

Experience of Anesthesia in Laparoscopic Surgery at the Secondary Level Hospital Located in Suburban Environment

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Abstract

Objective: Anesthesia for laparoscopic surgery is particular because of the cardiopulmonary repercussions of pneumoperitoneum. This study reports the experience in secondary level hospital located in suburban environment.

Methods: This is a cross-sectional study carried out at Monkole hospital from May 2016 to May 2023. It concerns patients anesthetized for laparoscopic surgery. Perianesthetic data were collected and analyzed with SPSS 26.0 for $p < 5\%$.

Results: Eighty-four patients (4.2%) were selected out of 2000 eligible patients. The median age was 31 years, the range between 15 and 30 years (40.5%), female gender and approved patients (70.3%) predominated. Comorbidities were: sickle cell disease, high blood pressure, thinness and obesity. The ASA class was: I (35.2%), II (36.3%) and III (28.6%). Anesthesia was general with intubation for all patients. Generally, the surgery lasted less than two hours and the anesthesia lasted more than two hours. Postoperative analgesia used morphine in 27.5%. The operative indications were dominated by lithiasis with or without cholecystitis (48.4%) and appendicitis (16.5%). Intraoper-

ative complications (18.7%) were: hypotension, allergy, spasm, accidental gallbladder and bile duct perforation. Postoperative complications (9.9%) were: anemia, digestive fistula, septic shock, multi-organ failure, acute lung edema and two deaths. Alcohol consumption was associated with intraoperative complications. Anesthesia duration greater than two hours, ASA3 class, alcohol consumption and cholecystectomy were associated with postoperative complications. **Conclusion:** Celiosurgery is not yet established in Monkole probably due to the lack of permanent surgeons and the higher cost than open surgery.

Keywords

Anesthesia, Celiosurgery, Monkole

1. Introduction

Anesthesia for laparoscopic surgery is particular because of the hemodynamic, ventilatory and neurological repercussions induced by the pneumoperitoneum and by the positioning of the patient [1]-[4]. Increased intra-abdominal pressure and hypercapnia after insufflation of carbon dioxide through the pneumoperitoneum during laparoscopic surgery are the mechanisms of hemodynamic, respiratory, etc. changes. The risks are linked to pneumoperitoneum and positioning (atelectasis, hypercapnia, gas embolism, renal attack, cardiovascular changes). Intra-abdominal pressure greater than 20 mmHg increases the risk of respiratory complications (atelectasis, gas embolism), renal attack, high and low blood pressure, rhythm disturbances. The main objectives of anesthetic management are understanding the primary pathophysiology, optimizing functional status and hemodynamics, and managing comorbidities to minimize the effects and impacts of pneumoperitoneum in patients undergoing this type of surgery [5] [6].

This is why this surgery is conventionally done under general anesthesia with tracheal intubation [7]. Volume-controlled ventilation with positive end expiratory pressure (PEEP) of approximately 5 cmH₂O is the most commonly used mode. Pressure-controlled ventilation is used if there is a significant rise in airway pressure with risk of barotrauma and in this case tidal volume must be monitored [6]. The laryngeal mask presents the risks of inhalation and displacement but is proposed and used by certain teams [8] [9]. However, publications on the advantages of locoregional anesthesia, particularly spinal anesthesia, exist in the literature [10]-[12].

Laparoscopic surgery is preferable over conventional laparotomy due to its advantages, such as less trauma, early mobilization, minimal blood loss, more aesthetic and small scars, reduced postoperative pain, postoperative recovery time and shorter hospital stay, as well as lower mortality and morbidity [5].

These advantages mean that it is now practiced in patients of all ages, including infants and even newborns [13]. It is performed almost for all surgeries and has

become the gold standard for cholecystectomy, appendectomy, splenectomy, gastroesophageal reflux surgery, colectomy, abdominal wall hernias, etc. [14] [15].

Postoperative pain is short-lived and almost 80% of patients may require the use of opioids. Locoregional anesthesia techniques (peri-medullary and peripheral) as well as the infiltration of local anesthetics are effective in this type of surgery [6].

Patient limitations to laparoscopic surgery can be: difficult access to the abdomen, obliteration of the peritoneal space, organomegaly, intestinal distension, and the potential for dissemination or recurrence of cancer, pregnancy, increased intracranial pressure, abnormalities of cardiac output and gas exchange in the lung, and chronic liver disease and coagulopathy. While many of these conditions were formerly considered absolute contraindications to laparoscopy, they are now considered, by many surgeons, to be only relative contraindications [16].

Although laparoscopic surgery has become the gold standard for many thoracic and abdominal visceral procedures in high-income countries [14] [15], it has been slow to develop in low-income countries. Thus, in the Democratic Republic of Congo, its practice dates back more than thirty years but its development is more recent and publications in anesthesia on this subject are rare. The study recently published in December 2023 by Muamba only concerned digestive endoscopy [17]. At the Monkole Hospital Center, the technique began around the year 2016 and this study reports the experience of anesthesia in laparoscopic surgery in this hospital since it has been practiced there.

2. Methods

2.1. Type, Period and Setting of the Study

This is an observational study carried out at Monkole Hospital Center (MHC) from May 2016 to May 2023 concerning patients who received anesthesia for laparoscopy for all indications. The MHC is a secondary level private hospital used as a general reference hospital for the Mont Ngafula I health zone. It organizes all medical services with an operating theater having basic minimum equipment for anesthesia.

