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EFFECT OF RESIDENT POST-GRADUATE YEAR ON OUTCOMES AFTER LAPAROSCOPIC CHOLECYSTECTOMY

Thesis

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By

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TO OBTAIN A MEDICAL DOCTORATE

KEYWORDS :

Laparoscopic cholecystectomy - Residents in training - Operative time - Complications - Patients' Outcomes.

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LIST OF ABBREVIATIONS

ASA	:American Society of anesthesiologists physical status classification
CT scan	:computerized tomography scan
LC	:Laparoscopic Cholecystectomy
MRI	:Magnetic resonance imaging
OR	:Operative room
PERI-OP	:Preoperative
POST-OP	: Postoperative
RD	:Resident trainees
SS	:Senior Surgeon

INTRODUCTION

Since Philippe Mouret performed the first laparoscopic cholecystectomy in 1987 [1], considerable progress has been made in the field of surgical instruments and equipment, and a great deal of experience in performing the laparoscopic cholecystectomy was acquired around the world.

One of the great advantages of laparoscopy is the possibility for the entire surgical team to see with the eyes of the surgeon.

For the surgeon in training, this is an important educational opportunity than the open surgery in which, in some steps of the operation, his vision is severely restricted.

Despite this advantage, there are some limitations of the laparoscopic surgery which are represented by the lack of tactile feedback, 2-dimensional vision, limited degree of movement of the instruments, and loss of natural hand-eye coordination.[2]

The teaching of laparoscopic surgery should be based not just on knowledge of the anatomy and the steps of operation but also on the learning of gestures and tricks of surgical technique which in some cases may be different from the laparotomy surgery. [3]

The primary aim of our study was to analyze whether the laparoscopic cholecystectomy performed by surgeons in training is a safe procedure by comparing the same operation performed by trainees and staff surgeons. The secondary aim was to analyze the possible differences within the group of surgeons in training with the progress of their learning-curve.

CHAPTER II

REVIEW OF THE LITERATURE

I.Biliary colic: Definition and clinical manifestations

Biliary colic (BC) is the term used for gallbladder (GB) pain experienced by patients without overt infection around the gall-bladder.

The pain is located in the epigastrium or right upper quadrant of the abdomen and is typically colicky in nature due to muscular spasm of the GB wall secondary to outflow tract obstruction [4].

Biliary colic is a syndrome typified by pain that ensues when an obstructing stone causes sudden distension of the gallbladder. “Colic” as defined in the dictionary as paroxysmal pain in the abdomen, is a misnomer, as biliary pain typically does not increase and decrease spasmodically. Severe right upper quadrant or epigastric pain begins suddenly and intensifies.

This steady pain usually lasts between 15 minutes to six hours and then gradually disappears over 30 to 90 minutes, leaving a vague ache and may be associated with nausea and vomiting. Its duration is seldom less than 15 minutes. The pain is often sufficiently severe for some to seek medical attention requiring the use of narcotics for relief. Episodes of pain occur irregularly (episodic), separated by pain-free periods lasting from days to years. The severity of pain also varies. This pain is unrelated to bowel movements and not associated with urination [5].

Biliary type pain can be precipitated following a large meal, the so-called “fatty food intolerance,” but is not specific for biliary tract disease. Biliary pain is mediated by splanchnic nerves and may radiate like angina to the back, right scapula or shoulder tip, or down the arm or into the neck. In rare circumstances, the pain may also be confined to the back [6].

BC affects 1-4% of the adult population known to suffer with cholelithiasis (gallstones) and is the most common presenting symptom [7].

II. Gallstone disease

1. Epidemiology

Gallstones are a common problem in developed countries. Gallstones are found in 10% to 15% of the adult population, but only about 20% of people with stones develop any biliary pain or complications such as acute cholecystitis, cholangitis or pancreatitis. The mortality rate for gallstone disease is relatively low at 0.6%. Women are twice as likely to develop gallstones as men. Some of the risk factors for cholesterol gallstones are not modifiable, for example ethnic and genetic background, increasing age and female gender. Modifiable risk factors include obesity, rapid weight loss, sedentary lifestyle and long-term parenteral nutrition. Certain situations where there is stasis in the gallbladder (spinal cord injury or use of drugs such as somatostatin) increase the risk for gallstones. Incremental obesity might increase the prevalence of cholesterol gallstones. In the United States there are an estimated 1.8 million visits in hospitals per year due to gallstone disease. In most of cases the visits are ambulatory and do not require overnight admission [7].

In France, the incidence of gallstones in the general population is 13.6 %. The number of cholecystectomies in France in 2010 was 106 060 (National Health Authority). Obesity appears to be a risk factor, increasing the incidence of nephrolithiasis of 21 to 38.5% in the obese population. Several histological study of the gallbladder in the obese population regained 86-97% of anomalies recovering 25% calculations, 50% of chronic cholecystitis and 38% of sludge. [7]

In Morocco, no official data allows to specify the incidence of gallstone disease in the general population and its repercussion.

2. Symptoms and Clinical Features

Most people with gallstones do not have symptoms; however those who do have symptoms are much more likely to develop complications. Seventy to 80% of symptomatic patients complain of biliary colic. Biliary colic is a visceral pain, thought to be caused by functional spasm, resulting from transient obstruction of the cystic duct by a stone. [8] The pain is characterized as episodic and severe epigastric pain; less commonly, it is located in the right upper quadrant, left upper quadrant, precordium, or lower abdomen. The pain generally has a sudden onset, rising in intensity, and lasting from 15 minutes to several hours. Pain may be accompanied by radiation to the interscapular region or the right shoulder often with vomiting and diaphoresis. Biliary colic may also present with symptoms of nonspecific dyspepsia such as intolerance of fatty foods, pyrosis, flatulence, aerophagia sweating, yellowish color of skin or sclera of the eye, and clay-colored stools are symptoms that suggest complications such as cholangitis and choledocholithiasis and warrant immediate medical attention. [9] The interval between “attacks” is unpredictable and may range from days to months or years. [10]

III Laparoscopic Cholecystectomy

"An Invention to Visualize the Internal Parts of the Body and their Diseases, with Illustrations"

Philip Bozzini, 1806

1. Overview

Laparoscopic cholecystectomy is a procedure in which the gallbladder is removed by laparoscopic techniques.

Laparoscopy is the endoscopic examination of the peritoneal cavity. A modern laparoscope is a rigid device with an optical channel which allows a view into the peritoneal cavity. A camera is attached to the exterior end of the laparoscope to allow recording and more comfortable viewing of the procedure. The optical channel is usually surrounded by a second channel which transmits the light that illuminates the peritoneal cavity. The light is supplied by fiber optic cable from a high intensity light source. [12]

The laparoscope and other surgical instruments are introduced into the peritoneal cavity through sleeves called trocars. These sleeves are 2-14mm in diameter. Smaller instruments, less than 4mm, may be introduced without a trocar. An insufflator is attached to a trocar, often the one holding the laparoscope and it creates and sustains a pneumoperitoneum. This inflation creates enough room for the surgeon to work. When the intervention is complete, the pneumoperitoneum is released and the instruments and trocars are removed. [13]

Laparoscopic surgery is part of the growing field of minimally invasive surgery. The goal of minimally invasive surgery is to perform the surgical intervention with as little damage to other structures as possible. These procedures typically result in faster recovery for the patient but present greater difficulty for the surgeon. [14]

2. Historic

Laparoscopic surgery, as it is currently performed, is a fairly recent development. However, the basic principles and methods used in modern laparoscopic surgery date back over one hundred years, and the general notion of examination of abdominal organs without making a large incision dates back over a thousand years. [15]

The earliest historical evidence of endoscopy comes from excavation of Pompeii (buried in an eruption in 79 A.D.). Archeologists found “specula” thought to have been used for vaginal, rectal, nasal, and otic examinations. A reference that is likely to have been contemporary occurs in the Talmud of Babylon (collated and recorded during the 4th century, but recorded largely from 1st century scholars) and refers to a lead pipe used to visualize the cervix via the vagina. [15]

The Arabian physician Albukasim (936-1013) is credited as being first to examine an internal organ (the cervix) using reflected light. Giulio Cesare Aranzi (1530-1589) followed later using mirrors and a camera.

The first interaction of gallstones and surgery dates back to 1687 when Stal Pert Von Der Wiel, while operating a patient with purulent peritonitis accidentally found gallstones. Nonetheless, the treatment of symptomatic gallstone disease remained primitive and ineffective until the 18th century.

Jean-Louis Petit, the founder of gall bladder surgery in 1733 suggested removal of gallstone and drainage of the gall bladder, thus creating fistula in patients with empyema, which he successfully performed in 1743.

Marion Simms must be credited with designing, perfecting and performing the first cholecystectomy on a 45-year-old woman with obstructive jaundice in 1878. [16] The modern methods of endoscopy rises in 1805 when Bozzini and an obstetrician

from Frankfurt began using the light of a candle directed to the tube for urethra and vagina inspection.

In 1897 the Berlin urologist Nitze together with the optician Rayne and a Viennese master contrived the first cystoscope equipped with lenses and a platinum conductor to create a lighting effect.

In 1910 Jakobeus, a surgeon from Stockholm, using a cystoscope performed the first successful laparoscopy and thoracoscopy on a human, and imported the term of laparoscopy into practice. [17]

In 1938 Yanosh Veresh from Hungary created a safe needle with a spring obturator for setting pneumothorax.

In 1947 Raul Palmer suggested the principle of control of abdominal pressure at insufflation.

In 1977 De Kok started performing appendectomy with a partial laparoscopic support.

In 1985 the surgeon Muhe from Germany first introduced the operation of laparoscopic cholecystectomy by using carbonic gas for insufflation, and a modified proctoscope for visualization. [17]

In 1987 in Lyon (France) the surgeon Philip Mouret performed laparoscopic cholecystectomy by using traditional laparoscopic technologies.

In 1997 Navarra described the first single incision laparoscopic cholecystectomy (SILC) but failed to gain popularity due to lack of proper instrumentation. [18; 19]

In 1999, Gagner and Garcia-Ruiz performed the first mini-laparoscopic cholecystectomy (MLC) with three 3-mm ports with either 10-mm or 12-mm ports gained a wide attention at the end of 1990s and at the beginning of 2000. [20]

A new evolution in the history of gallbladder surgery occurred in the past few years with the first cases of cholecystectomy by NATURAL ORIFICE TRANSLUMINAL ENDOSCOPIC CHOLECYSTECTOMY (NOTES). After several reports in animal models, Marescaux et al [21] performed the first NOTES cholecystectomy in a patient using transvaginal access and a single 2-mm abdominal entry port. The proponents of NOTES cite reduced postoperative pain, improved cosmetic and no significant difference in postoperative complications or rate of bile duct injury between TVC and CLC. Moreover, several studies reported no dyspareunia or difference in return to sexual activity between TVC and CLC groups after short-term follow up. TVC seems safe in selected patients when performed by skilled surgeons, but should be evaluated with regards to potential risks on subsequent fertility and discomfort during sexual intercourse. [22]

On September 7, 2001, Dr. Jacques Marescaux and Dr. Michel Gagner, while in New York, used the Zeus robotic system to remotely perform a cholecystectomy on a 68 year old female patient who was in Strasbourg, France. [23]

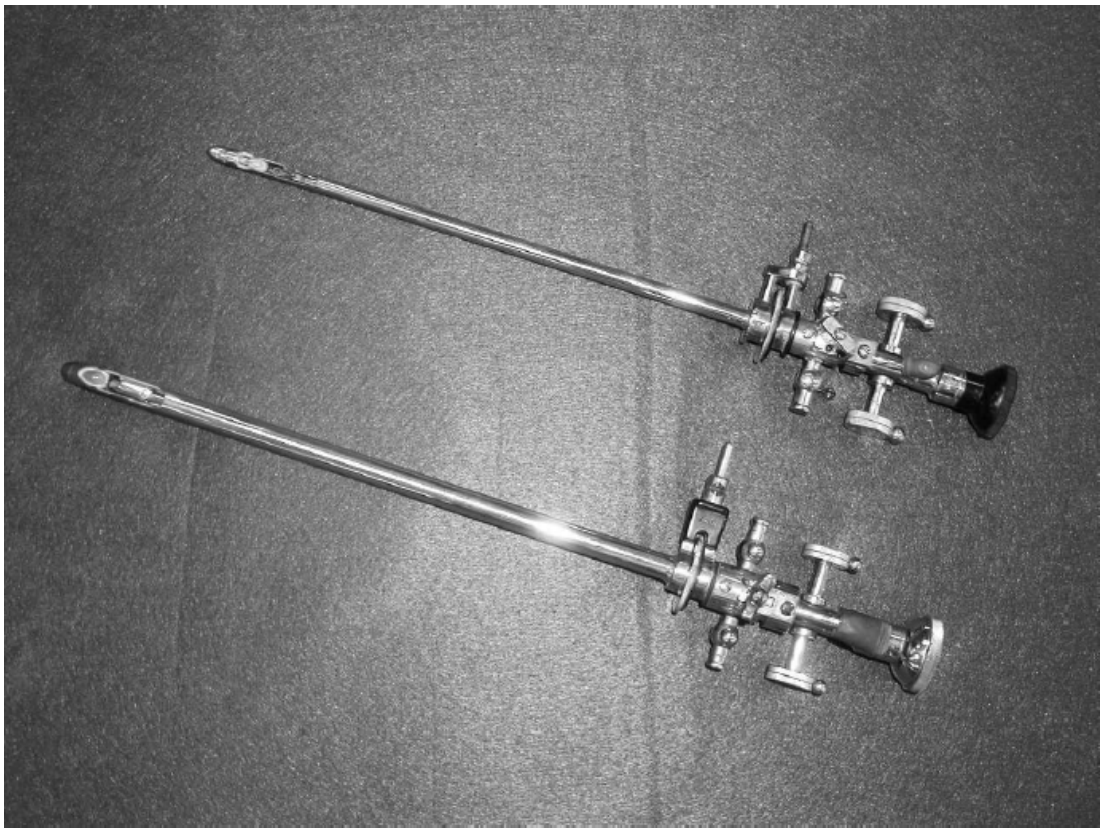


Figure 1: An image of two cystoscopes (circa 1910) from the UNC historical instruments collection. Instruments similar to these ones were used for early laparoscopies. Courtesy of Health Sciences Library, University of North Carolina at Chapel Hill.

