SD 6.683 and the extremes from 0 to 60 days). Among our patients, 11 patients (5.5%) suffered cardiorespiratory arrest on anesthetic induction.

The causes of death were: septic shock (11.44%), multiple organ failure (11.44%), cardiac arrest on induction (5.5%), respiratory distress (2.6%) , uremic encephalopathy (2.6%), cancer (2.4%), septic encephalopathy (1.9%) and diabetic ketoacidosis (1.9%).

3.7 Overall Patient Survival

The probability of survival was 71.6% on day 2 of admission to intensive care, 64.2% on day 3, 62.3% on day 4, 56.6% on day 5 and 51.9% on day 60. follow-up day in intensive care. The median length of stay was 3 days (EIQ: 1-5). The first two days of resuscitation represented the critical period

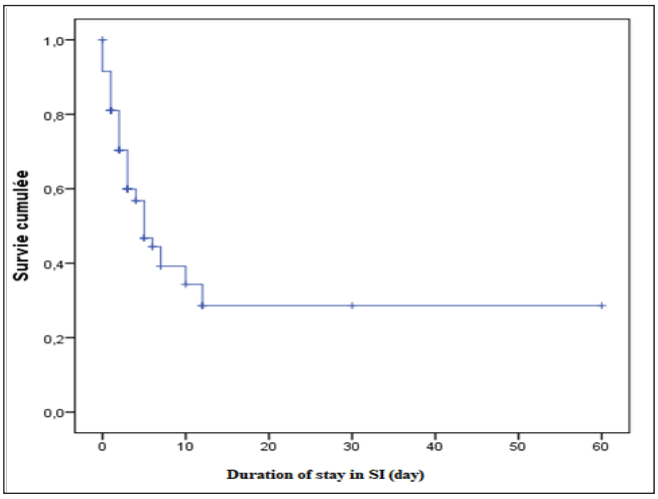

Figure 2. *Overall patient survival*

3.8 Mortality Predictors

In univariate analysis, the factors predicting mortality were: extreme ages ≤5 years and >65 years, comorbidities, altered consciousness at preoperative entry, pathological glycaemia, ASA class ≥III, intraoperative transfusion and the presence of intraoperative complications.

In the multivariate analysis, persisted as predictors of death: age > 65 years, altered consciousness at the entrance to the operating room, ASA class > III and the presence of intraoperative complications

Table 7. *Predictors of mortality in patients with PPO*

Variables	Univariate Analysis		Multivariate Analysis	
	P	HR (IC95%)	P	HRa (IC95%)
Age				
6-17		1		1
18-65	0,206	1,1(0,2-1,4)	0,406	1,2(0,1-1,6)
≤5	0,040	2,3(1,1-3,8)	0,410	1,3(0,1-3,1)
>65	0,035	2,4(1,8-3,9)	**0,035**	3,4(1,8-4,9)
Comorbidity				
No		1		1
Yes	0,038	2,2(1,7-3,3)	0,287	1,4(0,7-2,7)
Awareness				
Lucid		1		1
Altered	<0,001	2,8(1,6-5)	**0,032**	2,1(1,07-4,3)
Blood sugar				
Normal		1		1
Disturbed	0,023	1,5(1,06-2,3)	0,927	1,1(0,5-1,6)
ASA				
II		1		1
III	0,001	2,1(1,1-3,1)	0,140	1,2(0,3-1,7)
IV	0,001	2,1(1,1-3,3)	**0,001**	2,1(1-3,7)
V	<0,001	4,2(2,1-6,2)	**<0,001**	4,2(2,1-8,5)
Transfusion				
No		1		1
Yes	0,006	2,7(1,9-5,3)	0,354	1,5(0,6-3,9)
Intraoperative complication				
No		1		1
Yes	0,002	3(1,5-6,1)	**0,044**	2,2(1-4,6)

4. Discussion

The objective of this work was to search for predictors of mortality in patients anesthetized for PPO. Its results show a more frequent use of norepinephrine, postoperative mechanical ventilation and new halogens, contrary to previous studies. Mortality, although significant (37.7%), is low compared to the Mwembia study which reported a mortality rate of 74% in 2012.