2.2. Patient Selection

Patients of all ages and genders anesthetized for laparoscopy (with pneumoperitoneum) whether diagnostic or interventional in the field of gynecology, paediatric surgery and digestive surgery were included. Patients anesthetized for urological endoscopy, digestive or bronchial endoscopy were excluded.

2.3. Collection of Data

The data were collected by the investigators on the basis of a pre-established collection form containing all the study variables. As there is an anaesthesia database at Monkole Hospital, we simply extracted the data relating to laparoscopic surgery during the study period. The variables sought were the general characteristics of the patients: age according to the date of the last birthday, gender, coverage of

healthcare costs by the company or by the patient, home in relation to the health zone, medical history and body mass index. Paraclinical variables: hemoglobin level, number of platelets, prothrombin level (PT), activated partial thromboplastin time (aPTT), creatinemia, transaminases, performance of cardiac ultrasound and electrocardiography (ECG). Anesthetic variables: anesthetic techniques and products, ASA class, Mallampati and Cormack grades, airway management, duration of anesthesia and postoperative analgesia. Surgical characteristics: indication and surgical procedure, surgical specialty, duration of surgery and possible transformation into open surgery. Evolutionary variables: intra- and postoperative complications until hospital discharge and length of hospital stay.

2.4. Anaesthesia Protocol for Laparoscopic Surgery at the MHC

A pre-anaesthetic consultation is compulsory, and pre-operative examinations are requested on a case-by-case basis depending on the patient's condition. General anaesthesia with tracheal intubation and curarisation is the rule. Antibiotic therapy or antibiotic prophylaxis (using cefuroxime or, failing that, amoxicillin + clavulanic acid) is administered according to the type of surgery in the Altermeir classification. Propofol is used for induction and halogen for maintenance. Monitoring is basic: non-invasive arterial pressure, peripheral oxygen saturation, electrocardiography, alveolar gas, in particular exhaled carbon dioxide, which is maintained between 35 and 40 mmHg. Volume-controlled ventilation is the rule: a tidal volume of between 6 and 8 ml/kg of predicted weight, a positive end expiratory pressure (PEEP) of between 3 and 6 cmH₂O, and a plateau pressure that must not exceed 30 cmH₂O. Intra-abdominal pressure should not exceed 15 mmHg. Prevention of nausea and vomiting with dexamethasone plus ondasetron is not systematic. Analgesia is multimodal (paracetamol + ketoprofen followed by ibuprofen for 48 hours plus or minus tramadol or morphine if pain is rated higher than 3/10). Infiltration of trocar holes with ropivacaine is inconsistent due to its rarity on the Congolese market.

2.5. Statistical Analysis

Data was entered using Excel 2013, verified, coded and transferred to SPSS 26.0 for analysis. Quantitative variables are presented as mean with standard deviations or median with interquartile space and compared with Student's t test. Categorical variables are presented as frequency and compared with Pearson's Chi-square or Fisher's exact test. The search for factors associated with complications was carried out by logistic regression and the strength of association between a factor and a complication was measured by calculating the odds ratio and their 95% confidence intervals. For all tests, the p-value was set to less than 5%.

2.6. Ethical and Regulatory Aspects

The hospital management had given its agreement. The protocol was approved by the ethics committee under number ESP/CE/135/2024. The principles of confi-

dentiality and anonymity were respected in accordance with the Helsinki Convention. We have no conflict of interest in this work.

3. Results

During this period, 84 patients were anesthetized for laparoscopy for nearly 2000 eligible, or 4.5%. All 84 patients were analyzed.

3.1. General Patient Characteristics

Table 1 presents the general characteristics of the patients.

The median age was 31 years old, the group between 15 and 30 years old (34.1%) predominated with a significant difference $p = 0.034$, that of 30 to 45 years old represented 24.2%, that of 45 to 60 years old represented 17, 6%, those under 15 years old represented 15.4% and those over 60 years old represented 8.8%. The female gender predominated with a sex ratio M/F: 0.44 without significant difference ($p = 0.081$). Patients cared for by their companies were predominant (70.2 %) without a significant difference ($p = 0.327$). Patients from the health zone represented 17.9% compared to 82.1% for those not belonging to the health zone without significant difference ($p = 0.647$). Comorbidities were: sickle cell disease (25.3%), alcohol intoxication (25%), thinness (21.4%), high blood pressure (17.9%), obesity (14.3%), viral hepatitis (4.8%), gastritis (5.9%), digestive cancer (3.6%), asthma (2.2%), epilepsy (2.4%), diabetes (2.4%), valvular disease (1.2%), renal aggression under extrarenal purification (1.2%), pericarditis (1.2%) and diabetes (1.2%).

Table 1. General patient characteristics.