3. Retrograde Laparoscopic Cholecystectomy Steps:

1. Prepare the patient (French position)
2. Placement of first trocar (midline navel)
3. Creation of Pneumoperitoneum
4. Final Diagnosis
5. Place patient in Reverse Trendelenburg position slightly rotated to the left
6. Apply local anesthetics and 2-3 other trocars under visualization of scope
7. Assistant grasps fundus of gallbladder and retract superiorly
8. Grasp infundibulum of the gallbladder (may need some dissecting)
9. Create tension by pulling slightly superior and laterally on the infundibulum of the gall bladder
10. Dissect Calot's Triangle starting towards the infundibulum of the gall bladder and working your way to the common bile duct
11. Using the gallbladder as point of reference, place 2 distal clips and 1 proximal clip along the cystic duct.
12. Divide making sure both jaws are visible to prevent vascular injury
13. Using the gallbladder as point of reference, place 2 distal clips and 1 proximal clip along the cystic artery.
14. Divide and cauterize/clip any necessary collateral arteries
15. Dissect away the posterior wall of the gall bladder using an L-Hook. Make sure L-hook does not come in contact with other instrumentation to prevent tissue damage
16. Remove gallbladder via bag or trocar
17. Irrigate and Suction
18. Final visualization check
19. Deroofing of ovarian cyst
20. Irrigate and suction
21. Release of CO_2 and steri-strip or suture trocar incisions [24, 25,26]

"french position"

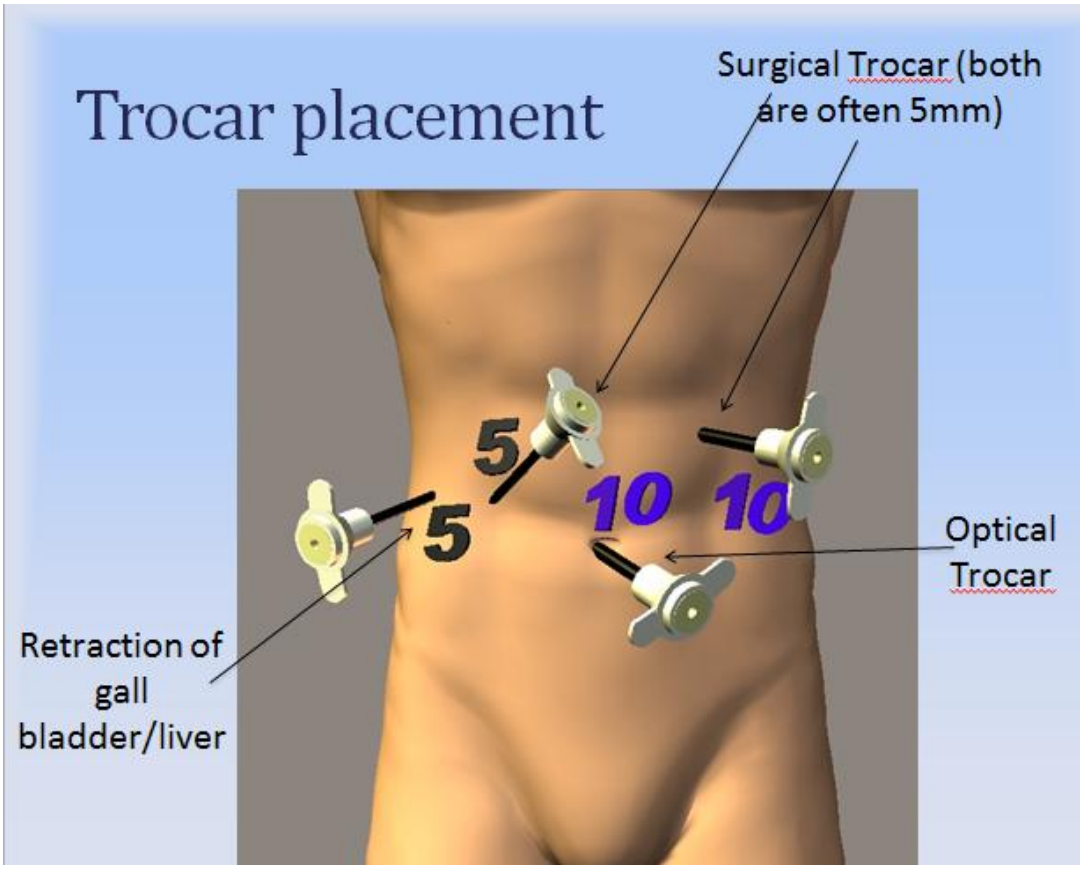


figure 2 : Trocar placement

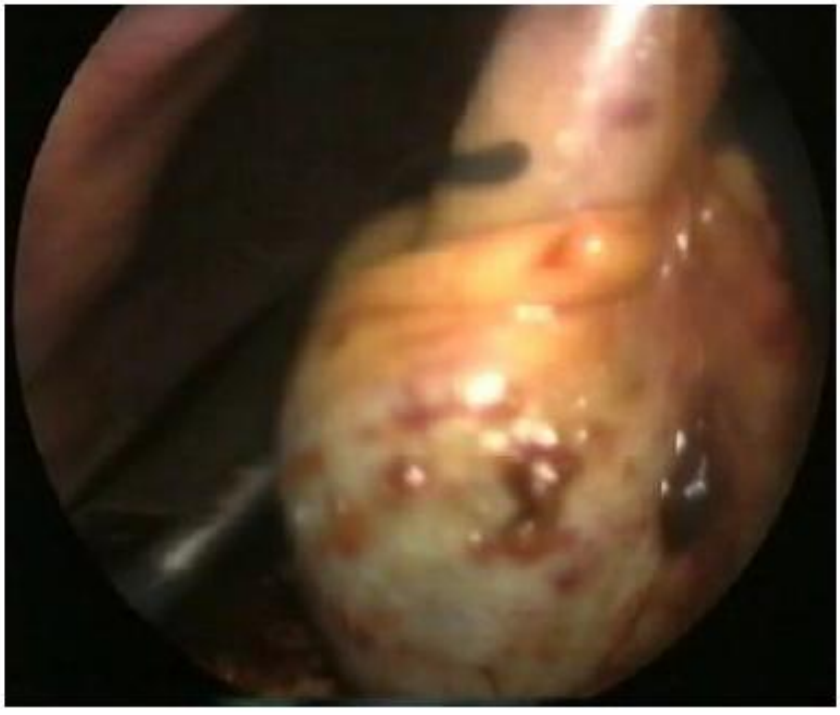
Etalement du pédicule hépatique lors d'une cholécystectomie laparoscopique par traction de l'infundibulum vésiculaire latéralement et vers le bas

Vue opératoire de la dissection complète du triangle de Calot en cours de cholécystectomie laparoscopique.

Vue opératoire de la dissection complète du triangle de Calot en cours de cholécystectomie laparoscopique, avec clippage de deux branches artérielles cystiques et du canal cystique avant de réaliser la CPO.

Vue opératoire de la dissection rétrograde du lit vésiculaire.

Vue opératoire de la vésicule biliaire placée dans un sac d'extraction



Vue opératoire de l'extraction de la vésicule par un des orifices de Trocart de 10 mm.

Figure 3 : operation steps (University hospital Hassan II Fes)

4. Operative Indications and Contraindications

The evaluation of the indication for cholecystectomy must include the risk of developing complications to gallstone disease, the risk of complications to surgery and, obviously, the expected effect on symptomatology. The cost for society must also be taken into consideration.

In screening studies there is an association between biliary colic (upper right abdominal quadrant pain) and occurrence of gallstones, making biliary colic the only predictor for gallstone disease. However, several studies show that one pain episode will not necessarily be followed by more episodes within a reasonably long time-span. This seems to justify a policy of watchful waiting after the first pain episode, at least among adults. Therefore guidelines usually only recommend ch olecystectomy to patients with repeat pain episodes or a complication resulting from gallstone disease. When the stones are symptomatic, some even recommend operation without delay in order to minimize costs and complications.

The authors recommend elective laparoscopic cholecystectomy in asymptomatic patients who fulfill the following criteria:

- Life expectancy >20 years
- Calculi >2 cm in diameter
- Calculi <3 mm in diameter and patent cystic duct
- Radiopaque calculi
- Calcified calculi
- Polyps in the gallbladder
- Nonfunctioning gallbladder
- Calcified gallbladder or “porcelain gallbladder”
- Severe concomitant chronic diseases
- Woman <60 years
- Individuals living in regions with a high prevalence of gallbladder cancer
- Suspicion/risk of malignancy [27]

Review of literature could not evidence any changes in absolute contraindications for LC. So they remain the same as in the 1994 EAES consensus statement:

1) Generalized peritonitis
2) Septic shock from cholangitis
3) Severe acute pancreatitis
4) Cirrhosis with portal hypertension
5) Severe coagulopathy that is noncorrected
6) Cholecysto-enteric fistula
7) Gall Bladder or Bile duct tumors
8) Mirizzi's Syndrome
9) Pregnancy in the final trimester [7]

5. Advantages and disadvantages comparing to open cholecystectomy

- Advantages:

1) Less pain
2) Smaller incisions
3) Better cosmesis
4) Earlier return to full activity
5) Low mortality
6) Shorter hospital stay
7) Decreased cost [7]

- Disadvantages :

1) Lack of deep perception
2) View controlled by camera operator
3) More difficult to control hemorrhage
4) Potential CO_2 insufflation complications
5) Adhesion/inflammation limit use
6) Slight increase in bile duct injuries [7]

6. Major Complications:

- Bile Duct Injuries/leak:

The iatrogenic trauma of bile duct is a peroperative catastrophe associated with a higher rate of morbidity and mortality. One of the common causes for injury occurs when anatomical structures are badly identified, confusing the cystic bile duct with the choledocho, clipping and section the common bile duct. It also may occur with electrocautery burns. These thermal injuries can difficult blood flow to the damaged structure. A burn of bile may manifest as an intraoperative bile leakage or postoperative necrosis and peritonitis or stenosis with ischemia. A correct and conclusive identification of cystic and common bile duct may help to prevent injuries.

- Bleeding:
  - Sites: liver, arterial sources, port insertion sites
  - Liver: removal gallbladder from fossa
  - Arterial source during resection usually cystic artery – clip if anatomical landmarks ensured [28]
- Intestinal perforation:
  - The second most common cause of mortality of laparoscopic surgery. Its incidence varies between 0.1% and 0.3% of cases. Approximately one third of these injuries occur during the access into the abdomen, but it may also occur during removal of instrumental, dissection of structures or electrocautery burns. One of the problems related to this complication is intraoperative difficulty to diagnose it. Most of lesions (70%) are diagnosed in the postoperative period and may have already evolved into a severe peritonitis. [29]

- Abscesses

The incidence of abscesses in LC is very low. Bile leakage and gallstone spillage remain the most frequent causes of abscesses after surgery. [30]

- Postoperative air embolism

Gas embolism is a rare complication (15 interventions/100,000/year) but with a high mortality (70- 90%) [52]. It is produced by the passage of CO2 to the venous system and then through the right ventricle to the pulmonary circulation. The gas can also pass to arterial blood circulation in any organ causing ischemia. There are two conditions that are required in order to produce gas embolism: the first one is a direct communication between the gas source and the vascular system, the second one is a favorable pressure gradient of gas inlet to circulation. These conditions occur during laparoscopic surgery at different times of the procedure

Most effective treatment is prevention: careful puncture gas, repeated aspiration, initial injection of gas at low flow and work with the least intra-abdominal pressure.[30]

- Injury to viscera
- Biliary strictures
- Biloma and Subhepatic abscess
- Retroperitoneal hematoma

CHAPTER III

OBJECTIVES AND HYPOTHESIS

I. Objectives:

1. To determine if laparoscopic cholecystectomy in patients with uncomplicated gallstones performed in our institution by residents in training is safe and done efficiently.
2. To compare perioperative and postoperative outcomes after laparoscopic cholecystectomy for two groups: patients operated by senior surgeons and patients operated by resident trainees.
3. To assess if the resident educational level impact the duration of procedures and occurrence of complications.
4. To appraise the residents learning by following the progress of their learning-curve.
5. To point out the likely gaps on the educational process in laparoscopic cholecystectomy performed by residents and suggest possible solutions.

II.Hypothesis:

1. Laparoscopic cholecystectomy performed in our institution is highly safe regardless of surgeon level.
2. The complication rate does not depend on the level nor the patients' backgrounds.
3. The duration of procedure and conversion rate decrease as laparoscopic experience increases.

CHAPTER IV

PURPOSE OF THE STUDY

General outcomes:

The primary aim of our study was to analyze whether the laparoscopic cholecystectomy performed by surgeons in training is a safe procedure by comparing the same operation performed by trainees and staff surgeons in term of perioperative and postoperative complications, length of hospital stay, morbidity and mortality were thoroughly analyzed in two groups of patients.

The secondary aim was to analyze the possible differences within the group of surgeons in training regarding to residency year level.

Specific outcomes:

1) Appraise the efficiency of residents' education on laparoscopic cholecystectomy at department of abdominal surgery at the University Hospital Hassan II of Fez
2) Compare our outcomes with those of several institutions worldwide through literature data.

CHAPTER V

PATIENTS

AND METHODS

I. Study Design

This study is a retrospective, cross-sectional, descriptive and comparative review of patient data.

II.Study Framework

University Hospital Hassan II of Fez is a 1050 bed teaching general hospital in Morocco servicing the north-eastern part of the country. Operative and clinical notes of all patients who underwent laparoscopic cholecystectomy at “department of abdominal surgery A” and “department of abdominal surgery B”, from January 2011 to December 2014 were reviewed retrospectively and the relevant data collected.

III. Patient Identification and data extraction

- A non-computerized search using as supports:
  - The consultation register
  - The hospitalization register: All patients admitted for laparoscopic cholecystectomy in context of chronic biliary colic or gallstones were reviewed.
  - operative reports
  - Medical charts
- A computer search by procedure, “laparoscopic cholecystectomy” on “the data collection computer system” of University Hospital Hassan II Fez “HOSIX”, using Patients’ Identification (IP) and nominal search.

Surgeon identification

- Our study included 9 senior surgeons and 19 resident trainees.
- In our institution residents start performing laparoscopic cholecystectomy in their PGY-3 (Post-graduated year-3) under the supervision of a senior surgeon.
- Surgeons' information and level were provided by the HR Human resources service in University Hospital Hassan II after the approval of the medical staff.

IV. Inclusion Criteria

All patients greater than 18 years of age, who had laparoscopic cholecystectomy, in the University Hospital Hassan II, for uncomplicated gallstones disease were included.

V.Exclusion Criteria

The exclusion criteria involved patients with complicated gallstone disease.

Were excluded patients with: Acute cholecystitis, cholecystoenteric fistula and gallbladder neoplasm.

VI.Statistical analysis :

The patient data were coded and entered on an Excel file. After validation, statistical analysis was performed using the analysis software IBM SPSS Statistics23 following 3 steps:

- Step 1: We performed a descriptive analysis of data collected. The results were presented as a percentage and mean ± standard deviation.
- Step 2: univariate analysis for comparing averages and percentages using statistical tests Student and khi 2 and fisher.
- Step 3: Multivariate analysis by logistic stepping down regression.

The results are reported in graphs and tables commented.

A $p<0.05$ was considered significant.

The data were expressed as means ± standard deviations using Student's t-test for continuous variables and the χ 2 test for dichotomous variables.

VII. Procedure flow:

The operative technique was performed by placing the patient according to the French school, accessing the abdominal cavity through minilaparotomy and Hasson trocar in the periumbilical area, placing the other three trocars according to the French school, and always trying to get the "critical view of safety".

The data, we have collected for each patient were gender, age, previous abdominal surgery, medical backgrounds, duration of surgery, conversion to laparotomy, intraoperative and postoperative complications, mortality, length of hospital stay, and return to operative room.

VIII. Limits of the study:

The follow-up of postoperative complications for patients, operated before the set-up of the data collection computer system “Hosix” on June 20, 2011, were delicate due to the lack of exploitable information about a subsequent hospitalization on the paper form files.

The sampler size with a consequent number of patients would have a noteworthy add-value.