4.1 Characteristics of the Study Population

In our study, the average age was 30.06 years with the extremes of 0 to 84 years, patients aged 18 to 64 years were in the majority with 67.2%. Our results are close to those of Oumar and differ from the literature data presented above, because we included children in addition the population in our country and in Africa in general is younger than that of European countries.

In our study, female patients predominated with 50.7% compared to males (49.3%). Our results are similar to those of Bader and different from other authors, because we included gyneco-obstetric pathologies. According to the study by Law et al. [17], there were more anastomosis failures in men than in women. In fact, during the study period (between September 1993 and November 1998), 196 patients had undergone anterior resection of the rectum, including 119 men and 77 women. The risk of anastomosis failure was estimated at 13.4% in men versus 5.2% in women.

And, according to the study conducted by Rullier et al. [18], the risk of anastomosis failure was 2.7 times higher in men than in women. In our study, out of 201 patients with PPO, including 102 women (only 39 had the release) for 99 men, of whom 49 (i.e. 49.4%) had presented the release of the anastomosis, so our results are similar to those of Law and Rullier. In addition, most men were operated on for tumor pathologies

The majority of our patients came from other hospitals and the financing of care was not secure. This is because there is no health coverage in our country and the organization of the health system is not optimal, since interventions sometimes take place in centers that have no safety standards.

4.2 Characteristics Related to the first surgery

Krukowski ZH et al. [19] had shown during a 10-year study that patients undergoing emergency surgery were more at risk of developing postoperative peritonitis than patients having undergone scheduled surgery. In our study, 28.4% of patients had a comorbidity, more than 62.7% were transferred from peripheral hospitals, 57.7% were operated on as an emergency and most by juniors. The fragile situation of the patients, the poor working conditions, the inexperience of the operator, are favorable to the development of a PPO as Lau W et al had shown in his study [20].

In our study, the main site of the initial surgery responsible for PPO was the appendix with 30.8%; followed by hail with 26.4% and the gyneco-obstetrical sphere: 16.4%. According to the study by Launey Y [6], the initial site of the surgery responsible for PPO was dominated by the colon rectum which represented 40%, then by the upper digestive tract and the small intestine with 30%, hepatobiliary surgery and pancreatic with 24%, and other sites accounted for 5%. The study by Bader FG [21] also reported that 41% of PPOs were of colorectal origin, 26% of small bowel origin, 14% gastroduodenal, 9% hepatobiliary and the other sites represented 8%.

Our results differ from those of these authors and this difference is explained by the advanced age in the European series with a predominance of colorectal tumoral pathologies, moreover in our environment, liver surgery is less practiced.

In our study, 59.2% of patients were operated on by juniors, our results are similar to studies that have shown a higher incidence of infectious complications in junior surgeons than in senior surgeons [20, 22]. In addition, appendectomy in our context is performed in small centers sometimes by non-physicians increasing the risk of PPO.

Third-generation cephalosporins or ciprofloxacin in mono or dual therapy with metronidazole and/or gentamicin or amikacin were the most used antibiotics in our series. Adamou H. [23] had found the results close to ours. It should be noted that the choice of antibiotic therapy depends on several parameters that must be taken into account according to literature data [24, 25, 26, 27]. In our setting, most patients have a low income, which explains the difficulty in buying the penems and glycopetics proposed in the literature, but more expensive. In addition, bacteriological analyzes are rarely carried out and therefore the treatment is almost always empirical. A study is underway within our department to determine the bacterial ecology and the resistance profile in intensive care units in the city of Kinshasa.

4.3 Postoperative Peritonitis

In our study, the average recovery time was 10 days with extremes ranging from 3 to 30 days. Our results

are close to the literature data. Indeed, Hopkins in the United Kingdom [28] had shown in his study that the PPO diagnosis presented two peaks: an early peak, between the fifth and seventh postoperative day, and a late peak, located after the second postoperative week, and which corresponds to the average time to observe the objective signs of release of the anastomoses. In the study by Traoré A [29], the time between the initial intervention and the second intervention was on average 8.35 days. In the study by Oumar Alpha T et al in 2014 in Senegal [20], the average treatment time was ten days.