Variables	n = 84 (%)	[Min-Max]	Median (IQR)	p
Sex				0.081
Male	26 (31)			
Feminine	58 (69)			
Age		[2 - 80]	31 (20 - 48.5)	0.034
<15	10 (11.9)			
15 - 30	34 (40.5)			
30 - 45	18 (21.4)			
45 - 60	15 (17.9)			
>60	7 (8.3)			
Patient category				0.327
Agreement	59 (70.2)			
Private	25 (29.8)			
Origin				0.647
Health zone	15 (17.9)			
Outside health zone	69 (82.1)			
Antecedent				-
High blood pressure	17 (20.29)			
Valvulopathy	1 (1.2)			

Continued

Pericarditis	1 (1.2)			
Epilepsy	2 (2.4)			
Gastritis	5 (5.9)			
Asthma	2 (2.4)			
Viral hepatitis	4 (4.8)			
Sickle cell disease	22 (26.2)			
Diabetes	2 (2.4)			
Obesity	12 (14.3)			
ARA/ERP	2 (2.4)			
Digestive cancer	3 (3.6)			
Alcohol poisoning	21 (25)			
BMI in Kg/m²		[13 - 45]	22.5 (19 - 27)	0.874
Thinness	18 (21.4)			
Normal	32 (38.1)			
Overweight	22 (26.2)			
Obesity	12 (14.3)			

Legend: ARA = acute renal attack, ERP = extrarenal purification, BMI = body mass index.

3.2. Additional Examination Data

Table 2 presents the data from the additional examinations.

The hemoglobin level was <7 g/dl in 40.5% and ≥7 g/dl in 59.5%. The platelet count was less than $150 \times 10^3/\text{mm}^3$ in 3.6%, between 150 and $450 \times 10^3/\text{mm}^3$ in 82.1% and $>450 \times 10^3/\text{mm}^3$ in 11.9%. The prothrombin level (PT) was normal (≥70%) in 51.2%, <70% in 35.7% and not achieved in 13.1%. Activated partial thromboplastin time (aPTT) was normal (<40 seconds) in 57.1%, pathological (≥40 seconds) in 17.9% and not achieved in 25%. Creatinemia was normal in 53.6%, pathological in 4.8% and not achieved in 41.6%. Transaminases were normal in 34.4%, pathological in 9.5% and not achieved in 56%. The electrocardiogram was normal in 2.4%, pathological in 6% and not performed in 91.6%. Cardiac ultrasound was normal in 3.6%, pathological in 4.8% and not performed in 91.6%. There were no significant differences for all variables.

Table 2. Data from additional examinations.

	n = 84 (%)	[Min-Max]	Median (IQR)	p
Hemoglobin in g/dl		[5 - 14]	11 (9 - 12)	0.41
<7	34 (40.5)			
≥7	50 (59.5)			
Platelet ($\times 10^3/\text{mm}^3$)		[78 - 783×10^3]	280.5 (214 - 355)	0.121
<150	5 (5.9)			
150 - 450	69 (82.1)			
>450	10 (11.9)			
PT in %		[10 - 142]	72 (60.5 - 85)	0.742
Not done	11 (13.1)			

Continued

<70 (low)	30 (35.7)			
≥70 (normal)	43 (51.2)			
aPTT in seconds		[20 - 68]	35 (30 - 38)	0.084
Not done	21 (25)			
Normal	48 (57.1)			
Pathological	15 (17.9)			
Creatinine mg/dl		[0 - 5]	1 (0 - 1)	0.113
Not done	35 (41.6)			
Normal (1.2)	45 (53.6)			
Pathological (≥1.2)	4 (4.8)			
AST in IU/L (X)		[12 - 474]	28 (15 - 42)	
ALT in IU/L (X)		[6 - 599]	22 (14 - 41)	
Transaminases				0.911
Not done	47 (56)			
Normal	29 (34.5)			
Pathological	8 (9.5)			
ECG				0.687
Not done	77 (91.6)			
Normal	2 (2.4)			
Pathological	5 (6)			
Echocardiography				0.724
Not done	77 (91.6)			
Normal	3 (3.6)			
Pathological	4 (4.8)			

Legend: PT = prothrombin level, APTT: activated partial thromboplastin time, ALT = alanine aminotransferase, AST = aspartate aminotransferase, ECG = electrocardiography. UI = international unit, X = average.

3.3. Anesthetic Data

Table 3 presents the anesthetic data.

Mallampati score was I (85.7%), II (12.1%), and III (2.2%). Cormack's grade was I in 94% and II in 6%. The ASA class was: I (35.2%), II (36.3%) and III (28.6%). Premedication was used in 19.8%. Anesthesia was general with intubation in 96.4%, combined with spinal anesthesia in 3.6%. The duration of anesthesia was less than two hours in 46.2% and two hours or more in 53.8%. The anesthetic products used were: propofol (94.6%), sevoflurane (79.1%), sufentanil (59.3%), suxamethonium (47.3%), pancuronium (42.9%), atracurium (40.5%), fentanyl (37.4%), prostigmine (16.5%), isoflurane (16.5%), rocuronium (8.82%), bupivacaine (4.4%), morphine (3.3%) and ketamine (2.2%). Postoperative analgesia used

morphine in 27.5%.

Table 3. Anesthesia data.