IX.The chart review

- Operative date:
- Name+ Patient Identification (IP):
- Gender:
- Age:
- Backgrounds:
    - Medical :

-Comorbidities (diabetes / high blood pressure / heart disease /kidney disease)

- PF: Weight/ Multiple pregnancies/ inflammatory bowel disease/ Drugs: Estrogens, hypolipidemic.
    - Chirurgical
- Preoperative Diagnosis: Gallstones / Biliary colic / Acute cholecytitis
- Postoperative Diagnosis: Gallstones / Biliary colic / Acute cholecytitis
- Paraclinic: Ultrasounds / CAT scan / RMI
- Timing of surgery from onset of symptoms (In Months) :
- Operator: Identity / Level
- Intraoperative courses
    - Operative time (min)
    - Conversion
    - Intraoperative difficulties: Dense adhesion, Anatomic Causes.
    - Intraoperative complications: Biliary Spillage, Bleeding, Intestinal injury, per procedural peritonitis
    - Drainage
- Postoperative outcomes:
    - Length of stay
    - Common bile duct injury and bile collection
    - Biliary fistula
    - Biliary peritonitis
    - Jaundice
    - Parietal complications
    - Return to Operative Room

-Mortality

CHAPTER VI

RESULTS

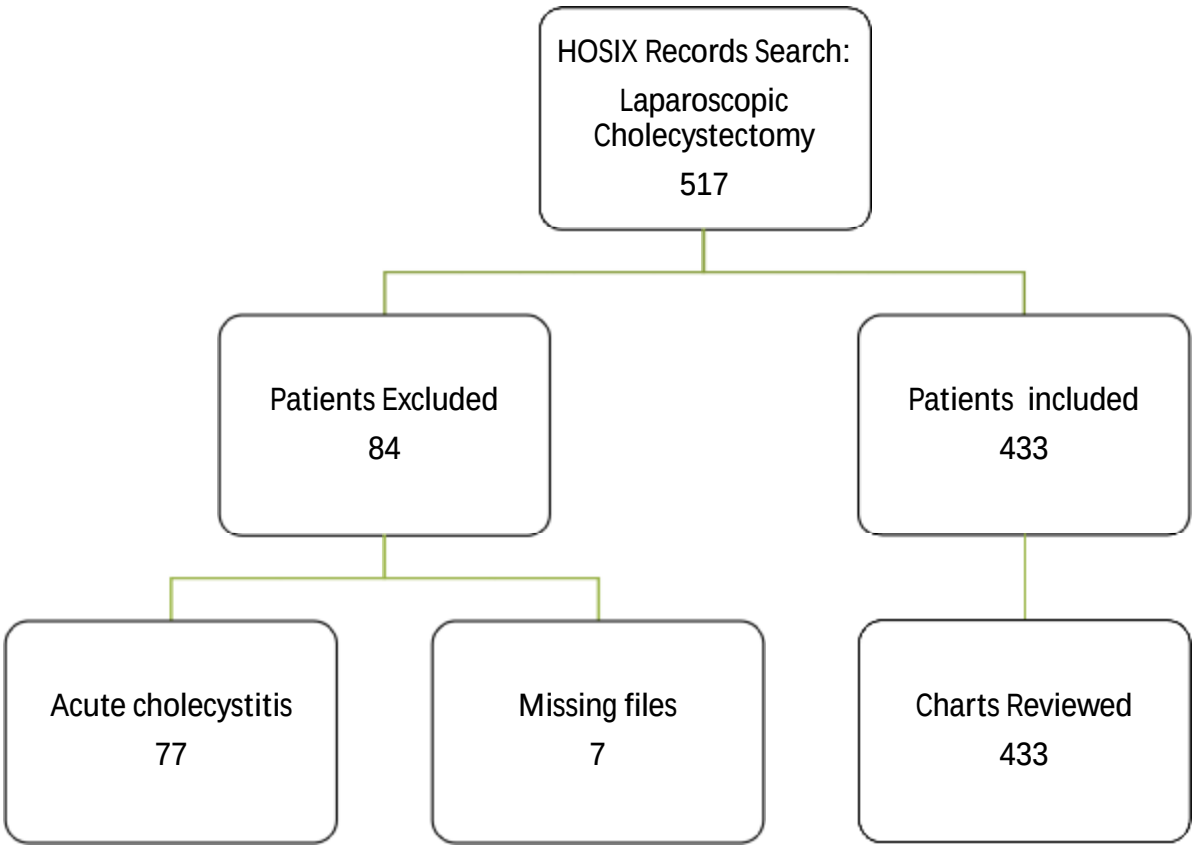
I.Sample size

From January 2011 to December 2014, there were 517 laparoscopic cholecystectomies performed at the University Hospital Hassan II of Fez.

84 patients were excluded from the study:

- 7 excluded files due to missing baseline characteristics
- 77 for acute cholecytitis (Exclusion Criteria).

Four hundred thirty three medical charts were reviewed.



The table below shows the patients distribution by years:

Table 1 : Patients distribution over the years of the study

Year	Patients	Percentage
2011	119	28%
2012	112	26%
2013	115	26%
2014	87	20%
Total	433	100%

Out of 433 laparoscopic cholecystectomies, 146 (33.7%) were performed by residents, and 287 (66.3%) were performed by seniors surgeons.

Table 2: Surgeons distribution

Level	Number of surgeries	Percentage
Senior surgeon	146	34%
Resident	287	66%

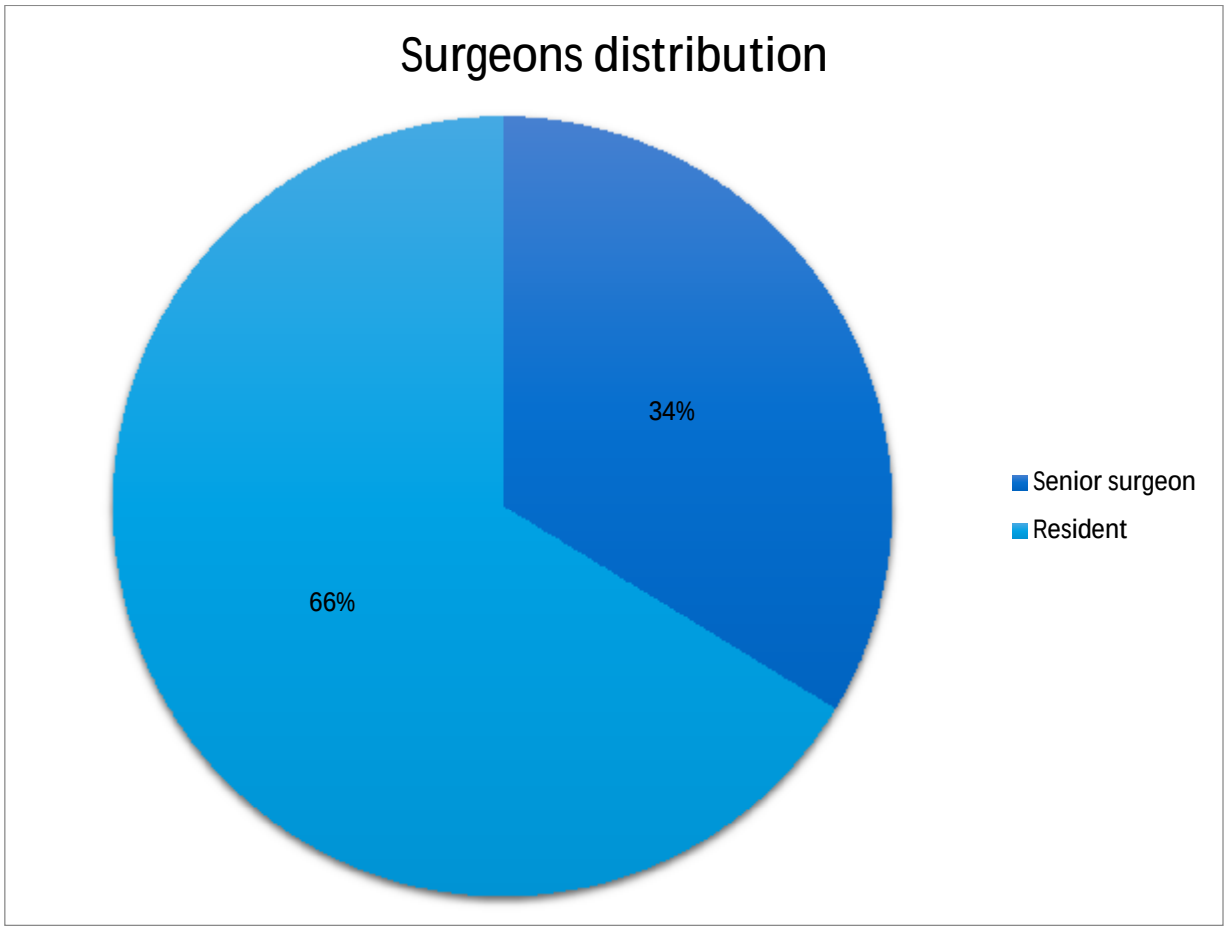


Chart 1 : Surgeons distribution

II.Demographic: age and gender distribution, Background

1 Age and gender distribution

The age of patients ranged from 18-87 years with a mean of 49 ± 15 years.

They were no significant difference between the mean age of patients operated by senior surgeons (49 ± 16 years) and once operated by residents (49 ± 15 years) P = 0.829

The gender distribution revealed a female predominance (86%). The sex-radio was 0.17 (6 women to 1 man).

Table 3: Patients distribution by age:

Age	Number	Percentage
<20	4	1%
20-29	55	13%
30-39	73	17%
40-49	75	17%
50-59	120	27%
60-69	71	17%
>70	35	8%
Total	433	100%

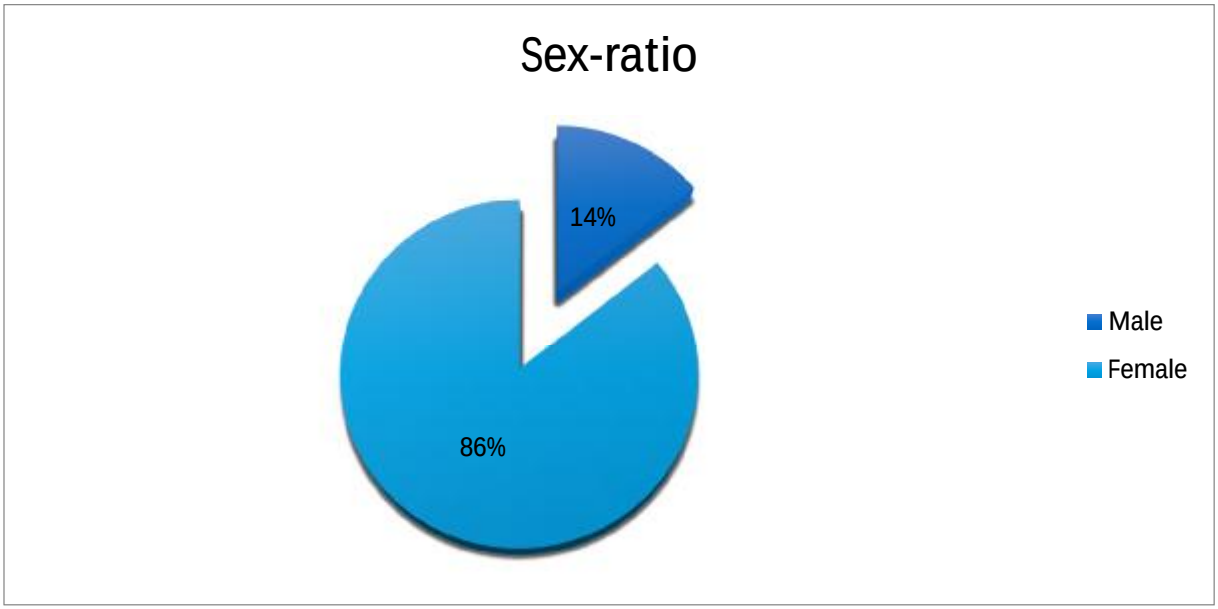


Chart 2: Sex-ratio

Table 4 : Age and sex distribution

	Senior Surgeons	Residents	P value
Sample size	146	287	
Middle Age	49	49	0.829
Gender			
Male	20	42	
Female	126	245	
Total	146	287	0.885

2 Backgrounds

133 patients were suffering from an associated commorbidities (30%). The table bellow (table 5) indicates patients distribution according to their commorbidities.

Out of the 433 patients of our study, 111 were admitted via the Emergency Department of severe biliary colic (26 %) and 322 by appointment for an elective surgery (74%)

Table 5 : Patients commorbidities

Comorbidity	Staff	Percentage
Diabetes	27	6%
High Blood Pressure	35	8%
Heart Disease	7	2%
Pancreatitis	75	17%
Jaundice	9	2%
Kidney Disease	1	0.2%
Goiter	8	2%
Others	10	2%

Table 6 : Patients surgical backgrounds

Surgical background	Staff	Percentage
Appendectomy	4	1%
Hepatic hydatid cyst	2	1%
Inguinal hernia	6	1%
Cesarean delivery	14	3%
Hysterectomy/adnexectomy	8	2%
Mastectomy/ Patey	3	1%
Nephrectomy	2	1%
Thyroidectomy	6	2%

III. Paraclinics

1 Ultra-sounds

All patients of our Sample had already undergone abdominal ultrasound. Gallstone and/or biliary stone diagnosis was remained in every case.

2 CT and MR Cholangiography

CT scan was mandatory in 77 cases and MR cholangiography in 2 cases for a better exploration of the biliary tract especially when pancreatitis diagnosis was expected.

Table 7: Paraclinics

	Staff	Percentage
Ultra-sounds	433	100%
CT-scan	77	18%
MR-cholangiography	2	0.5%

IV. Timing of surgery from onset of symptoms

The average timing of surgery from onset of symptoms was 5.9 mounths. Actually, all the sugeries performed were elective. The average timing of surgery from onset of symptoms in residents sampler was 6 mounths

versus 5.6 mounths in seniors surgeons sampler (P=0.462).

Table 8: Timing of surgery from onset of symptoms

Level	Timing of surgery in mounths	P value
Senior surgeons	5.6	
Résidents	6	
Overall	5.9	0.462

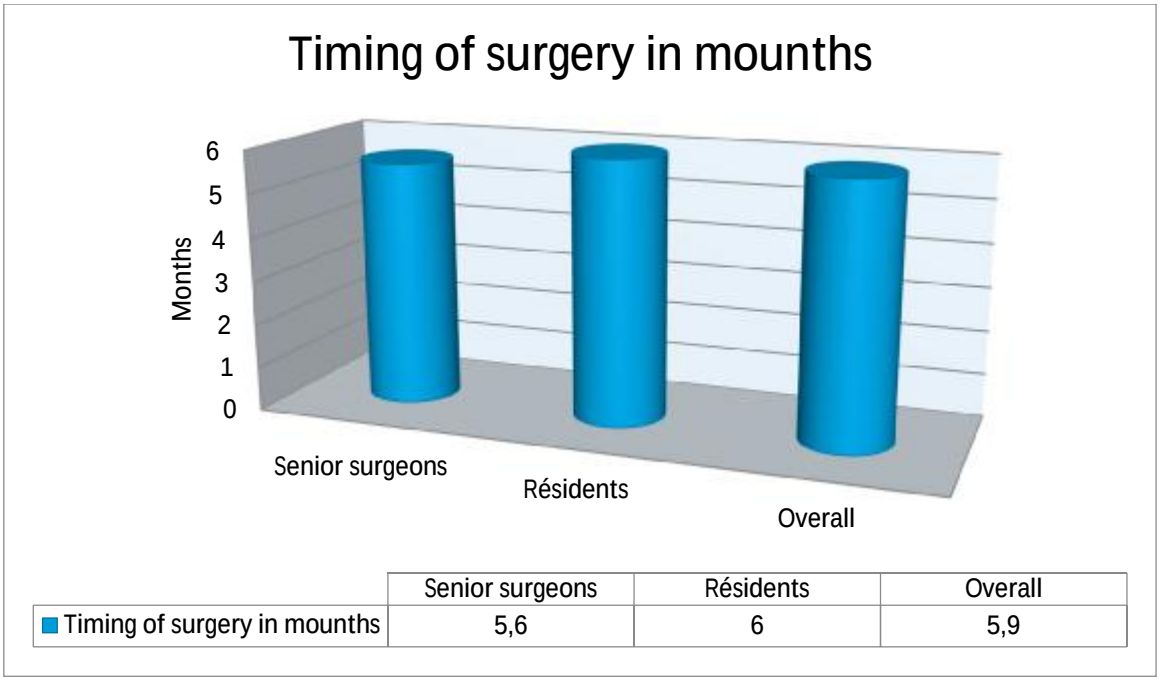


Chart 3: Timing of surgery from onset of symptoms

V. Intraoperative course

1. Intraoperative difficulties

- Among the 433 LC performed, 54 were reported comprising intraoperative difficulties.
- Dense adhesion, inflammatory and anatomic causes were the most common difficulties faced by the surgeons. The release of adherence and Calot's triangle dissection require massive diligence in order to avoid biliary duct, vascular and intestinal injury.
- The number of intraoperative difficulties was respectively 32 in residents sampler (11%) and 22 in senior surgeons sampler (15%) P=0.509
- Dense adhesion was reported in 11% of cases, anatomic difficulties in 0.5% and inflammatory in 0.7%.