In our study, 30% had altered consciousness before entering the operating room. Our results are similar to Hssaida et al in Morocco in 2000 [30] who found altered consciousness in 36% of patients. With the difference that in our environment, there is no health coverage, and therefore the means of care depend on the family, itself often destitute. The time between diagnosis and surgery can be long, thus favoring the development of septic encephalopathy.

Intra-abdominal infections are the second cause of sepsis and septic shock after respiratory infections. In PPO, hemodynamic failure is very frequent and determines the prognosis of patients. In a study conducted by Montravers et al in France [5] which included 100 patients reoperated for PPO over a period of 5 years, 67% patients were in sepsis among which 20% had septic shock. Launey Y [6], in a study including 201 patients, 125 were in septic shock, i.e. 62%, this is similar to our study where 84.6% of patients had a tachycardia witnessing disturbed hemodynamics and attested by the fact that many patients were already on norepinephrine before the operating room.

Respiratory failure is also common in peritonitis. In our study, 70.6% of patients had polypnoea, a sign used to detect patients at risk of sepsis in the quick SOFA [31]. It's a pity that we don't have the oxygen saturation data. In a study conducted by Montravers [5], among the 100 patients included, 44 or 44% had presented with respiratory failure related to postoperative peritonitis. Similarly, in the study by Bader FG [21], respiratory failure was found in 43.3% of patients. Mulier S [32] found dyspnea in 20.6% of patients.

This respiratory distress is explained by the fact that respiratory complications are very frequent after abdominal surgery, generally resulting from the association of several factors. Basic atelectasis by decrease in respiratory function (abdominal distension, diaphragmatic dysfunction, postoperative context, pain), inhalation and limitation of diaphragmatic travel by pain, especially during midline incisions above and below the umbilical, very frequently used in our context.

Fever is the most frequent, faithful and earliest sign of PPO [33]. A fever between the third and tenth postoperative day indicates two out of three cases of intra-abdominal sepsis [34]. Its intensity of the fever ($\geq$ 38.5°C) could be an element of orientation [35]. In the AFC retrospective series of 2010(28), 63.7% of patients had fever and in that of Bader FG [21], 35.1% of patients had fever. In the prospective study by Gall et al [36], out of 100 patients with a fever above 39°C during the first ten postoperative days, 66% of patients had an intra-abdominal infection, the remaining 34 had an extradigestive disease. (catheter thrombophlebitis, wall abscess, urinary and lung infections, etc.) or no cause found [36].

Our results corroborate those of the literature because 77.1% of our patients had a fever.

In our study, the majority of patients were classified as ASA III in 58% and ASA IV in 33.8%. Our results differ from those of Kunin (31) who had a predominance of ASA class II. The repercussions of PPO on organ functions, aggravated by the delay in treatment, explain why many of our patients were classified as ASA III or IV.

4.4 PPO Preoperative Biological Data

In PPOs, biological examinations are generally disappointing and only serve to assess the clinical impact and the need for resuscitation. The biological examinations do not generally allow to move towards the diagnosis before the stage of visceral failure. In our study, glycemia was performed in 69.7% of patients and 26.4% had pathological glycemia. Studies have shown that glycemic control is also a parameter associated with reduced mortality in these patients with sepsis [37]. However, in our study hyperglycemia, which seemed to be associated with mortality in univariate analysis, did not emerge in multivariate analysis.

In our series, 10.9% of patients had severe anemia, 66.7% moderate anemia. Our results are similar to those of Harouna [10] who found moderate anemia in 50% of patients. In our tropical environment, anemia is multifactorial: of bacterial origin (sepsis), frequent malarial infections, intestinal parasites, and malnutrition can explain this high rate.

Hyperleukocytosis was present in 35.8% in our series. Hyperleukocytosis (>12000/mm ^{3}) is the only biological test considered useful for the diagnosis of postoperative peritonitis. This sign is commonplace since it is very common in the period following surgery, but it should attract attention if it persists beyond the third postoperative day or if the leukocyte level increases between two successive examinations. [41] or that it is of high concentration (>15–20000/mm ^{3}) [38]. Bader FG [21] found an average white blood cell count of 17,300/mm ^{3}. In Paugam 's study Burtz et al [39], the evolution of leukocytosis did not make it possible to differentiate persistent intra-abdominal infections from forms of simple evolution [40]. Our results show that hyperleukocytosis does not sufficiently predict PPO, as it was only present in 35.8%.