Variables	N = 84 (%)	[Min-Max]	Median (IQR)	p
Mallampati				0.746
1	71 (84.5)			
2	11 (13.1)			
3	2 (2.4)			
Grade of Cormack and Lehane				0.04
1	79 (94.5)			
2	5 (5.95)			
ASA				0.888
1	28 (33.3)			
2	31 (36.9)			
3	25 (29.8)			
Premedication	18 (21.4)			
Type of anesthesia				0.072
GA with OTI	81 (96.4)			
SA + GA with OTI	3 (3.6)			
Duration of anesthesia in hours		[50 - 450]	120 (85 - 170)	0.036
<2	38 (45.2)			
≥2	46 (54.8)			
Anesthetic products				
Propofol	82 (87.6)			
Sevoflurane	69 (82.1)			
Sufentanil	48 (57.1)			
Suxamethonium	43 (51.2)			
Pancuronium	38 (45.2)			
Atracurium	35 (41.7)			
Fentanyl	36 (42.9)			
Isoflurane	15 (17.9)			
Rocuronium	8 (9.5)			
Bupivacaine	3 (3.6)			
Morphine	3 (3.6)			
Ketamine	2 (2.4)			
Postoperative analgesia				0.330
Without morphine	60 (71.43)			
With morphine	24 (28.57)			

Legend: ASA = American Society of anesthesiologists, GA= general anesthesia, OTI = oro-tracheal intubation, SA: spinal anesthesia.

3.4. Surgical Data

Table 4 presents the surgical data.

The indications for surgery were: appendicitis (17.9%), lithiasis with or without

cholecystitis (52.4%), diagnostic exploration (5.95%), hernia (7.1%), gynecological pathology (5.95%) including: (uterine myoma, endometriosis, ruptured hemorrhagic ovarian cyst, recto colpocele) and other pathologies (11.9%) including: splenic abscess, splenomegaly, digestive fistula, gastric cancer, duodenal cancer, pyocholecyst with liver abscess and Hirschprung disease. The surgical specialties were: adult digestive surgery (76.2%), pediatric surgery (17.9%) and gynecology (5.95%). The surgical procedures were: cholecystectomy (52.4%), appendectomy (17.9%), exploration (8.3%), hernia repair (7.1%); gynecological procedures (7.1%) including: myomectomy, ovarian cystectomy, hysterectomy and removal of endometriosis nodule; other procedures: splenectomy, splenectomy with cholecystectomy, gastroduodenal anastomosis, hepato-cholecystectomy, incision drainage of hepatic abscess plus cholecystectomy and cleaning. The average duration of surgery was 103 minutes and it was less than two hours in 67.85% and two hours or more in 32.15%. Three interventions were transformed into open surgery.

Table 4. Surgical data.

Variables	n = 84 (%)	[Min-Max]	Median (IQR)	p
Indication				0.899
Appendicitis	15 (17.9)			
Lithiasis + or – cholecystitis	44 (52.4)			
Diagnostic	5 (5.95)			
Hernia	6 (7.1)			
Gynecological	5 (5.95)			
Other intraabdominal pathology	10 (11.9)			
Surgical specialty				0.291
Gynecology	5 (5.95)			
Digestive Surgery	64 (76.2)			
Pediatric surgery	15 (17.9)			
Main surgical procedure				0.484
Appendectomy	15 (17.9)			
Cholecystectomy	44 (52.4)			
Exploration	7 (8.3)			
Hernia cure	6 (7.1)			
Gynecological procedures	6 (7.1)			
Other acts	8 (9.5)			
Duration of surgery in hours		[25 - 400]	80 (50 - 140)	0.027
<2	57 (67.85)			
≥2	27 (32.15)			
Transformation into open	3 (3.6)			

3.5. Scalable Data

Table 5 presents the intra- and postoperative complications.

Intraoperative complications were present in 17.9% and consisted of: arterial hypotension (8.3%), probable allergic reaction (3.6%), spasm (2.4%), accidental gallbladder perforation (1.2%), common bile duct injury (1.2%), hemorrhage (1.2%) and carbon dioxide failure (1.2%). Postoperative complications were present in 10% and consisted of: anemia requiring transfusion (3.6%), vomiting (1.2%), digestive fistula (2.4%), septic shock (1.2%), failure multi-visceral (1.2%), acute lung edema due to valvular disease (1.2%) and there were three deaths or 3.6% caused by cancer with metastasis, multi-organ failure and a probably stroke likely. The length of hospital stay was two days for 18 patients (21.4%), three days for 40 patients (47%), four days for 11 patients (13.1%) and five days or more for 15 patients (17.8%).

Table 5. Intra and postoperative complications.

Variables	Frequency (n = 84)	%
Intraoperative complications		
Absent	69	82.1
Low blood pressure	7	8.3
Probable allergic reaction	3	3.6
Spasm	2	2.4
Gallbladder perforation	1	1.2
Common bile duct injury	1	1.2
Hemorrhage	1	1.2
Carbon dioxide outage	1	1.2
Intraoperative transfusion	10	11.9
Postoperative complications		
Absent	76	90
Anemia requiring transfusion	3	3.6
Vomiting	1	1.2
Surgical revision	3	3.6
Digestive fistula and biliary fistula	2	2.4
Septic shock	1	1.2
Multi-organ failure	1	1.2
Acute pulmonary edema	1	1.2
Vaso -occlusive crisis	1	1.2
Death (stroke, cancer, MOF)	3	3.6
Length of hospital stay (X and extreme)	4.2 (1 to 10)	
Two days	18	21.4
Three days	40	47.6
Four days	11	13.19
Five days more	15	17.8

Legend: MOF = multiple organ failure, X = average.

3.6. Factors Associated with Complications

Table 6 presents factors associated with complications.