Table 9: Intraoperative difficulties distribution by level

Level	Number	Percentage	P value
Senior surgeon	22 / 146	15%	
Residents	32 / 287	11%	0.509
Total	54	12%	0.509

Table 10 : Intraoperative difficulties causes

Level	Senior surgeon (n=146)	Residents (n=287)	Total
Dense adhesion	20 13.6%	29 10%	49 11%
Anatomic causes	1 0.7%	1 0.3%	2 0.5%
Intense inflammation	1 0.7%	2 0.7%	3 0.7%
Total	22 15%	32 11%	54 12.5%

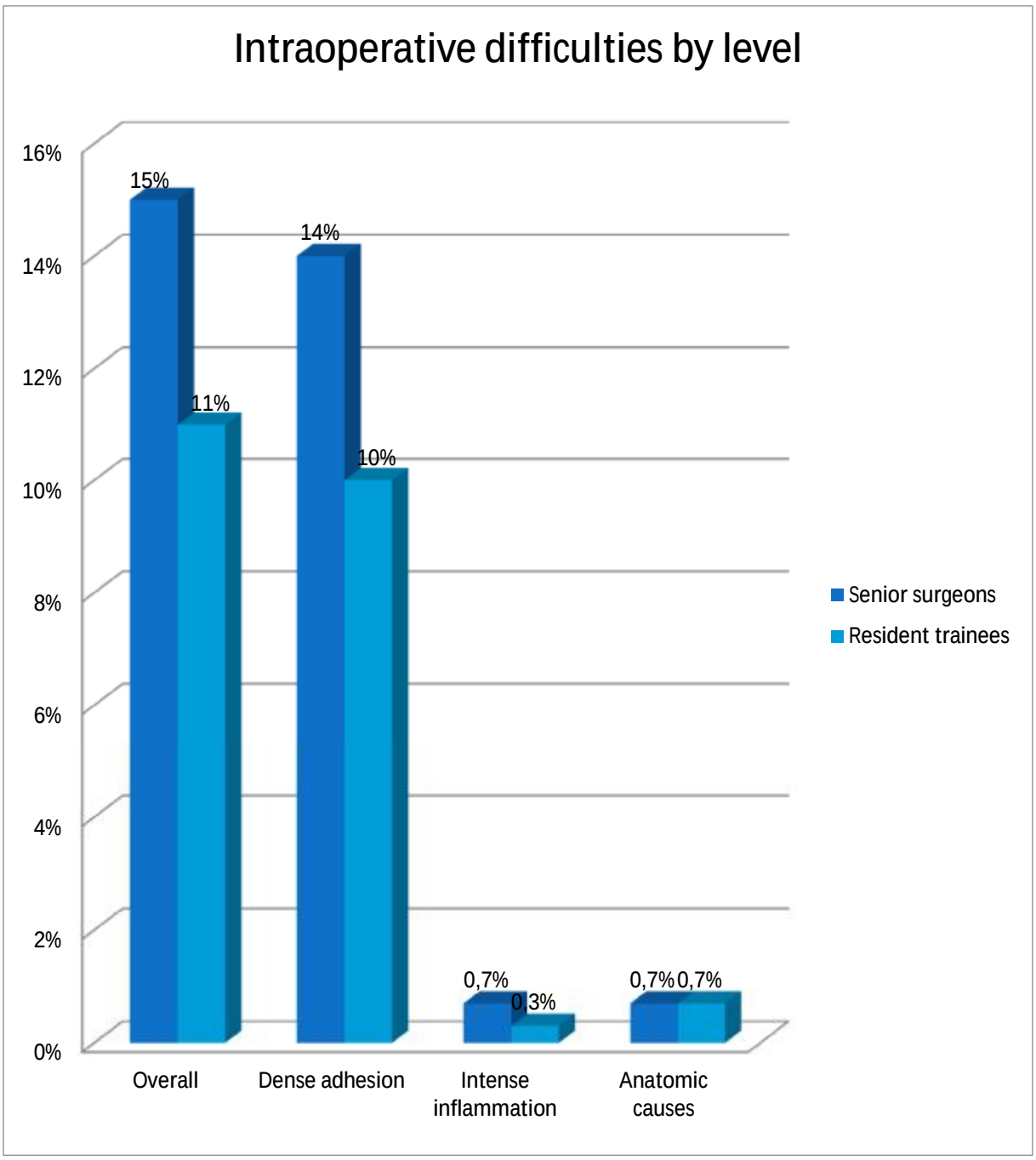


Chart 4: Intraoperative difficulties by level

2 Intraoperative complications

14 cases of intraoperative complications were reported.

Intraoperative complications included biliary spillage, bleeding and hemodynamic instability.

2 cases of intraoperative hemodynamic instability were reported: widespread subcutaneous emphysema and circulatory shock. Both were conveniently managed by the operative staff.

We notice that no case of intestinal injury was reported.

The number of intraoperative complications was respectively 11 in residents (4%) and 3 in senior surgeons sampler (2%) P=0.368

Biliary spillage was reported in 1% of cases, incontrollable bleeding in 1.6% and hemodynamic instability in 0.5%

Table 11: Intraoperative difficulties distribution by level

Level	Number	Percentage	P value
Senior surgeon	3 / 146	2%	
Residents	11 / 287	3.8%	0.368
Total	14	3.2%	0.368

Table 12: Intraoperative complications causes

Level	Senior surgeon (n=146)	Residents (n=287)	Total (n=433)
Biliary spillage	0 0%	5 1.7%	5 1%
Bleeding	2 1.3%	5 1.7%	7 1.6%
Hemodynamic instability	1 0.7%	1 0.3%	2 0.5%
Total	3 2%	11 3.8%	14 3.2%

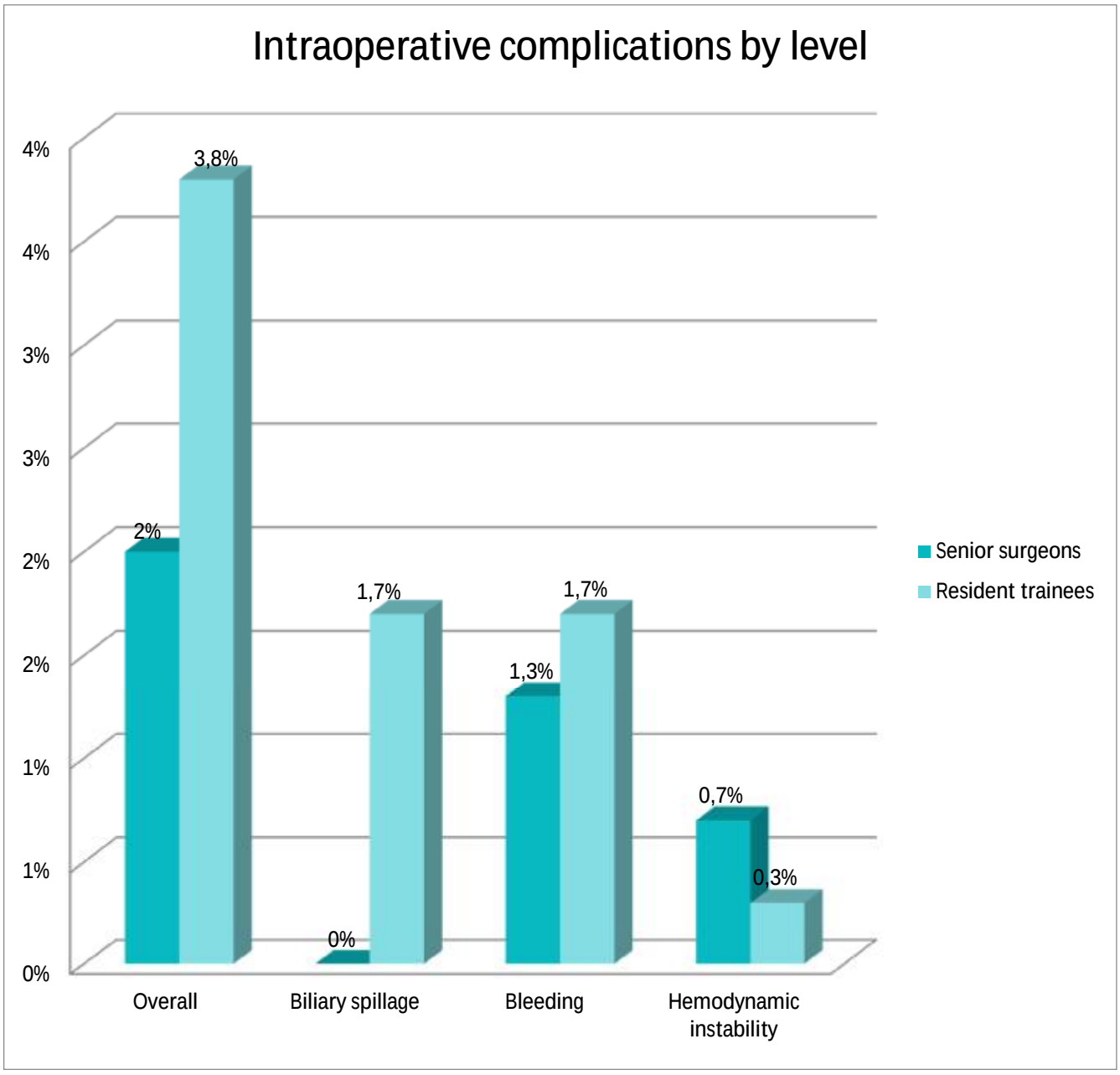


Chart 5: intraoperative complications by level

3. Conversion to open laparotomy:

Most of the conversions from laparoscopy to laparotomy have been performed due to unclear anatomy and inability to proceed in laparoscopy safely.

Among the residents, the percentage of conversion was 8% (23/287) while among senior surgeons, it was 8.2% (12/146) P=0.538

The main causes of conversion were dense adhesion, uncontrolled bleeding, iatrogenic trauma anatomic variation and technic difficulties.

Table 13: Conversion distribution by level

Level	Number	Percentage	P value
Senior surgeon	12	8.2%	
Residents	23	8%	0.538
Total	35	8.1%	0.538

Table 14: Conversion causes by level

Level	Senior surgeon (n=146)	Residents (n=287)	Total (n=433)
Dense adhesion	5 3.6%	7 2.4%	12
Pediculitis	1 0.7%	5 1.7%	6
Bleeding	2 1.4%	5 1.7%	7
Iatrogenic trauma of bile duct	1 0.7%	1 0.3%	2
Technic difficulties	1 0.7%	1 0.3%	2
Anatomic causes	1 0.7%	3 1%	4
Hemodynamic instability	1 0.7%	1 0.3%	2
Total	12 (8.2%)	23 (8%)	35 (8.1%)

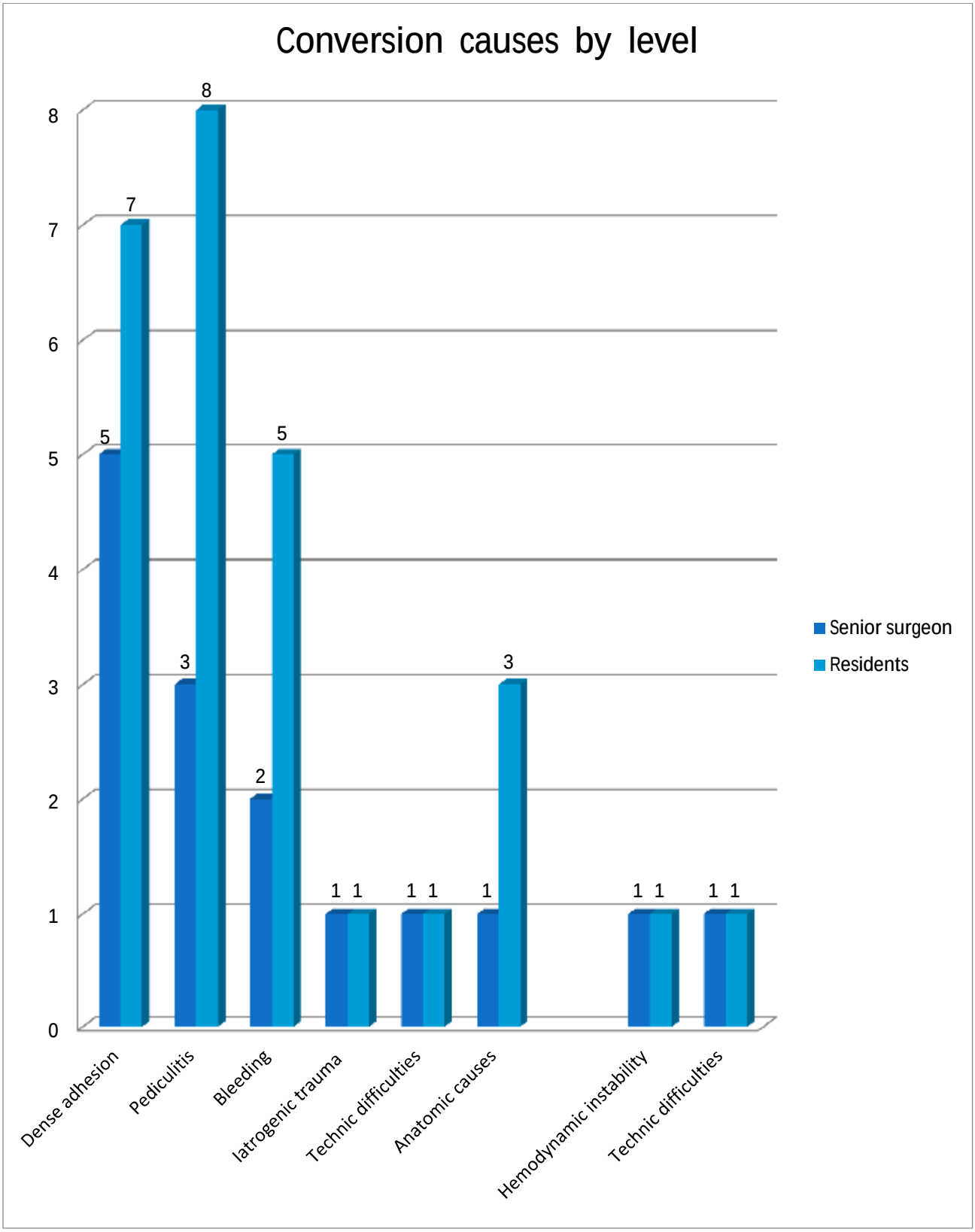


Chart 6: Conversion causes by level

4. Drainage

In our sampler, the drainage was required in 292 cases (67,4%). The insertion of a sub-hepatic drain was required in 69% of surgeries performed by residents, while only 63% of senior surgeons' interventions required drainage. P=0.141

Table 15: Drainage rate by level

Drainage	Yes	No	Ratio
Senior surgeon	93	53	63%
Residents	199	88	69%
Overall	292	141	67%
P value			0.141

5. Operative time

The primary objective of the study was to determine the influence of the seniority level of the resident and staff surgeon performing the operation on the time from incision to closure.

Overall duration of operation was 84±32 minutes.

The mean duration of operation performed by residents was 96±28 (35–200) minutes, while the mean duration of operation performed by staff surgeons was 61±25 (14–170) minutes, P < 0.001.

The influence of intraoperative difficulties, complications and conversion on operative time was also established.

The mean procedure time increased in surgeries with intraoperative difficulties (109±33 minutes) in both groups: 120±27 minutes in residents and 75±28 minutes in senior surgeons. P<0.001

In cases when conversion to open laparotomy was required, the average procedure time was 118±32 minutes: 125±26 minutes in residents and 103±37 minutes in senior surgeons. P = 0.047.