The existence of sepsis is a risk factor for the appearance of thrombocytopenia. This is a predictive factor of mortality which is all the more important as the numbers of platelets are low. According to a recent study [41] on a large group of patients, a drop greater than or equal to 30% in the initial platelet count was an independent predictor of hospital mortality (Odds ratio = 1.54).

In our study, only 36.2% had a platelet count, of which 3.5% had thrombocytopenia. This poor performance of this examination is explained by the lack of financial means, so patients are brought to the operating room without knowing all the repercussions of PPO on organ functions. However, thrombocytopenia did not emerge as a factor associated with morbidity and mortality in our series, probably because the platelet count was not done in all patients.

4.5 PPO Intraoperative Anesthetic Data

The choice of probabilistic antibiotic treatment must be made according to local epidemiological data and prior antibiotic treatments [42-44]. Recommendations often mention combinations of antibiotics, particularly in cases of severe infection. In our study, the use of third-generation cephalosporins (C_3G) associated with metronidazole was 44.3%; the association piperacillin tazobactam with aminoside was used in 30.3% and that of C_3G + aminoside in 25.4% of the patients. The choice of antibiotics in our context is dictated not by recommendations or local epidemiology which is not known, but by market availability and financial accessibility.

General anesthesia with orotracheal intubation using the rapid-sequence induction technique was the most widely used technique according to data in the literature [45, 46, 47]. For anesthetic drugs, we have observed an increasingly frequent use of the propofol/ketamine combination at induction to preserve the often precarious hemodynamics of these patients. Ketamine alone being the drug of first choice for patients in shock. Sevoflurane (20.4%) and isoflurane have appeared on the market and are now among the products used. However, anesthetic products did not have an effect on morbidity and mortality. Halothane is still widely used (30.8%) because it is cheaper, available and many anesthesia machines only have a halothane vaporizer. The low use of atracurium while it is advantageous in this type of patients at high risk of renal and hepatic dysfunction is due to its rarity on the market with a relatively high cost. It is however necessary to underline the dependence of the practices on the drugs available on the market and the financial accessibility.

The duration of anesthesia was more than two hours in 90% of cases. Indeed, the duration of an intervention depends on the intraoperative discoveries and the acts performed , but also on the habits or experiences of the teams. However, duration of anesthesia greater than two hours was associated with the occurrence of intraoperative complications.

4.6 PPO Intraoperative Surgical Data

In our study, wide laparotomy was performed in almost all patients, the laparoscopic route having been used in only two. The need for more in-depth exploration and the habits of surgeons for this type of intervention may explain the preference for laparotomy over laparoscopy. The intraoperative findings, and therefore the causes of PPOs in our series were consistent with literature data as shown in Table 21. Almost all studies show that anastomotic release is by far the main etiology of PPO. Other causes are described in the study by Traoré A [29], which are digestive fistulas 25%, intestinal necrosis 12.2% and eviscerations 8.8%. It should be noted that in 10% of cases, the cause is not found [34].

The main objective of surgical management of postoperative peritonitis is to permanently eliminate the source of sepsis. Peritoneal lavage with at least six liters of warm saline is one of the pillars.

In our study, peritoneal lavage was performed in all patients, which corresponds to data from the literature, although we did not specify the quantity of liquid used as well as the details of intraoperative management of peritoneal lavage liquid. Mulier S. et al [32] showed

in a retrospective series of 96 patients who had PPO, that if the source of sepsis is not controlled during the first operation, postoperative mortality is 100% versus 24% if she is. Similarly, incomplete cleaning of the peritoneal cavity was associated with 100% mortality compared to 17% in the other cases. Launey Y et al [6] described in their series a peritoneal lavage carried out with at least six liters of saline in 175 patients, 120 of whom survived.