In multivariate analysis, alcohol consumption was associated with intraoperative complications. While anesthesia duration greater than two hours, ASA3 class, alcohol consumption and cholecystectomy were associated with the occurrence of postoperative complications.

Table 6. Factors associated with complications.

Factors associated with intraoperative complications				
Variables	p-Value	OR (95% CI)	p-Value	ORa (95% CI)
Age < 60 years	0.044	0.11 (0.015 - 0.94)	0.038	0.13 (0.018 - 0.94)
Anesthesia duration ≥ 2 hours	0.065	1.52 (0.73 - 9.98)	0.371	0.97 (0.55 - 3.6)
Surgery duration ≥ 2 hours	0.519	0.53 (0.07 - 3.6)	1	0
Female gender	0.063	1.46 (0.61 - 6.88)	0.091	1.41 (0.45 - 6.05)
Cardiovascular disease	0.253	1.19 (0.48 - 7.5)	0.418	1.2 (0.35 - 5.6)
Alcohol consumption	0.082	1.56 (0.71 - 7.7)	0.019	1.98 (1.13 - 9.1)
Hemoglobin < 7 g/dl	0.87	0.87 (0.17 - 4.45)	0.987	0.81 (0.12 - 4.78)
ASA3	0.997	1.08 (0.01 - 3.9)	0.72	1.14 (0.14 - 8.7)
Indication				
Appendicitis and exploration	1	0	1	0
Cholecystectomy	0.991	0.98 (0.05 - 17.9)	0.013	1.3 (1.06 - 8.84)
Hernia	1	0	1	0
Factors associated with postoperative complications				
Variables	p-Value	OR (95% CI)	p-Value	ORa (95% CI)
Age > 60 years	0.296	0.25 (0.02 - 3.29)	0.051	0.15 (0.01 - 1.16)
Anesthesia duration ≥ 2 hours	0.087	1.2 (0.83 - 11.12)	0.032	2.21 (1.35 - 14)
Surgery duration ≥ 2 hours	0.998	1.0 (0.83 - 11.12)	0.43	0.48 (0.08 - 2.8)
Female gender	0.452	0.54 (0.11 - 2.6)	0.336	0.52 (0.13 - 1.96)
Cardiovascular disease	0.773	1.36 (0.16 - 11.3)	0.925	1.08 (0.2 - 5.8)
Alcohol	0.046	1.98 (1.32 - 12.3)	0.018	3.27 (1.56 - 19.6)
Hb < 7 g/dl	0.756	0.74 (0.12 - 4.8)	1	0
Sickle cell disease	0.612	2.96 (0.05 - 15.9)	0.522	1.89 (0.65 - 7.21)
ASA3	0.058	2.04 (0.94 - 16.99)	0.017	3.57 (1.57 - 22.3)
Indication				
Appendicitis and Exploration	1	0	1	0
Cholecystectomy	0.53	1.87 (0.25 - 13.8)	0.013	1.3 (1.06 - 8.84)
Hernia	1	0	1	0

Legend: ASA = American Society of Anesthesiologists, Hb = hemoglobin.

4. Discussion

This study was carried out to report the experience of laparoscopic anesthesia at the secondary level hospital located in suburban environment which only concerned 84 patients or 4.2% of eligible cases. The median age was 31 years with a predominance of the group between 15 and 30 years ($p = 0.034$) and of the female gender. Patients cared for by their companies were the majority. Indeed, the cost of laparoscopic surgery remains higher than open surgery, so patients whose costs (medical expenses, instead of costs) are covered by the company have access to it more easily than those who have to provide by themselves. Note that health coverage is not yet effective for surgery in the DRC. Comorbidities were: sickle cell disease (25.3%), alcohol consumption (25%), cardiovascular pathology (17.6%) and obesity (14.3%). Paraclinical examinations were not systematically requested. The ASA class was: I (35.2%), II (36.3%) and III (28.6%). Anesthesia was general with intubation for all patients maintained with halogens. The indications for operation were mainly vesicular and appendicular. Anesthesia often lasted more than two hours and postoperative analgesia used morphine in 27.5%. All patients were treated in hospital. Intraoperative complications were present in 18.7% and mainly represented by arterial hypotension (9.8%). Postoperative complications were present in 9.9% and consisted mainly of anemia requiring transfusion (5.4%) and three deaths (metastatic cancer, multiple organ failure and stroke) were recorded postoperatively. Alcohol consumption and ASA class 3 were associated with intraoperative complications. Anesthesia duration greater than two hours, ASA3 class, alcohol consumption and cholecystectomy were associated with postoperative complications.

Anesthesia was general with intubation for all patients although the literature abounds for locoregional anesthesia, particularly perimedullary anesthesia [11] [18]. The debate on the choice between general anesthesia and locoregional anesthesia remains open, the patient's opinion should sometimes be preponderant and certain intraoperative positions are uncomfortable for the patient under locoregional anesthesia. A recent meta-analysis [19] in laparoscopic gynecological surgery did not show the advantages of spinal anesthesia compared to general anesthesia. The laryngeal mask although recommended by certain authors [8] [9] was not used due to the risk of inhalation as the duration of surgery often exceeded one hour. The little team experience does not yet allow this risk to be taken. No cholecystectomy or appendectomy was performed under regional anesthesia. However, cases of cholecystectomy and appendectomy by laparoscopic surgery under locoregional anesthesia peri-medullary are published in the literature [20] [21].