Table 16: Procedure duration by level

	Procedure duration	Range	P value
Senior surgeons	61±25	14-170	-
Residents	96±28	35-200	<0.001
Sum	84±32	14-200	<0.001

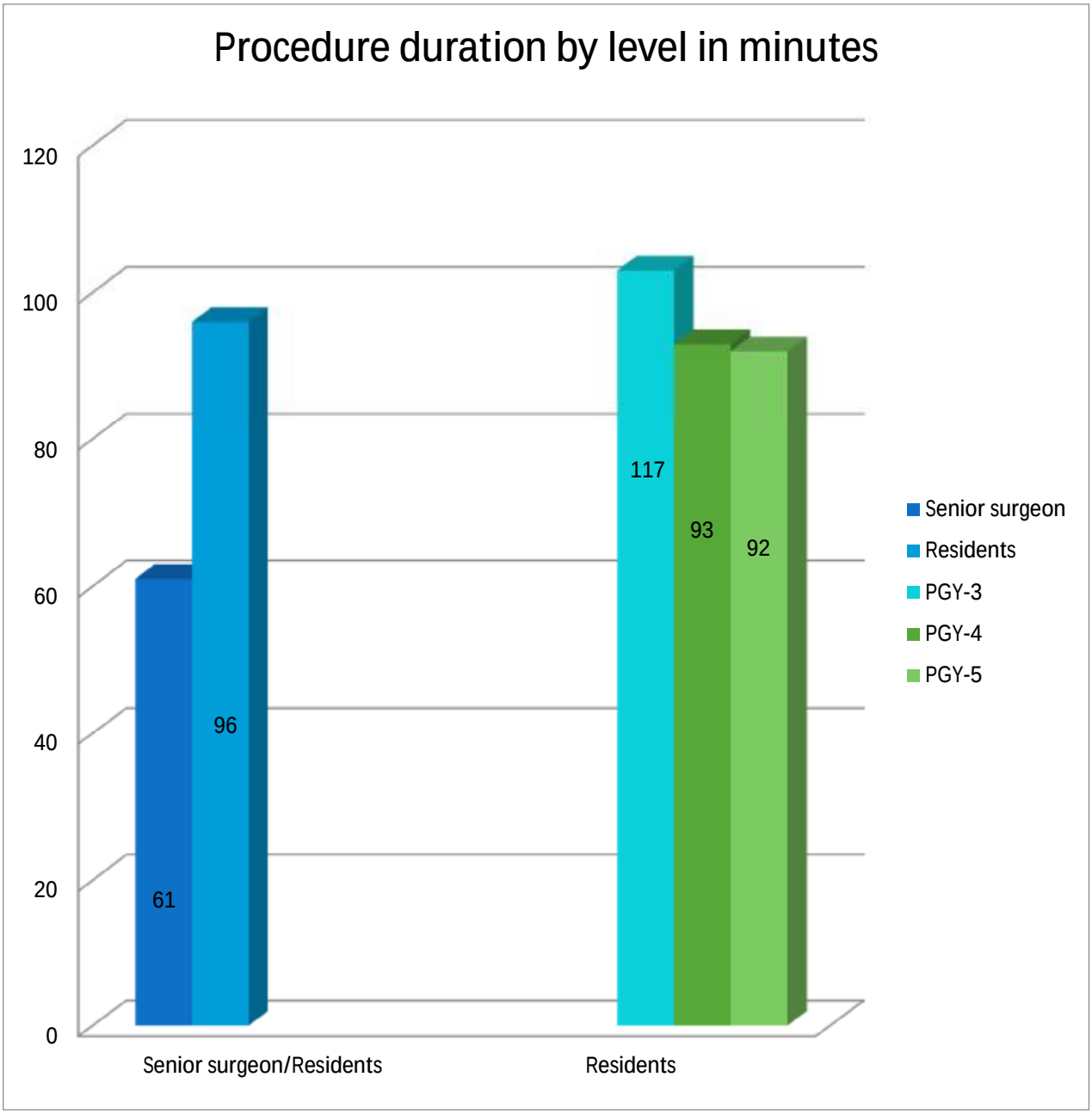


Chart 7: Procedure duration by level

Table 17: Procedure duration and intraoperative complications

Intraoperative complications	Yes (Duration in min)	No (Duration in min)
Senior surgeons	83±35	56±21
Residents	121±27	92±26
Sum	109±33	80±29
P Value	<0.001	<0.001

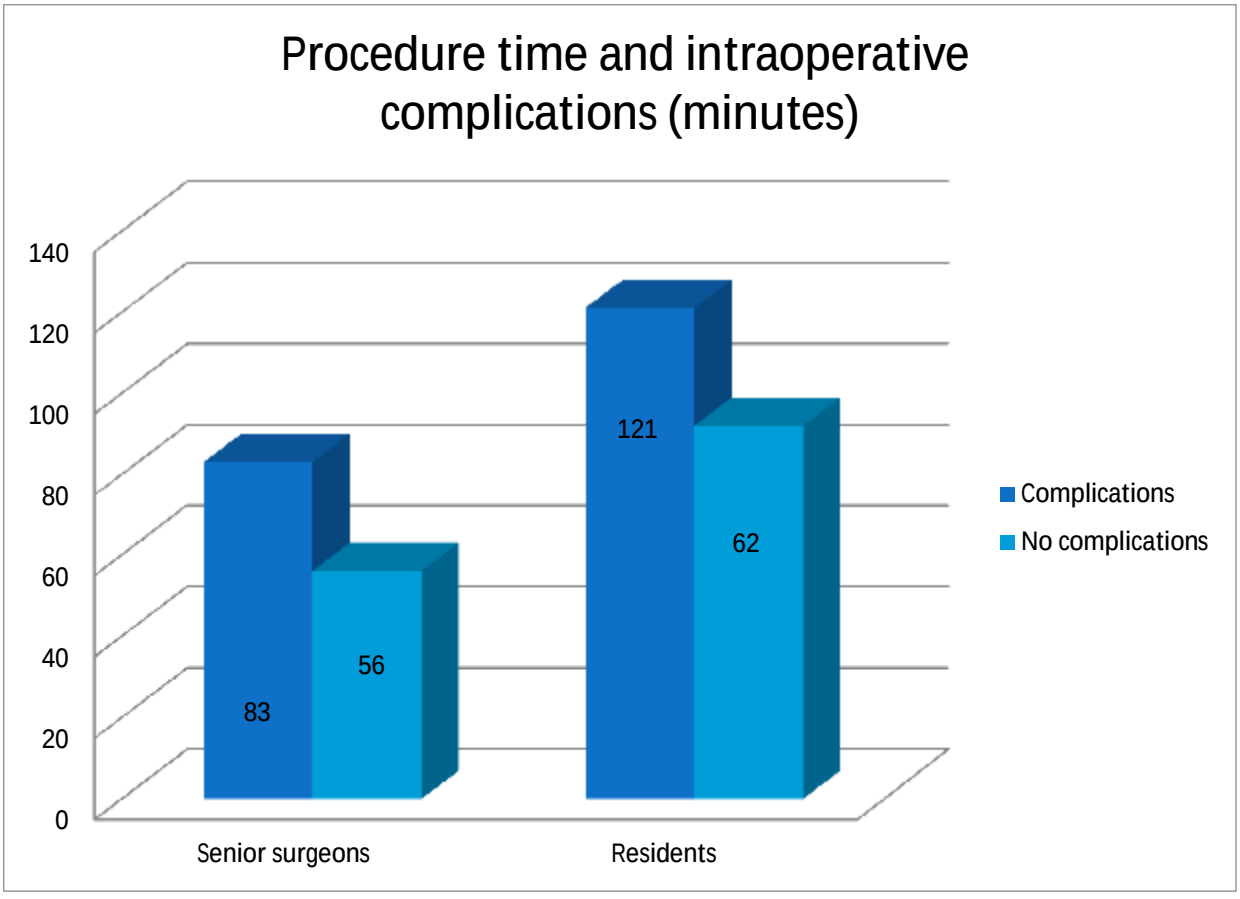


Chart 8: Procedure duration and intraoperative complications

The procedural time was significantly longer when intraoperative complications were associated in both senior surgeons and residents groups.

Table 18: Procedure duration and conversion

Conversion	Yes (Duration in min)	No (Duration in min)
Senior surgeons	103±37	57±19
Residents	125±26	94±27
Sum	117±32	81±30
P Value	0.047	-

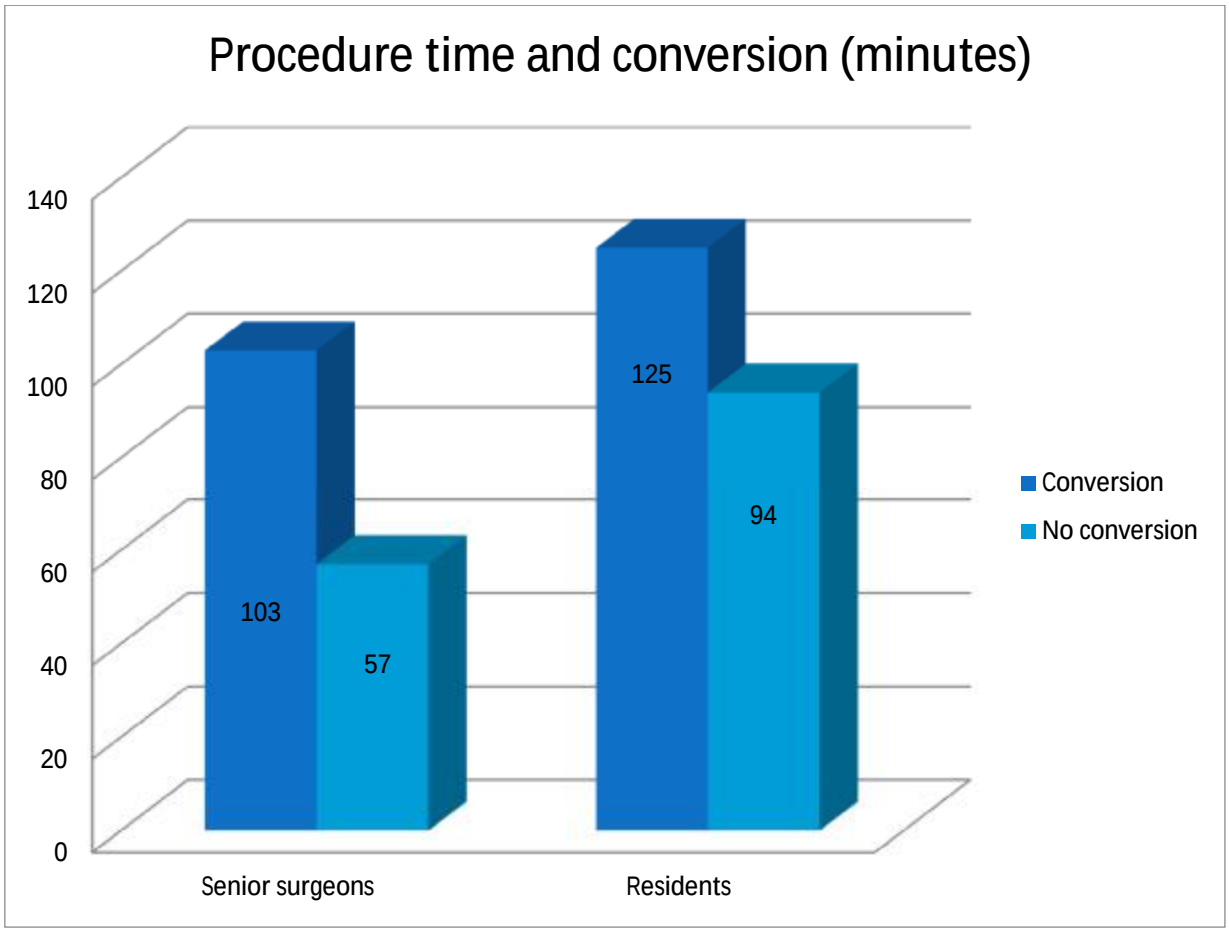


Chart 9: Procedure duration and conversion

The procedural time was significantly longer when conversion to open laparotomy was required in both senior surgeons and residents groups.

VI. Postoperative course

1. Mean length hospital stay:

- The mean length hospital stay time in our series was 3.66±1.62 days. There was a trend towards shorter length of hospital stay in patients treated by senior surgeons (3.09±1.28 days) as compared to those treated by residents (3.95±1.78 days). P<0.001

- The mean length hospital stay increased in both groups when intraoperative complications were associated. (4.66±2 days in residents and a shorter hospital length stay in senior surgeons 3.75±1.2 days) P<0.001

- The mean length hospital stay increased also in conversion cases in both groups (5.09±1.7 days in residents and 4.5±1.4 days in SS) P<0.001, and in surgeries when drainage was required (4±1.7 days in RD, 3.3±1.1 in SS) P=0.17.

Table 19 : mean length hospital stay (in days)

Mean length hospital stay (in days)	Duration	P Value
Senior surgeons	3.09	
Residents	3.95	
P Value		<0.001

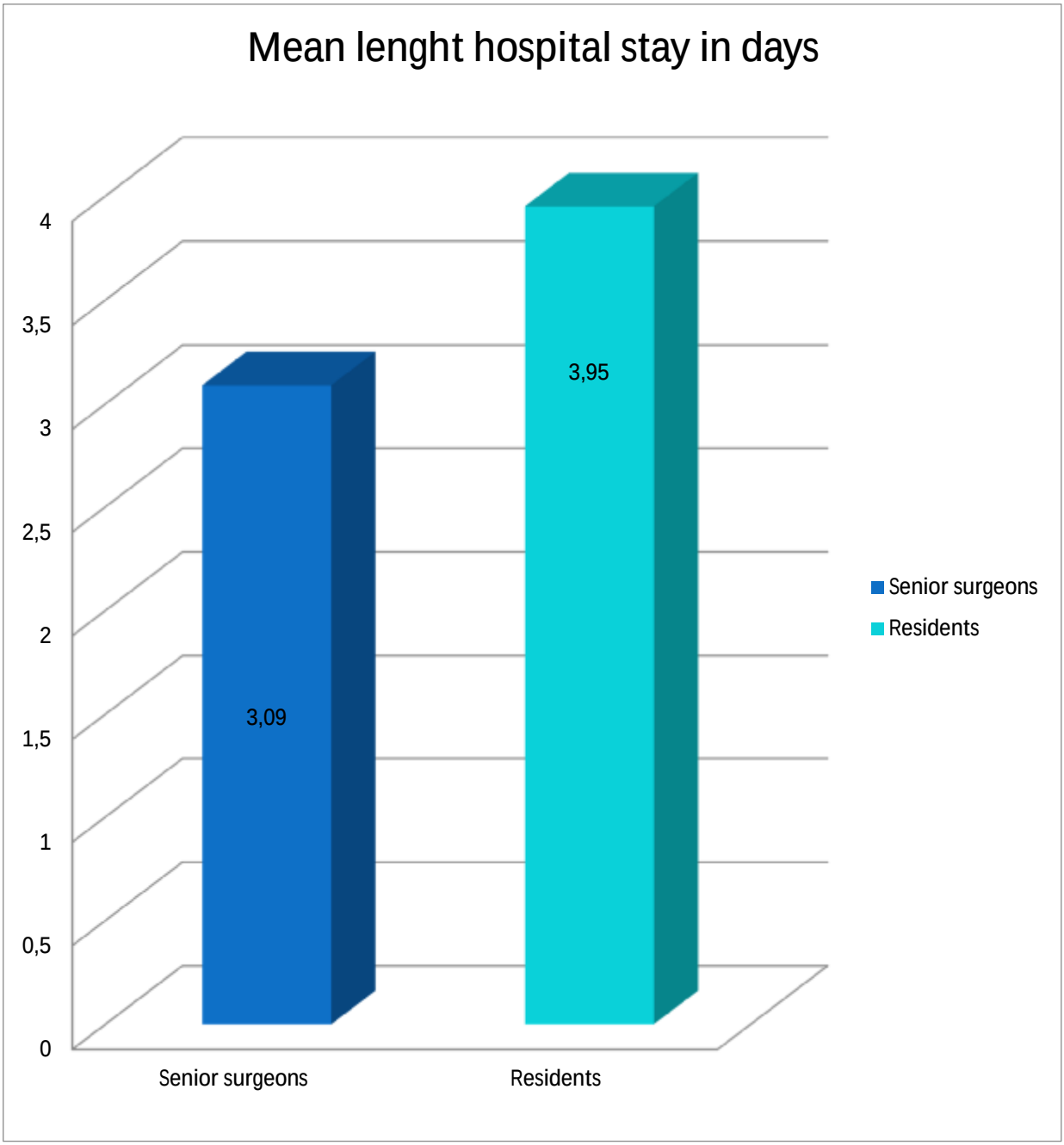


Chart 10: mean length hospital stay in days

Table 20: Mean length hospital stay and intraoperative complications (in days)

Intraoperative Complications	Yes	No
Senior surgeons	3.75	2.93
Residents	4.66	3.82
P value		<0.001