The joining of the intestine to the wall or stoma was the main procedure in 71.6% of cases. This is consistent with literature data [29, 48]. In Oumar A's series [89], the stoma was the most performed surgical procedure in 41% of cases. The placement of a peritoneal drain, although discussed, is recommended by some authors [49] and it was the rule and the only treatment for residual abscesses (16.4%) apart from lavage.

Intraoperative transfusion was performed in 66.7% of our patients because of frequent preoperative anemia: including 66.7% of cases of moderate anemia and 10.9% of cases of severe anemia. Our results correspond to those of Oumar A [89], of whom 42.2% of patients had benefited from a transfusion.

In our series, because of the high frequency of arterial hypotension (16.9%) and septic shock (27.9%), vasoactive amines were used in 57.3% of patients with norepinephrine (49.8 %) in the lead as recommended in septic shock [50]. This strong use of noradrenaline is an evolution in the management of shock in our environment and a consequence of its availability on the market having reduced its cost and having made it financially accessible. Adrenaline was used in 5.5% of patients, these were patients who presented with cardiac arrest at induction. Dobutamine was used in 1.5% of patients with cardiogenic shock. Trends are still divided for the choice between norepinephrine and dobutamine in cardiogenic shock despite the latest recommendations.

Nineteen patients, or 9.5%, were put on mechanical ventilation postoperatively. Even if this is a consequence of the severity of the patients, as evidenced by the poor survival of ventilated patients; This is another evolution in patient care. Indeed, a few years ago, it was rare to keep a patient ventilated postoperatively because of the lack of equipment.

4.7 Progression Data of Patients with Postoperative Peritonitis

In our study, intraoperatively, septic shock sometimes present preoperatively was the most common complication (27.9%). Arterial hypotension came second with 16.5% and 11 patients or 5.5% died following an unrecovered cardiac arrest at induction. Indeed, the third sector created in case of peritonitis causes a drop in blood pressure and moreover, surgical manipulations can promote the release of toxins and the phenomena of translocation responsible for arterial hypotension and septic shock.

Postoperative complications (septic shock: 47 cases, multiple organ failure: 35 cases, acute kidney injury: 9 cases, severe anemia: 4 cases, respiratory distress: 4 cases, septic encephalopathy: 3 cases, persistent fever: 3 cases, diabetes imbalance : 3 cases, PPO: 2 cases) were present in 41% of patients. Mortality was 37.7% and 52% of patients were admitted to acute care for less than 5 days in 42.5%. The average length of stay was 4.2 days (SD 6.683 and the extremes from 0 to 60 days). Our results are close to those of some authors. Indeed, Oumar A [20], in 2014 in Senegal, had found as postoperative complications: 42% hemodynamic failure including 8.9% cardiac complication; 6.7% respiratory, postoperatively, 53.3% of patients were transferred to acute care, with an average length of stay in intensive care of 3 days with extremes of 1 to 17 days and the mortality rate was 24, 5%. And, in the study by Launey Y. in 2017 [6] in France, postoperative complications were represented by: septic shock, acute respiratory distress syndrome (ARDS) and acute renal failure.

4.8 Mortality

In our study, the mortality rate was 37.7%, and the causes of death were: septic shock (11.44%), multiorgan failure (11.44%), cardiac arrest at induction (5.5%), respiratory distress (2.6%), uremic encephalopathy (2.6%), cancer (2.4%), septic encephalopathy (1.9%) and diabetic ketoacidosis (1.9%). This rate is similar to the results of Launey Y [6] who, in a large cohort of intensive care patients, had found a mortality rate of 31% for PPO, and those of Oumar A [20] in whom this rate stood at 24.5%.

On the other hand, our mortality is lower compared to the results of Hssaida R in 2000 in Morocco [63] who was only interested in the PPO of elderly subjects (65-85 years) and found a mortality of 68.7%. And was influenced by the presence of comorbidities. For Mbuyi Freddy (2012) [15] and Mbala (2008) at the CUK the mortality rate was 40.5% and 44% respectively, while Mwembia (2012), in his multicenter series including all ages, found a mortality of 74% for PPOs.

Our study is the one with the lowest mortality rate

demonstrating improvements in the management of peritonitis in our environment. The presence of intensive care anesthesiologists, the availability of norepinephrine, new halogens and ventilatory support equipment could explain this improvement.