Maintenance of anesthesia was done with halogens (sevoflurane or isoflurane) for all patients although the literature suggests total intravenous anesthesia with propofol because of the postoperative nausea and vomiting common in this type of surgery [22]. However, prevention with dexamethasone and ondasetron was

often used and vomiting occurred in 1.2%. The duration of anesthesia was less than two hours in 46.2% and two hours or more in 53.8%. It must be recognized that the durations of the acts were quite long due to learning. In fact, most often it was a single laparoscopist who worked with the learners and also trained them in the technique, which extended the duration of the procedures.

Postoperative analgesia used morphine in 27.5% without the use of peripheral blocks, particularly the transversus abdominis block, and rarely local infiltration of xylocaine, contrary to certain literature which reports nearly 80% use of opioids [6].

The operating indications were dominated by appendicitis (16.5%) and lithiasis with or without cholecystitis (48.4%). This corroborates literature data [14] [15]. Pyloromyotomy for hypertrophic pyloric stenosis is currently performed under laparoscopic surgery [13]. No cases of newborns were recorded in this series due to lack of equipment adapted to this type of patient; the youngest in this series was two years old. The management of ruptured ectopic pregnancy, already possible even in less developed countries [23], was not possible due to the availability of the surgeon.

Eleven patients, or 11.9%, including 7 who underwent diagnostic laparoscopy, were not hospitalized; however, all patients treated for interventional laparoscopy were hospitalized, although laparoscopic surgery has the advantage of being performed on an outpatient basis [24] [25]. The reason is the level of understanding of patients, the journeys made from home to hospital, the duration of which varies greatly due to transport difficulties (traffic jams on the road) in the city of Kinshasa. However, a meta-analysis of randomized controlled trials did not show the advantages of ambulatory cholecystectomy compared to hospitalization in terms of mortality and morbidity except patient satisfaction which was in favor of ambulatory surgery [26]. It should be noted that apart from the blood count, all other examinations were not systematically requested in all patients in accordance with the recommendations of the French Society of Anesthesia and Intensive Care [27].

Intraoperative complications were present in 18.7% and dominated by arterial hypotension (9.8%) in accordance with literature data [1]-[6]. Indeed, from the insufflation of carbon dioxide, after a brief increase in blood pressure linked to the increase in vascular resistance, especially splanchnic resistance, the drop in venous return following the increase in intra-abdominal pressure is accompanied by a reduction in venous return and stroke volume and therefore a reduction in blood pressure [1]-[6]. A significant increase in airway pressures was not observed, nor a significant decrease in tidal volume, probably because the increase in intra-abdominal pressure was limited to less than 16 mmHg. Indeed, intra-abdominal pressure greater than 20 mmHg is associated with an increase in respiratory and hemodynamic complications [6]. An accidental injury to the common bile duct had occurred and required conversion to laparotomy for repair without any consequences. On the other hand, the accidental perforation of the vesicle before its extraction was managed under laparoscopic surgery without problem.

It must be recognized that the allergic reactions suspected in 3.6% were not the subject of an allergological investigation due to lack of resources. Postoperative complications present in 9.9% mainly consisted of anemia requiring transfusion (5.4%). This is explained by the fact that 25% of patients had sickle cell disease, 20% had hemoglobin <7 g/dl preoperatively. Note that for all these sickle cell patients, no transfusion exchange or measurement of hemoglobin levels was carried out. A case of biliary fistula occurred postoperatively and was always treated laparoscopically without any vital or functional consequences. On the other hand, the case of digestive fistula (2.1%), on the ground of metastasized cancer in an 80-year-old patient died in a picture of septic shock. ASA class 3 multiplies by 4 the risk of complications in accordance with data from the general literature [28]. While age below 60 was protective. Without an obvious explanation, alcohol consumption was associated with the occurrence of intra- and postoperative complications (risk multiplied by 2 and 3). Indeed, none of the patients in this series had cirrhosis, only one had metastatic liver cancer and none were in liver failure. In Kamaran's study [29], male sex was an independent risk factor for conversion to open surgery (aOR 2.65 (1.03 - 6.94)). In this series, during cholecystectomy, only one case of conversion was recorded following damage to the common bile duct without the necessary equipment for its repair under laparoscopy. Cholecystectomy appears to be a factor associated with the occurrence of postoperative complications, but this is a bias probably due to the small size of the sample. Cholecystectomy is one of the oldest and easiest procedures to perform in laparoscopic surgery [14] [15]. The absence of surgeons trained in laparoscopy seems to be an important factor limiting the development of laparoscopic surgery in low-income countries such as the DRC, in accordance with the results of the of the systematic review carried out by Wilkinson in 2021 [30].

This study has the limitations of being single-center and retrospective but has the merit of being the first published and allows us to note that laparoscopic surgery is beginning to be practiced in the city of Kinshasa and in the DRC.

5. Conclusion

Laparoscopic surgery is not yet established at the MHC due to the absence of permanent surgeon(s) and its cost which is higher than open surgery and perhaps also the under-information of patients on the advantages of the technique. Subsequent studies investigating the determinants of the non-development of laparoscopic surgery prove useful in verifying these hypotheses in DRC.

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Contribution of the Authors

Alphonse Mosolo: study design, data collection and writing of the manuscript.