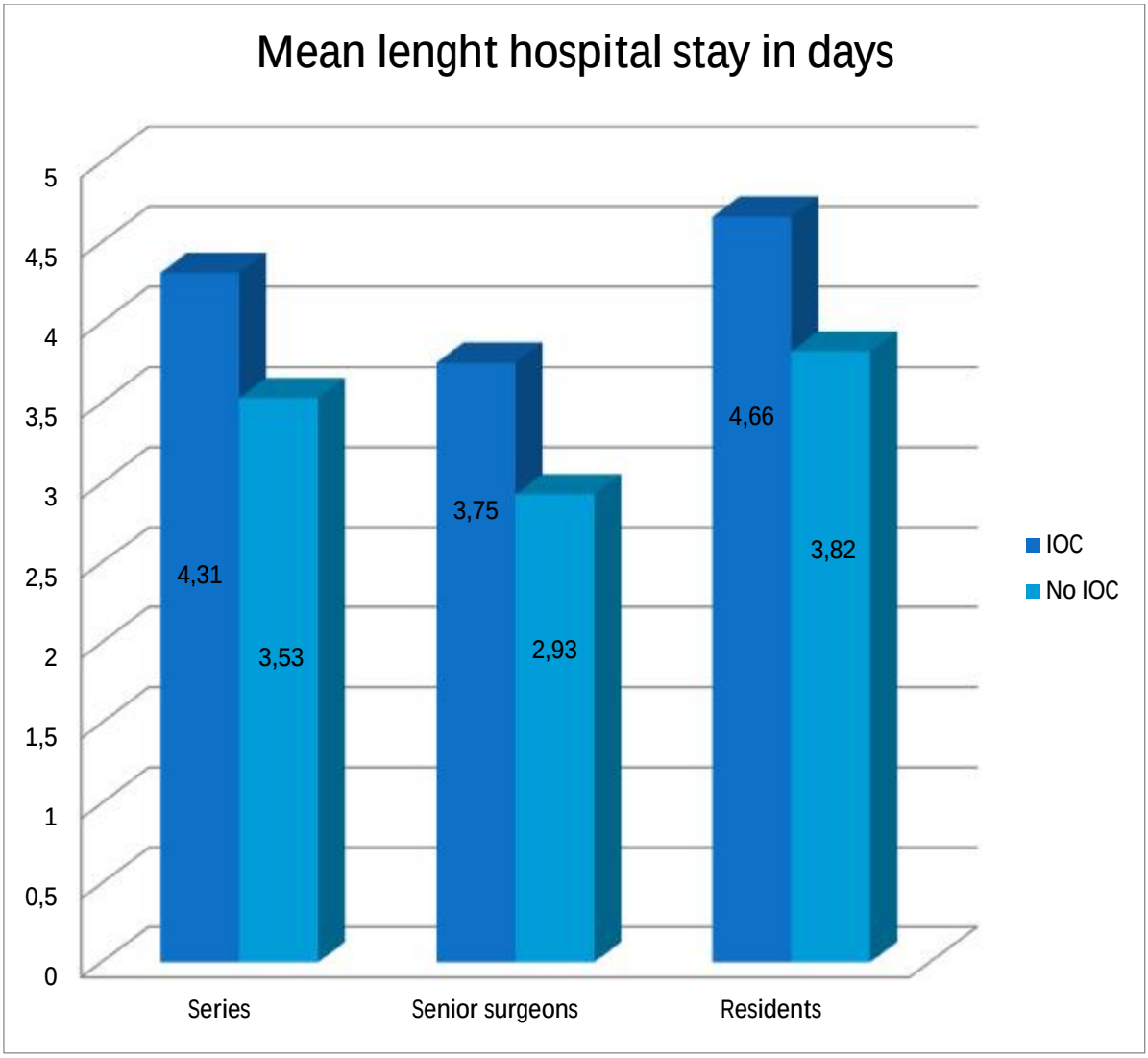


Chart 11: Mean length hospital stay and IO complications

Table 21: Mean length hospital stay and drainage

Drainage	Yes	No
Senior surgeons	3.26	2.79
Residents	4.04	3.75
P value		<0.001

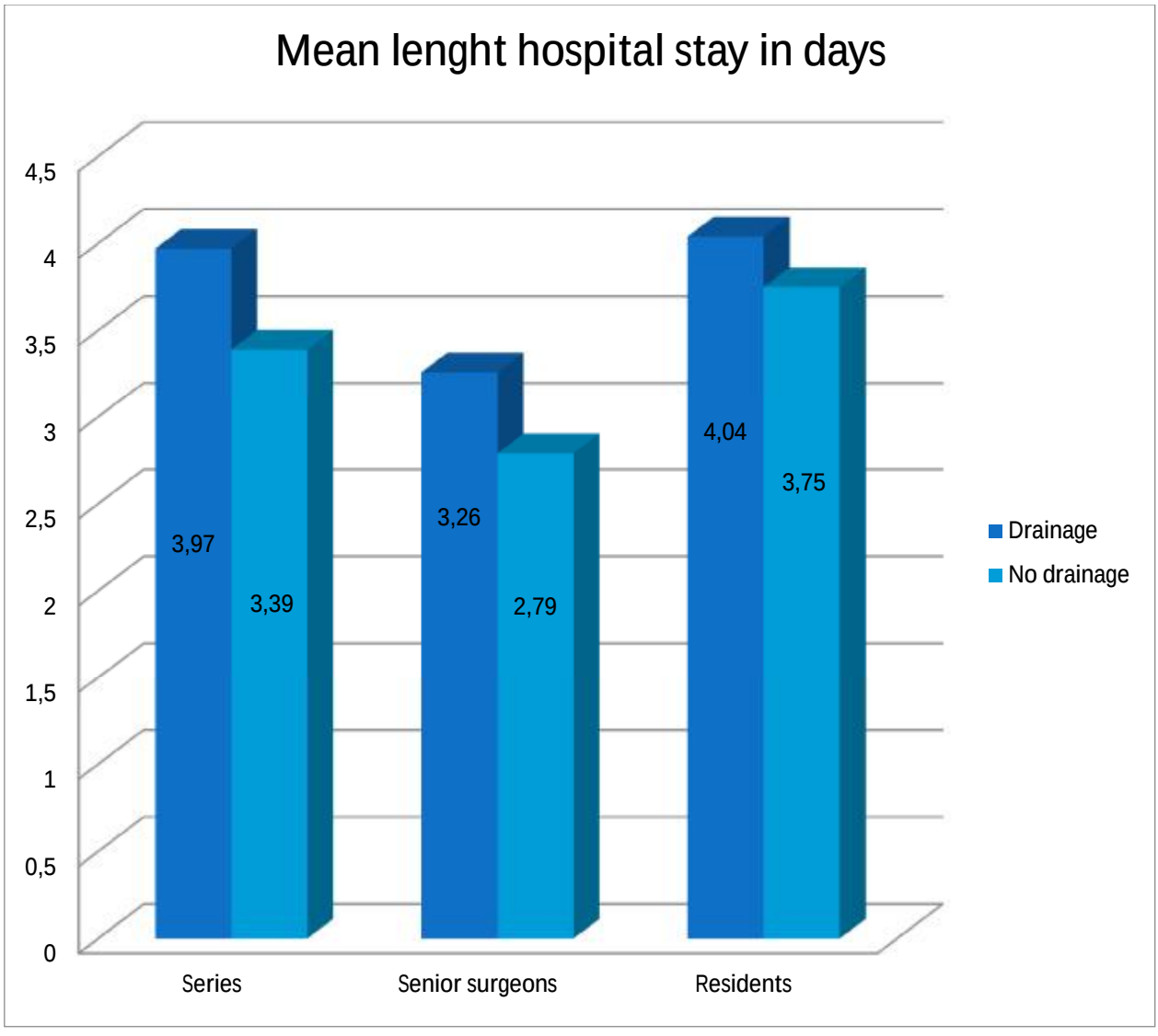


Chart 12 : Mean length hospital stay and drainage

Table 22: Mean hospital stay in conversion cases

Conversion	Yes	No
Senior surgeons	4.5	2.96
Residents	5.09	3.85
P value		0.17

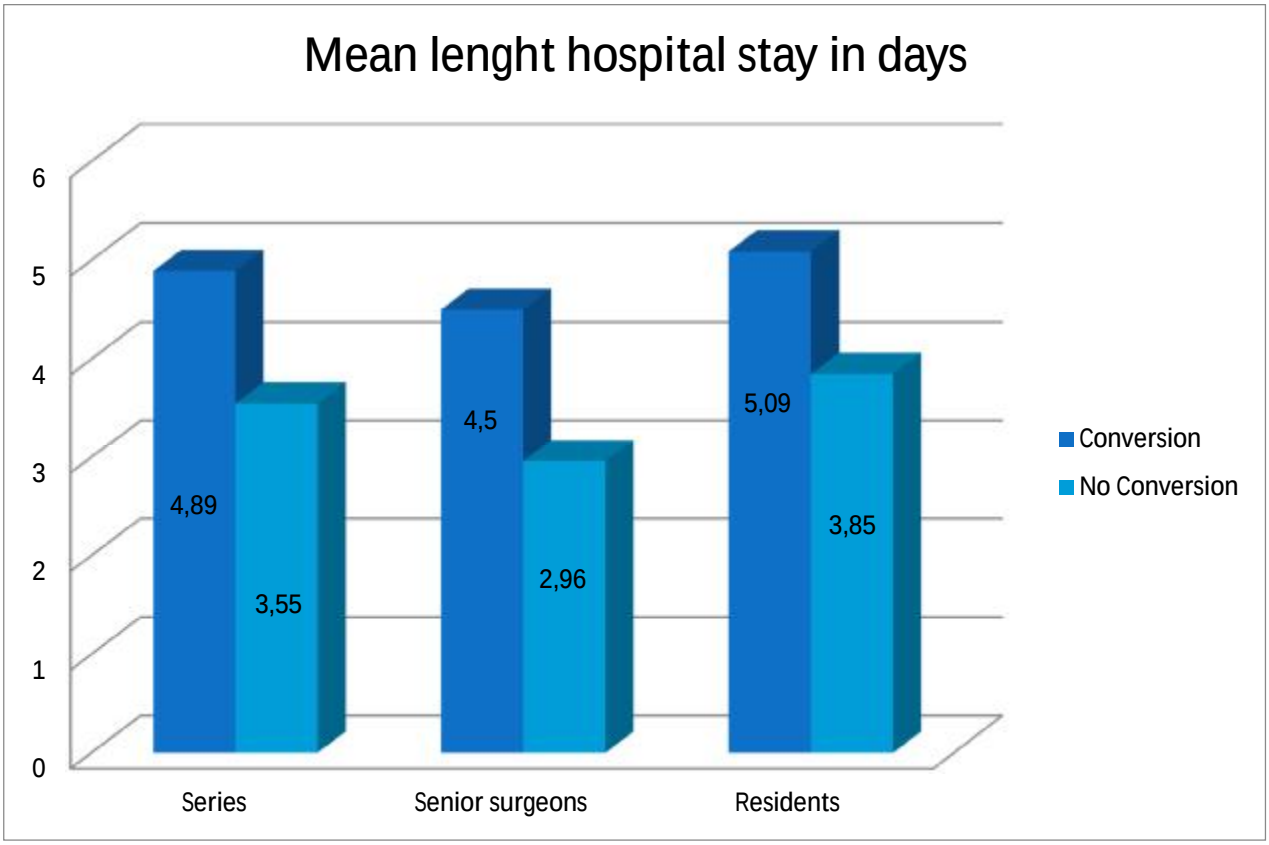


Chart 13: Mean hospital stay in conversion cases

2. Postoperative complications

All cases of postoperative common bile duct injury and bile collection, biliary fistula, biliary peritonitis, jaundice (retained stone/ bile collection), parietal complications and return to OR were recorded.

Out of 433 LC performed, 11 cases of postoperative complications were withdrawn. There were no differences in the percentage of postoperative complications in patients operated by residents (9/287, 3.1%) versus patients operated by staff surgeons (2/146, 1.3%), P =0.223 :

- 6 cases of parietal complications (Wound infection, eventration), 5/287, 1.7% in residents and 1/146, 0.7% in SS. P=0.342
- 4 cases of common bile duct injury, bile collection and biliary fistula were reported (3/287, 1% in RD, 1/146, 0.7%) P = 0.583
- One case of jaundice after a biloma in RD sampler (1/287, 0.3%) P=0.663.
- Any case of biliary peritonitis was reported.
- 3 Cases of return to OR (operative room) in residents' sampler for eventration (3/287, 1%) and none in senior surgeons. P=0.290

3. Mortality

Any death was recorded in our series.

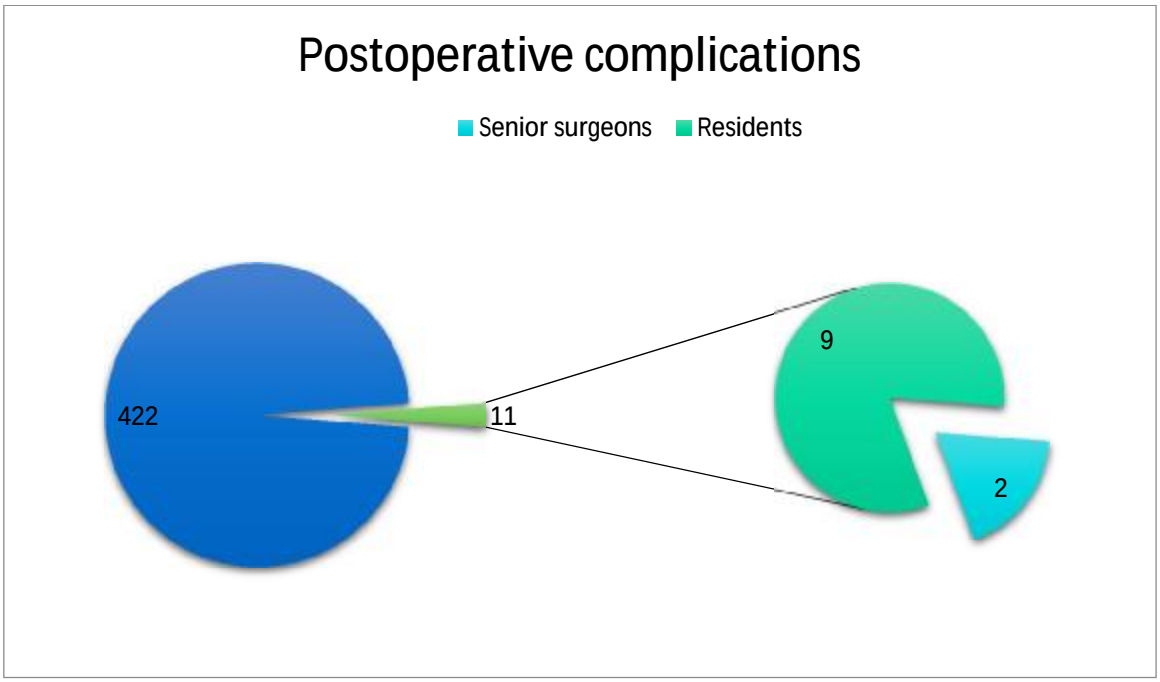


Chart 14 : Postoperative complications rate

Table 23: Postoperative complications distribution

	Senior surgeon	Resident	P value
Common bile duct injury	1	3	0.583
Parietal Complications	1	5	0.342
Jaundice	0	1	0.663
Return to OR	0	3	0.290
Mortality	0	0	-

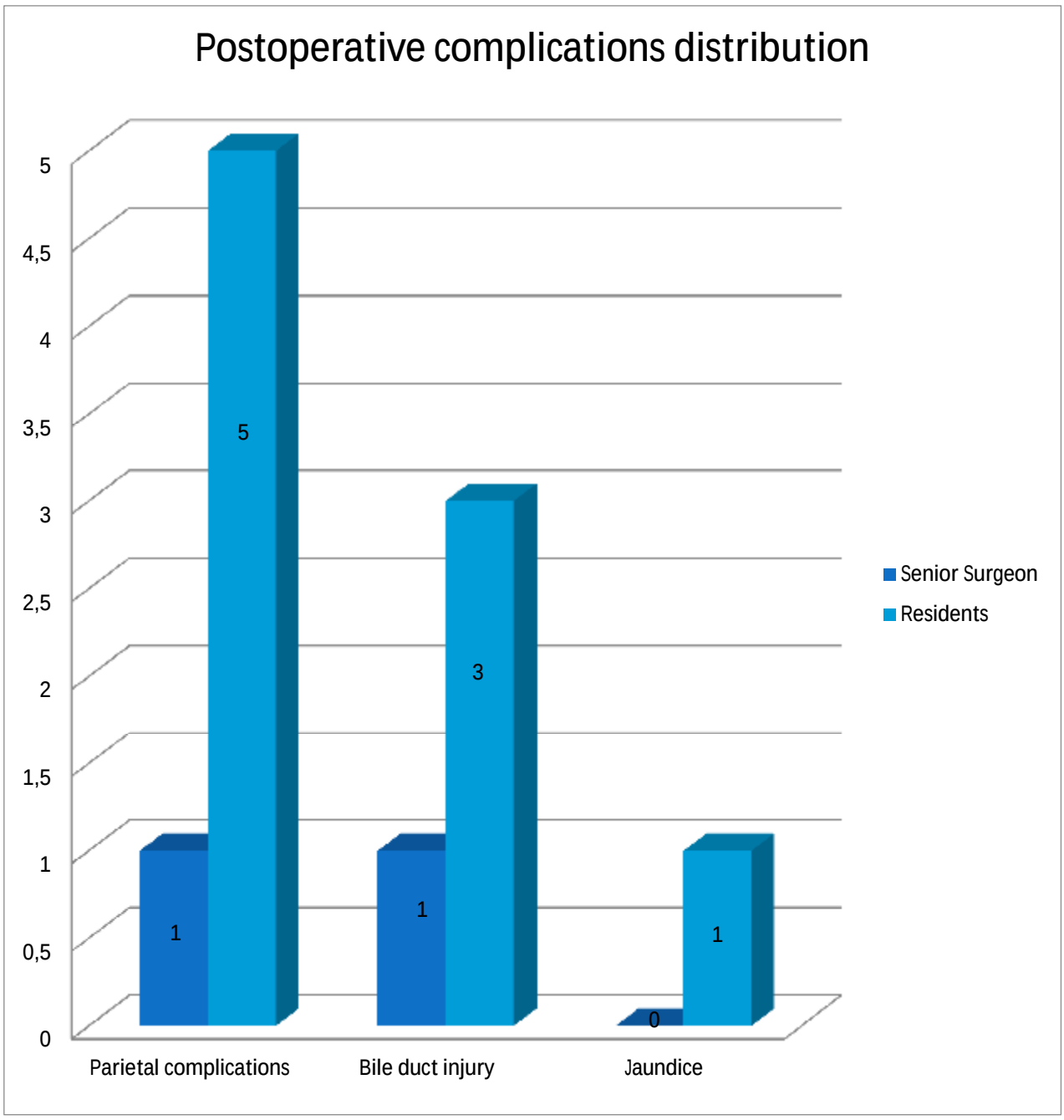


Chart 15 : Postoperative complications distribution

VII. Residents' surgery outcomes

1. Sampler size

- A total of 287 laparoscopic cholecystectomies were performed by resident trainees.
- Among the residents, a total of 62 LC were performed by PGY-3, 117 by PGY-4 and 108 by PGY-5.
- The table and chart below shows the patients distribution by the first surgeon.