4.9 Predictors of PPO Patient Mortality

The management of PPO is based on 3 objectives: control of septic shock, appropriate and early antibiotic therapy and early surgery. Several studies have shown that if they are not reached, the mortality rate increases considerably [3, 51, 52]. Thus in the literature, the factors of poor prognosis in the PPO are diverse and can be related to the patient, to the initial surgery and the reoperation, to the per and postoperative complications in particular the organ failure and the quality of the care as inappropriate antibiotic therapy [22, 53,54]. In multivariate analysis, four factors emerged as predictors of mortality during PPO: age > 65 years, altered consciousness at the entrance to the operating room, ASA class > III and the presence of intraoperative complications. Nevertheless, no anesthetic drug had a significant impact on the mortality rate.

Launey Y [6], in his study of mortality risk factors in PPO, had identified three risk factors: the SAPS Score (Simplified Acute Physiology Score) (odds ratio: 1.03), medical complications in particular organ failure (odds ratio: 6.02) and number of reoperations (odds ratio: 2.45) he underlines that the first hours following the diagnosis of PPO are crucial for the prognosis. Thus, rapid control of organ failure is necessary to achieve a better outcome. We did not calculate the SAPS score in our series because the results of the biological examinations which enter into its calculation were not often available. Nevertheless, age, which is one of the SAPS calculation variables, emerged in our series as a predictor of mortality. Similarly, the presence of complications is accompanied by a poor prognosis, as Launey had observed.

For Mulier S et al [32] the mortality was 30% in 96 patients with PPO like us, he had identified as risk factors independent of mortality; advanced age (odds ratio: 1.125) for each year of age added) and altered state of consciousness (odds ratio: 11.76).

In a retrospective study [52] including 102 patients, the mortality rate was 39.2% and 4 independent risk factors for mortality were identified: age ≥ 60 years, multiorgan failure, insufficient antimicrobial treatment and the stercoral aspect of the peritoneal fluid. These results are close to ours although we did not study the appearance of the liquid in our series because of missing data.

Reiss in 2010 [55] in his study on the prognostic factors of PPO mortality had found as predictors of mortality: age >65 years, ASA class >3, cold intervention and intraoperative finding (presence stercoral fluid). In the series of 60 patients with PPO, Carlet et al [56] showed that mortality increased from 6% in the event of appropriate antibiotic treatment and correct surgical treatment, to 71% in the event of inappropriate empirical antibiotic therapy even with a adequate surgery. Age and ASA class greater than III appear to be factors encountered in all series, including ours.

On the other hand, Montravers et al [57] showed that inappropriate empirical treatment significantly increased the mortality of PPO (p For Morzougui et al [58], inappropriate empirical antibiotic therapy was an independent predictor of mortality. N Having carried out bacteriological analysis, it is difficult for us to discuss this point, although antibiotic therapy did not influence mortality in our series.

According to the 2015 SFAR expert consensus, the risk factors for mortality are represented by the state of shock on admission, ASA class ≥3, the time to recovery >24 hours after diagnosis. Our results support these data. Nevertheless, the delay in taking care of more than 24 hours did not emerge, probably because the majority of patients had a delay of more than 24 hours, or even more than six days. Several authors have found a delay >48 h as a predictor of mortality [32, 38, 40]. Age is found in almost all severity scores. As we have seen, advanced age and comorbidities are risk factors for mortality. In addition, age alone is a serious factor and a poor prognosis due to frailty, aging and comorbidities.

5. Conclusion

Despite their low frequency, PPO remain a formidable condition, burdened with heavy mortality. This study allowed us to identify as predictors of mortality: advanced age, altered state of consciousness, ASA class greater than three and the presence of intraoperative complications. These factors seem to be more related to the patient's condition than to the anesthesia. The realization on a larger scale of other prospective studies seems necessary in order to identify other factors likely to influence mortality.

Conflict of Interest

No conflict of interest has been declared by the authors.

Authors' Contributions

AR and GM designed, collected, interpreted, wrote and edited the manuscript. AN analyzed the data, read and corrected the article. WM and BB supervised, interpreted and corrected the article. EM analyzed the samples. All authors have read and approved the final version of the article.

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