Wilfrid Mbombo: study design, data collection and writing of the manuscript.

Freddy Mbuyi: data collection and correction of the manuscript.

Marc Tshilanda: statistical analyses.

All other authors: correction of the manuscript.

Conflicts of Interest

All authors declare no conflict of interest in this work.

References

- [1] Gut, C.N., Oniu, T., Mehrabi, A., Schemmer, P., Kashfi, A., Kraus, T., et al. (2004) Circulatory and Respiratory Complications of Carbon Dioxide Insufflation. *Digestive Surgery*, **21**, 95-105. <https://doi.org/10.1159/000077038>
- [2] Zuckerman, R.S. and Heneghan, S. (2002) The Duration of Hemodynamic Depression during Laparoscopic Cholecystectomy. *Surgical Endoscopy*, **16**, 1233-1236. <https://doi.org/10.1007/s00464-001-9152-0>
- [3] Rauh, R., Hemmerling, T.M., Rist, M. and Jacobi, K.E. (2001) Influence of Pneumoperitoneum and Patient Positioning on Respiratory System Compliance. *Journal of Clinical Anesthesia*, **13**, 361-365. [https://doi.org/10.1016/S0952-8180\(01\)00286-0](https://doi.org/10.1016/S0952-8180(01)00286-0)
- [4] Hirvonen, E.A., Poikolainen, E.O., Pääkkönen, M.E. and Nuutinen, L.S. (2000) The Adverse Hemodynamic Effects of Anesthesia, Head-Up Tilt, and Carbon Dioxide Pneumoperitoneum during Laparoscopic Cholecystectomy. *Surgical Endoscopy*, **14**, 272-277. <https://doi.org/10.1007/s004640000038>
- [5] Gokdemir, B.N. and Cekmen, N. (2023) Laparoscopic Surgery and Anesthesia. *JARSS*, **31**, 173-187. <https://doi.org/10.54875/jarss.2023.63496>
- [6] Hayden, P. and Cowman, S. (2011) Anaesthesia for Laparoscopic Surgery. *Continuing Education in Anaesthesia, Critical Care & Pain*, **11**, 177-180. <https://doi.org/10.1093/bjaceaccp/mkr027>
- [7] Gerges, F.J., Kanazi, G.E. and Jabbour-Khouri, S.I. (2006) Anesthesia for Laparoscopy: A Review. *Journal of Clinical Anesthesia*, **18**, 67-78. <https://doi.org/10.1016/j.jclinane.2005.01.013>
- [8] Maltby, J.R., Beriault, M.T., Watson, N.C., Liepert, D. and Fick, G.H. (2002) The LMA-ProSeal™ Is an Effective Alternative to Tracheal Intubation for Laparoscopic Cholecystectomy. *Canadian Journal of Anesthesia*, **49**, 857-862. <https://doi.org/10.1007/BF03017420>
- [9] Maltby, J.R., Beriault, M.T., Watson, N.C., Liepert, D.J. and Fick, G.H. (2003) LMA Classic and LMA-ProSeal Are Effective Alternatives to Endotracheal Intubation for Gynecologic Laparoscopy. *Canadian Journal of Anesthesia*, **50**, 71-77. <https://doi.org/10.1007/BF03020191>
- [10] Imbelloni, L.E., Fornasari, M., Fialho, J.C., Sant'Anna, R. and Cordeiro, J.A. (2010) General Anesthesia versus Spinal Anesthesia for Laparoscopic Cholecystectomy. *Revista Brasileira de Anestesiologia*, **60**, 217-227. [https://doi.org/10.1016/S0034-7094\(10\)70030-1](https://doi.org/10.1016/S0034-7094(10)70030-1)
- [11] Tiwari, S., Chauhan, A., Chatterjee, P. and Alam, M.T. (2013) Laparoscopic Cholecystectomy under Spinal Anaesthesia: A Prospective, Randomized Study. *Journal of*