Table 24: Residents distribution by PGY level

Level	Number	Percentage
PGY-3	62	22%
PGY-4	117	41%
PGY-5	108	37%
Total	287	100%

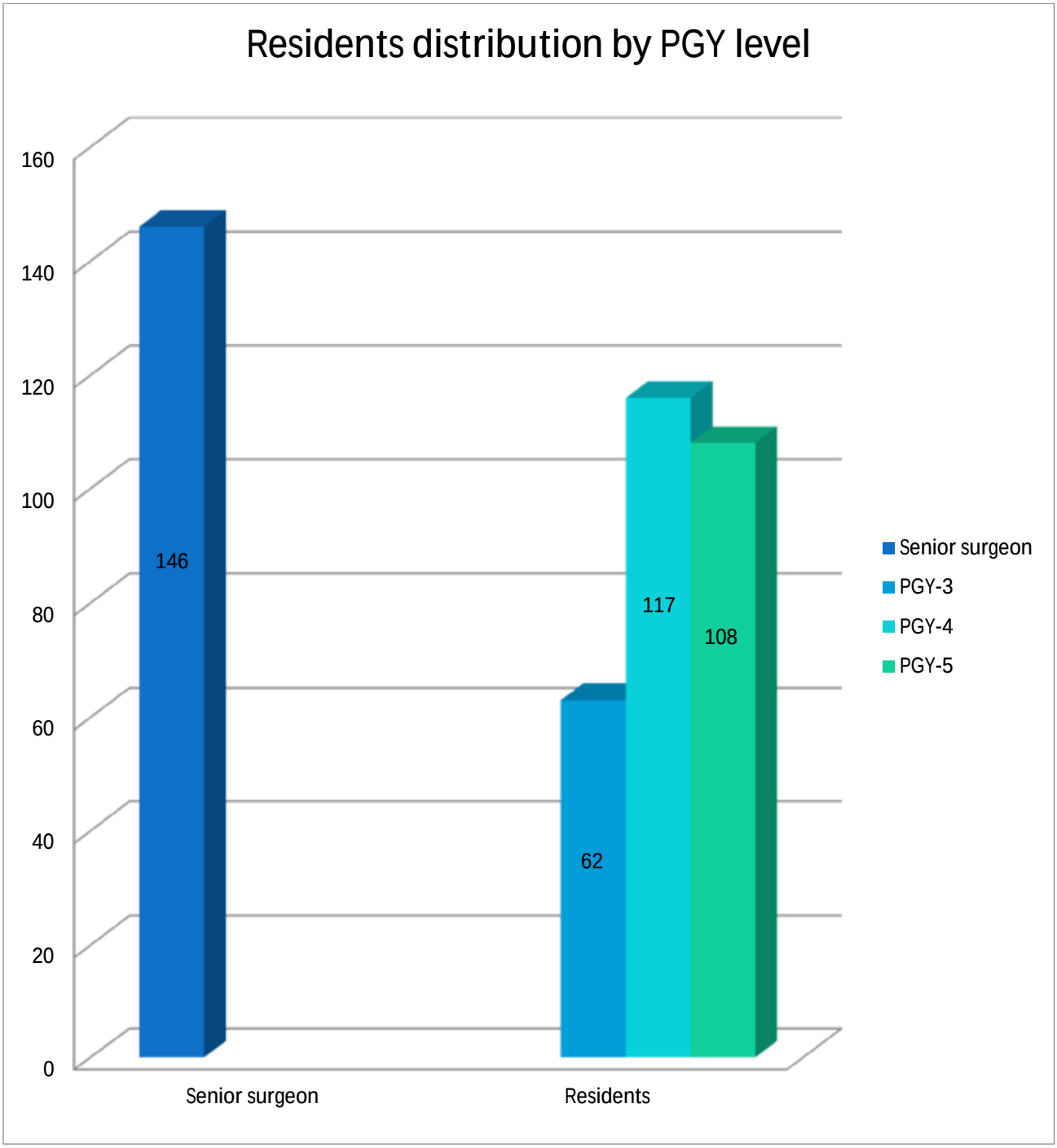


Chart 16: Residents distribution by PGY level

2. Demographics

- Age distribution by level:

- 47.7 years old in PGY-3
- 50.3 years old in PGY-4
- 50.4 years old in PGY-5

- Sex ratio

- 0.19 in PGY-3
- 0.16 in PGY-4
- 0.17 in PGY-5

Table 25 : Mean age and gender distribution

Level	Mean age (in years)	Sex ratio
PGY-3	47.7	0.19
PGY-4	50.3	0.16
PGY-5	50.4	0.15
Total	49.4	0.16

-Medical backgrounds

- 30 % of patients in PGY-3
- 32% of patients in PGY-4
- 30% of patients in PGY-5

-Surgical backgrounds:

- 9% of patients in PGY-3
- 8% of patients in PGY-4
- 8% of patients in PGY-5

- Duration of symptoms:

- 5.8 months in PGY-3
- 6.1 months in PGY-4
- 6.1 months in PGY-5

Table 26 : Backgrounds

Level	Medical backgrounds	Surgical backgrounds	Duration of symptoms
PGY-3	30%	9%	5.8 months
PGY-4	32%	8%	6.1 months
PGY-5	30%	8%	6.1 months
Total	30%	8%	6 months

3. Intraoperative difficulties

Intraoperative difficulties included dense adhesions, inflammatory and unclear anatomy.

We notice no significant difference between the 3 levels:

-11.9% in PGY-3 (P=0.593)

-11.9% in PGY-4 (P=0.398)

- 9.2% in PGY-5 (P=0.365)

Table 27: Intraoperative difficulties causes in residents

Level	PGY-3 (n=62)	PGY-4 (n=117)	PGY-5 (n=108)
Dense adhesion	7 11.3%	13 11.1%	9 8.3%
Anatomic causes	0 0%	1 0.8%	0 0%
Intense inflammation	1 1.6%	0 0%	1 0.9%
Total	8 12.9%	14 11.9%	10 9.2%
P value	0.593	0.398	0.365

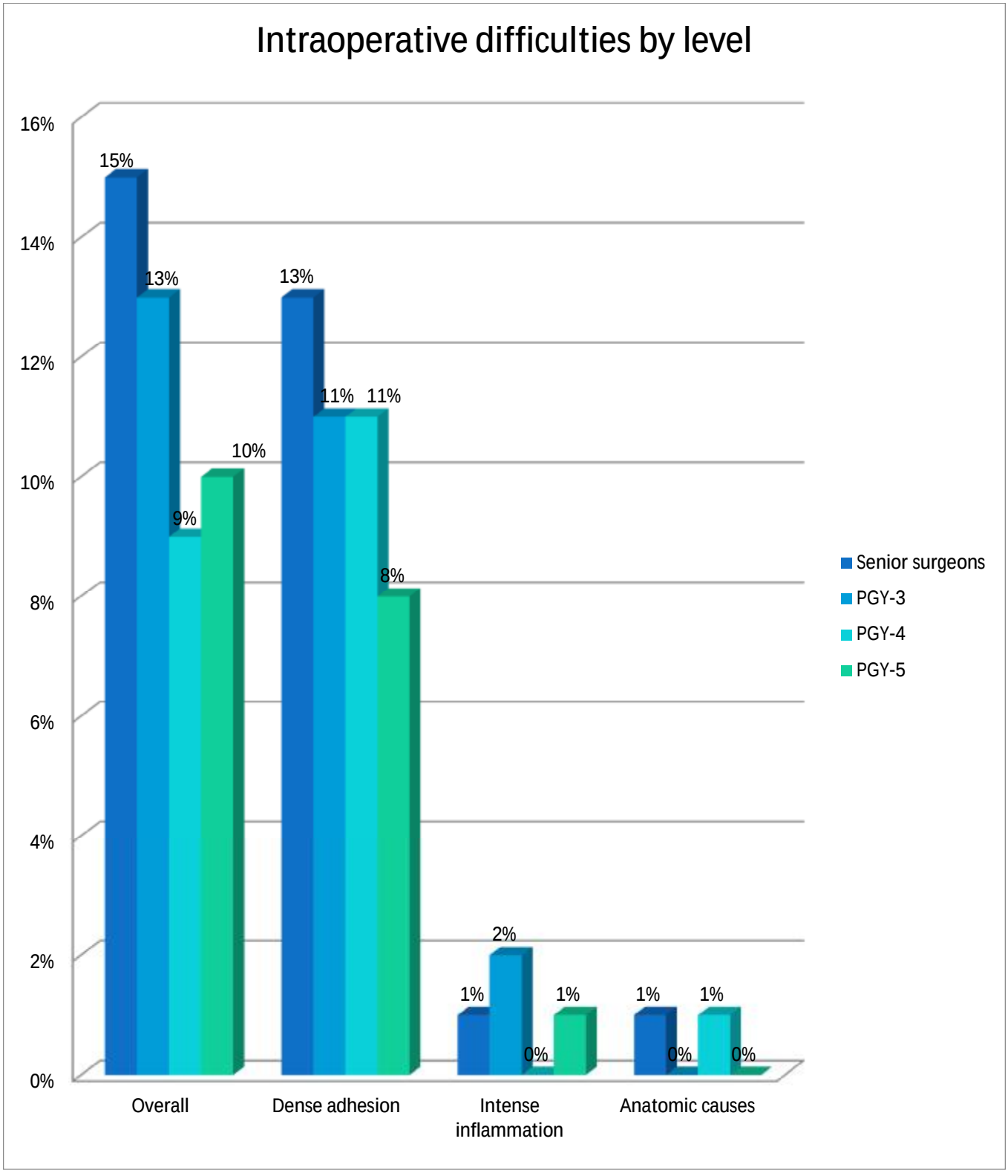


Chart 17: Intraoperative difficulties by level

4. Intraoperative complications

- 14 cases of intraoperative complications were reported in residents' sampler
- Intraoperative complications included biliary spillage, bleeding and hemodynamic instability.
- No significant difference was observed between the 3 levels:
  - 3.2% in PGY-3 (P=0.656)
  - 3.4% in PGY-4 (P=0.450)
  - 4.5% in PGY-5 (P=0.528)

Table 28: Intraoperative complications causes in residents

Level	PGY-3 (n=62)	PGY-4 (n=117)	PGY-5 (n=108)
Biliary spillage	1 1.6%	2 1.7%	2 1.8%
Bleeding	1 1.6%	2 1.7%	2 1.8%
Hemodynamic instability	0 0%	0 0%	1 0.9%
Total	2 3.2%	4 3.4%	5 4.5%
P value	0.656	0.450	0.528

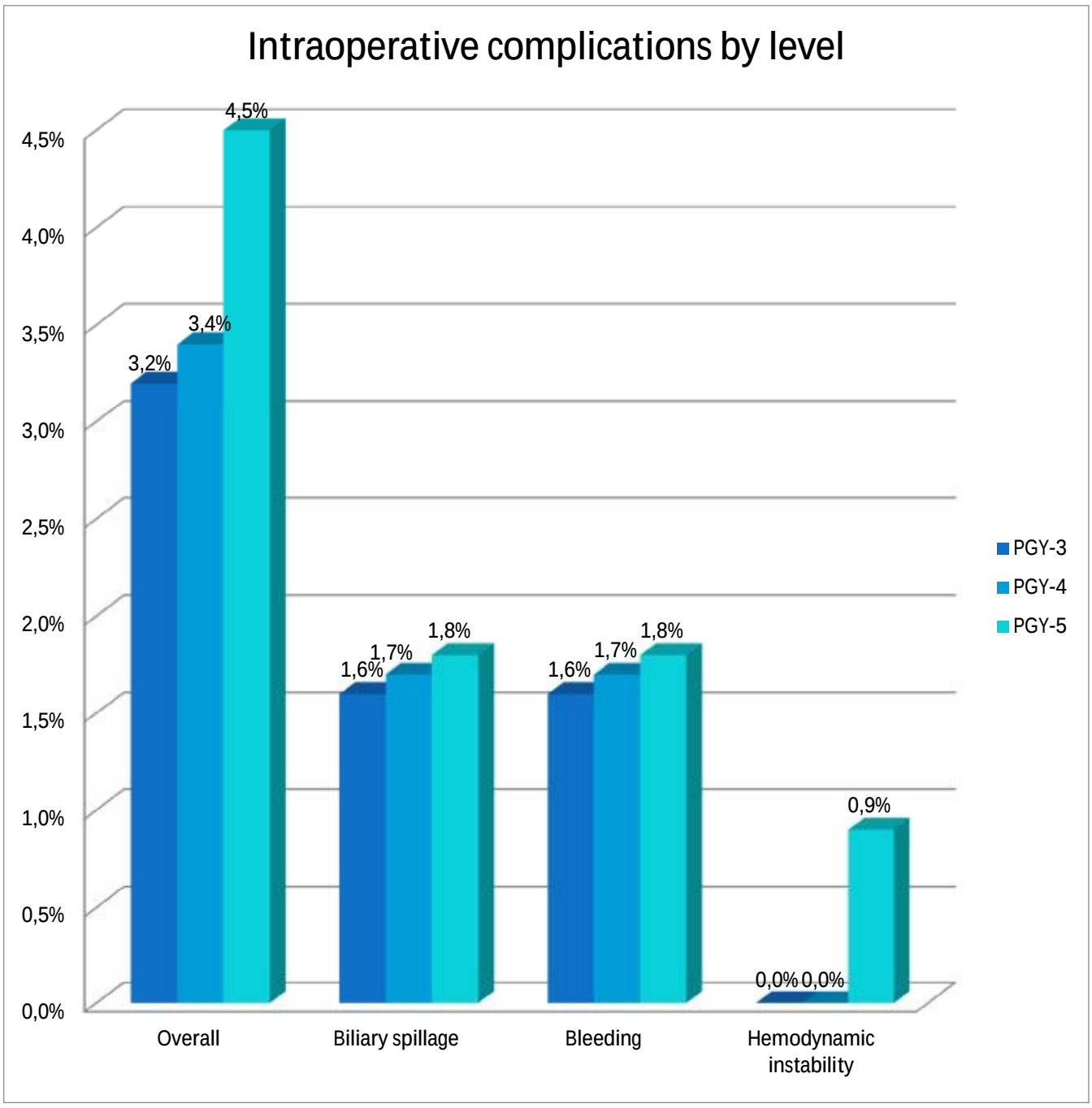


Chart 18: intraoperative complications by level

5. Conversion to open laparotomy

- Intraoperative difficulties and complications can lead to conversion to open laparotomy to unsure a better management of the procedural hazards.
- 23 conversions were reported in residents' sampler
- We notice no significant difference between the 3 levels:
  - 8% in PGY-3 (P=0.500)
  - 9.4% in PGY-4 (P=0.423)
  - 6.5% in PGY-5 (P=0.639)