- Minimal Access Surgery*, **9**, 65-71. <https://doi.org/10.4103/0972-9941.110965>
- [12] Uğur, B.K., Pırbudak, L., Öztürk, E., Balat, Ö. and Uğur, M.G. (2020) Spinal versus General Anesthesia in Gynecologic Laparoscopy: A Prospective, Randomized Study. *Turkish Journal of Obstetrics and Gynecology*, **17**, 186-195. <https://doi.org/10.4274/tjod.galenos.2020.28928>
- [13] Alain, J.L., Grousseau, D., Longis, B., Ugazzi, M. and Terrier, G. (1996) Extramucosal Pyloromyotomy by Laparoscopy. *European Journal of Pediatric Surgery*, **6**, 10-12. <https://doi.org/10.1055/s-2008-1066457>
- [14] Peycelon, M., Parmentier, B., Raquillet, C., Louvet, N., Audry, G., et al. (2013) Videosurgery in Children: Current Progress and Future Perspectives. *Archives de Pédiatrie*, **20**, 509-516. <https://doi.org/10.1016/j.arcped.2013.02.073>
- [15] Keus, F., Gooszen, H.G. and Van Laarhoven, C.J. (2010) Open, Small-Incision, or Laparoscopic Cholecystectomy for Patients with Symptomatic Cholecystolithiasis. An Overview of Cochrane Hepato-Biliary Group Reviews. *About the Cochrane Database of Systematic Reviews*, No. 1, CD008318. <https://doi.org/10.1002/14651858.CD008318>
- [16] Bowers, S.P. and Hunter, J.G. (2006) Contraindications to Laparoscopy. In: Whelan, R.L., Fleshman, J.W. and Fowler, D.L., Eds., *The Sages Manual*, Springer, 25-32. https://doi.org/10.1007/0-387-29050-8_4
- [17] Muamba, J.D., Mbombo, W., Nantulu, C., Mfulani, G., Mubunda, R., Kandongo, D., et al. (2023) Inventory of the Practice of Sedation Procedural Analgesia in Digestive Endoscopy: Cases of the Hospitals in the City of Kinshasa. *International Journal of Anesthesia and Clinical Medicine*, **11**, 106-114.
- [18] Bajwa, S.J.S. and Kulshrestha, A. (2016) Anaesthesia for Laparoscopic Surgery: General vs Regional Anesthesia. *Journal of Minimal Access Surgery*, **12**, 4-9. <https://doi.org/10.4103/0972-9941.169952>
- [19] Corte, L.D., Mercurio, A., Morra, I., Riemmam G, de Franciscis, P., Palumbo, M., et al. (2022) Spinal Anesthesia versus General Anesthesia in Gynecological Laparoscopic Surgery: A Systematic Review and Meta-Analysis. *Gynecologic and Obstetric Investigation*, **87**, 1-11. <https://doi.org/10.1159/000521364>
- [20] Mazzone, C., Sofia, M., Sarv , I., Litrico, G., Di Stefano, A.M.L., La Greca, G., et al. (2023) Awake Laparoscopic Cholecystectomy: A Case Report and Review of Literature. *World Journal of Clinical Cases*, **11**, 3002-3009. <https://doi.org/10.12998/wjcc.v11.i13.3002>
- [21] Uzman, S., Donmez, T., Erdem, V.M., Hut, A., Yildirim, D. and Akinci, M. (2017) Combined Spinal-Epidural Anesthesia in Laparoscopic Appendectomy: A Prospective Feasibility Study. *Annals of Surgical Treatment and Research*, **92**, 208-213. <https://doi.org/10.4174/astr.2017.92.4.208>
- [22] Inada, E. (2016) [Anesthetic Management of Gynecological Laparoscopic Surgery]. *Masui*, **65**, 918-923. (In Japanese)
- [23] Edjo Nkilly, G., Okoue Ondo, R., Matsanga, A., Sougou, E., Manli, D., Tchantchou, T.D.D., et al. (2020) Management of Ruptured Ectopic Pregnancies: Celiosurgery versus Laparotomy. *Health Sciences and Disease*, **21**, 21-24.
- [24] Balciscuet, A.I., Barber , F., Lorenzo, J., Mart nez, S., Sebasti n, M. and Balciscueta, Z. (2021) Ambulatory Laparoscopic Cholecystectomy: Systematic Review and Meta-Analysis of Predictors of Failure. *Surgery*, **170**, 373-382. <https://doi.org/10.1016/j.surg.2020.12.029>
- [25] Johanet, H., Laubreau, C., Barei, R., Descout, F., Foulon, J.P. and Tixier, V. (2002)

- Outpatient Laparoscopic Cholecystectomy. *Annals of Surgery*, **127**, 121-125.
[https://doi.org/10.1016/S0003-3944\(01\)00695-2](https://doi.org/10.1016/S0003-3944(01)00695-2)
- [26] Hao, X.Y., Shen, Y.F., Wei, Y.G., et al. (2017) Safety and Effectiveness of Day-Surgery Laparoscopic Cholecystectomy Is Still Uncertain: Meta-Analysis of Eight Randomized Controlled Trials Based on GRADE Approach. *Surgical Endoscopy*, **31**, 4950-4963. <https://doi.org/10.1007/s00464-017-5610-1>
- [27] Mollieux, S., Pierre, S., Bléry, C., Marret, E. and Beloeil, B. (2012) Formalized Recommendations from SFAR Experts: Systematic Pre-Interventional Examinations. *AFAR*, **31**, 752-763. <https://doi.org/10.1016/j.annfar.2012.06.009>
- [28] Thepmankorn, P., Choi, C.B., Haimowitz, S.Z., Parray, A., Grube, J.G., Fang, C.H., Baredes, S. and Eloy, J.A. (2022) ASA Physical Status Classification and Complications Following Facial Fracture Repair. *Annals of Otolaryngology, Rhinology & Laryngology*, **131**, 1252-1260. <https://doi.org/10.1177/00034894211059599>
- [29] Kamran, K., Afridi, Z.U., Muqim, R.U. and Khalil, J. (2013) Does Sex Affect the Outcome of Laparoscopic Cholecystectomy?: A Retrospective Analysis of Single Center Experience. *Asian Journal of Endoscopic Surgery*, **6**, 21-25.
<https://doi.org/10.1111/j.1758-5910.2012.00152.x>
- [30] Wilkinson, E., Aruparayil, N., Gnanaraj, J., Brown, J., Jayne, D. (2021) Barriers to Training in Laparoscopic Surgery in Low- and Middle-Income Countries: A Systematic Review. *Tropical Doctor*, **51**, 408-414.
<https://doi.org/10.1177/0049475521998186>