Table 29 : Conversion distribution in resident trainees

Level	Number	Percentage	P value
PGY-3	5	8%	0.500
PGY-4	11	9,4%	0.423
PGY-5	7	6,5%	0.639
Total	23	8.1%	0.538

6. Drainage

- There was a tendency to have a slightly higher rate of drainage in junior resident trainees comparing to seniors residents.
- We notice no significant difference between the 3 levels:
  - 74% in PGY-3 (P=0.493)
  - 68% in PGY-4 (P=1.000)
  - 67% in PGY-5 (P=0.390)

Table 30: Drainage rate

Drainage	Yes	No	Ratio	P value
PGY-3	46	16	74%	0.493
PGY-4	80	37	68%	1.000
PGY-5	73	35	67%	0.390

7. Operative time

- Operative time was significantly longer in resident trainees comparing to senior surgeons
- In residents' sampler, operative time was significantly longer in PGY-3:
  - 103 minutes in PGY-3 (P=0.018)
  - 93 minutes in PGY-4 (P=0.123)
  - 92 minutes in PGY-5 (P=0.110)

Table 31: Procedure duration by level

	Procedure duration	Range	P value
PGY-3	103±27	60-170	0.018
PGY-4	93±28	45-185	0.123
PGY-5	92±29	35-200	0.110
Sum	96±28	35-200	0.066

8. Mean length hospital stay

- Mean hospital length stay was significantly shorter in PGY-4.
- There is a significant difference between the 3 levels:
  - 4.2 days in PGY-3 (P=0.026)
  - 3.6 days in PGY-4 (P=0.011)
  - 4.2 days in PGY-5 (P=0.017)

Table 32 : Mean length hospital stay in residents (in days)

Mean length hospital stay (in days)	Duration	P Value
PGY-3	4.2	0.026
PGY-4	3.6	0.011
PGY-5	4.2	0.017
Overall	3.95	0.025

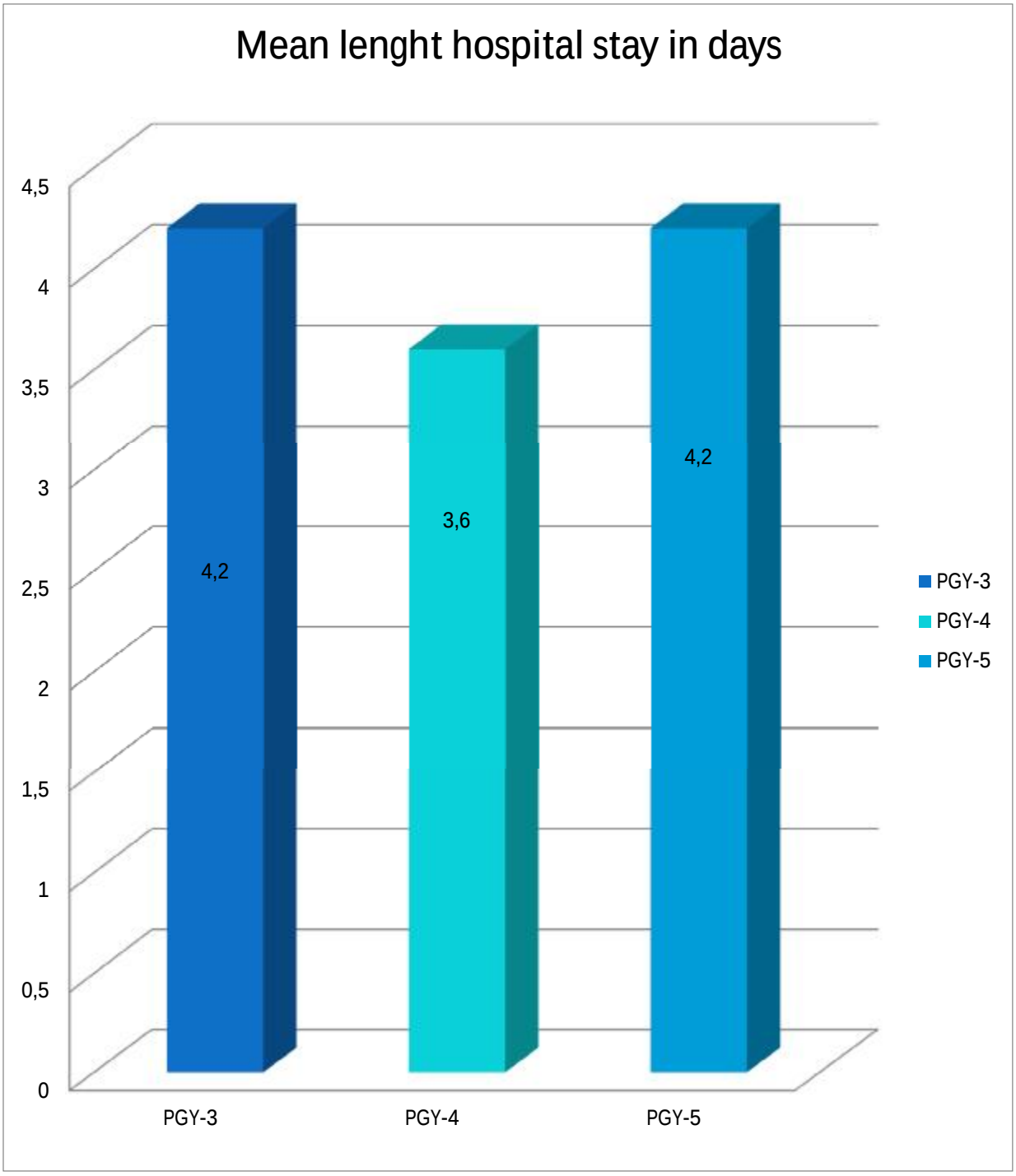


Chart 19: Mean length hospital stays in residents (in days)

9. Postoperative complications:

- 9 cases of postoperative complications were reported in residents' sampler and 3 cases of return to operative room.
- Any death was recorded in our series

Table 33: Postoperative complications in residents

	Postoperative complications	P Value
PGY-3	1 (1.6%)	0.553
PGY-4	5 (4.2%)	0.621
PGY-5	3 (2.8%)	0.509
Overall	9 (3.1%)	0.603

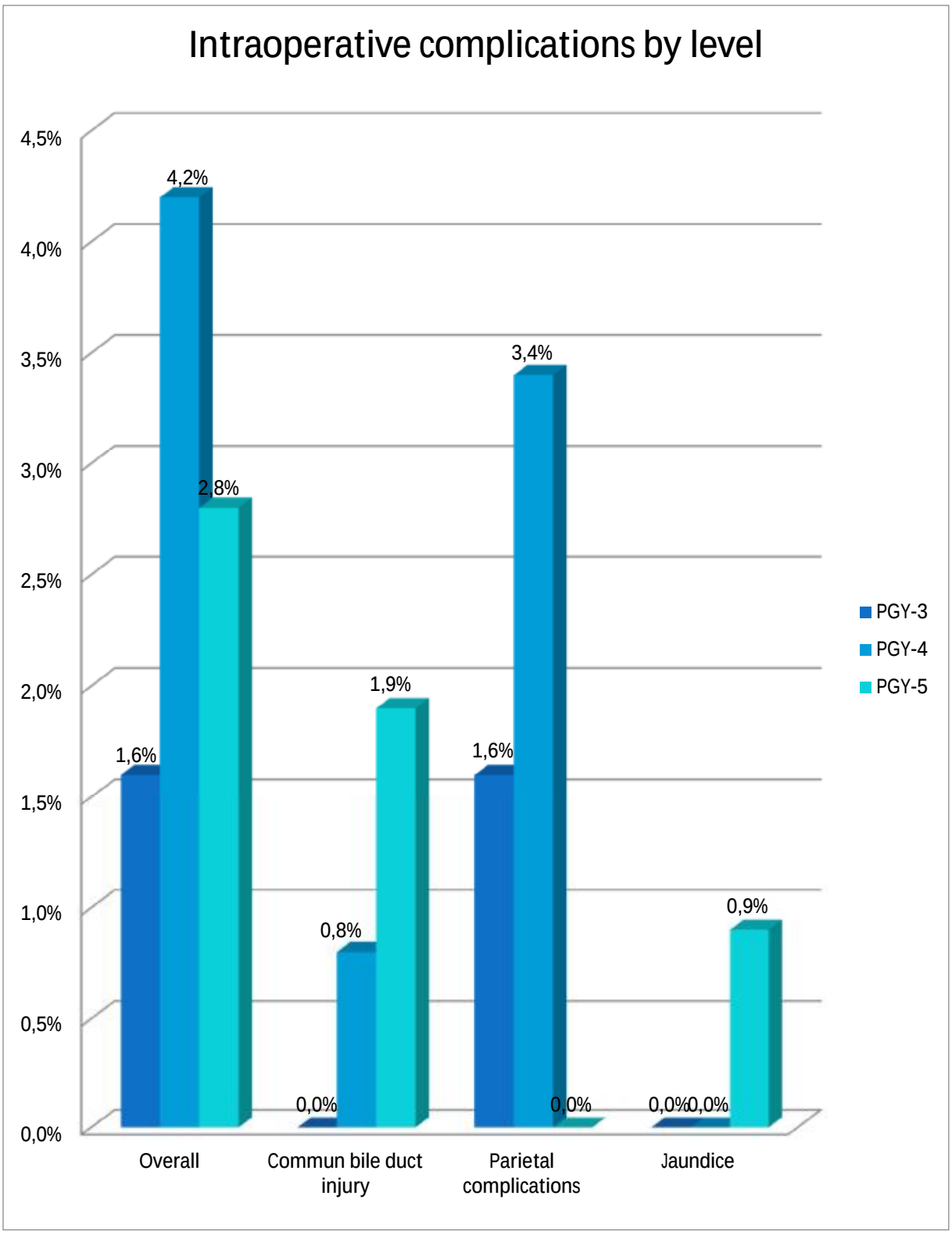


Chart 20 : Postoperative complications by level

VIII. Summary

Table 34: Summary table - Demographics

	Senior surgeon (n=146)	Resident (n=287)	P value
Middle Age	49.7	49.4	0.829
Sex ratio	0.17	0.16	0.885
Comorbidity	45 (31%)	88 (30%)	0.528
Surgical backgrounds	21 (14%)	24 (8%)	0.203
Duration of symptoms (in months)	5.6	6	0.462
Intraoperative difficulties	22 (15%)	32 (11%)	0.156

Table 35: Summary table – Outcomes

	Senior surgeon (n=146)	Residents (n=287)	P value
Intraoperative complications	3 (2%)	11 (3.8%)	0.368
Conversion	12 (8%)	23 (8%)	0.538
Drainage	93 (63%)	199 (69%)	0.141
Operative time (in minutes)	61	96	<0.001
Mean hospital stay (in days)	3.09	3.95	<0.001
Postoperative complications	2 (1.3%)	9 (3.1%)	0.223
Return to OR	0	3 (1%)	0.290
Mortality	0	0	-

Table 36: Summary table – Residents' outcomes

	PGY-3 (n=62)	PGY-4 (n=117)	PGY-5 (n=108)	P value
Intraoperative complications	2 (3.2%)	4 (3.4%)	5 (4.5%)	0.586
Conversion	5 (8%)	11 (9.4%)	7 (6.5%)	0.723
Drainage	46 (74%)	80 (68%)	73 (67%)	0.640
Operative time (in minutes)	103	93	92	0.066
Mean hospital stay (in days)	4.2	3.6	4.2	0.017
Postoperative complications	2 (3.2%)	4 (3.4%)	5 (4.6%)	0.603
Return to OR	1 (1.6%)	2 (1.7%)	0	0.400
Mortality	0	0	0	-

CHAPTER VII

DISCUSSION

I. Sampler size

We examined the outcomes of 433 consecutive elective LC performed bysenior surgeons and trainee residents performed in University Hospital Hassan II between January 2011 and December 2014. To our knowledge, this is the first study specifically examining the impact of resident-led and resident-performed procedures on operative times and outcomes of LC in Morocco.

At present, laparoscopic cholecystectomy is one of the most common surgical operations performed by surgical residents in the United States, with evidence of increased rates during the last few years. This operation is considered to be very effective and safe in the hands of American trainees, who perform more than one hundred laparoscopies during their residentships, 68% of these consisting in cholecystectomies. [31]

In Morocco, surgical residents receive the major part of their educational program at University Hospital which is a third level hospital, with a low LC rate. Furthermore, the safety restrictionsand the lack of hospitalization beds and medical staffaffect negatively the productivity of general surgical trainees, with a resultant decrease in operative volume and autonomy.

Thus, our sampler size seems substantial comparing to European series but lessnoteworthy comparing to American series.

Table 37: Sampler size repartition according to different authors

Series	Country	Year	Sample size	RD Rate	SS Rate
D. Pariani et al. [32]	Italy	2014	569	246 (43%)	323 (57%)
S. Suuronen et el. [33]	Finland	2010	787	485 (62%)	302 (38%)
Bencini et al.[34]	Italy	2008	342	171 (50%)	171 (50%)
Haji et al. [35]	U.K	2009	562	276 (49%)	286 (51%)
Koulas et al. [36]	Greece	2006	1370	445 (33%)	925 (67%)
Fahrner et al. [37]	U.S.A	2012	1747	770 (44%)	997 (56%)
Gifford et al. [31]	U.S.A	2015	1202	787 (66%)	415 (34%)
Our Series	Morocco	2016	433	287 (66%)	146 (34%)

II. Demographic

1 Age

The mean age in our series was 49 years with extremes ranging from 18 to 87 years old. The 50-59 mean age group aggregated 27% of patients.

- There was no significant difference between senior surgeons group and residents group (P=0.829).
- The mean age in our study was in line with the average for other series.
- It has been observed that in our series the advanced age does not contraindicate laparoscopic surgery; the extreme age was 87 years.

2 Sex ratio

- Different studies demonstrated that hormonal factor is a non-negligible cause of gallstones. [4;7;10]
- In our series, 86% of patients were female with a sex ratio of 0.17 which is similar to European and American series.
- The sex ratio was similar in two other studies hold in University Hospital Hassan II in 2014 (0.19) [38] and Ibn Khatib Hospital Fes in 2010 (0.08) [39]

The table below compares the mean age and sex-ratio in different studies:

Table 38: Sex Ratio and Mean Age distribution compared to different authors

Series	Overall Mean age	Mean age in SS	Mean age in residents	Sex Ratio
D. Pariani et al. [32]	55	56	55	0.66
S. Suuronen et el. [33]	54	56	51	0.35
Bencini et al.[34]	54	53	55	0.58
Haji et al. [35]	51	-	-	0.22
Koulas et al. [36]	46	49	45	0.28
Fahrner et al. [37]	55	58	52	0.56
Gifford et al. [31]	41	-	-	0.33
Our Series	49	49.7	49.4	0.17

III Intraoperative courses

1. Operative duration

As expected, our data show that the duration of operation was significantly higher in laparoscopic cholecystectomies performed by residents compared to those performed by staff surgeons (96*versus* 61 minutes). P<0.001

The same difference in the duration of laparoscopic cholecystectomy was reported by a study published by Böckler [40] et al. although with times higher than what we found (119 minutes for residents versus 97 minutes for senior surgeons).

The difference in duration of the operation can be explained, in part, as evidenced by other studies in the literature, with the lower surgical skill of the residents and in part by the fact that it is often the staff surgeon himself to teach the resident that time should not be a primary concern and that he should always pay maximum attention to what he is doing even in the steps of the operation that may seem simple.

Our study shows that the duration of laparoscopic cholecystectomy decreases over the 5 years of training in general surgery with the gradual progress in the learning curve: 103 minutes in PGY-3, 93 minutes in PGY-4 and 92 minutes in PGY-5.

A similar result has been also pointed out by Kauvar et al.[41] whose study has shown showed that the mean duration of laparoscopic cholecystectomy performed by residents in the first three years of training was 88 minutes, versus 73 minutes in the last 2 years of training.

Compared to European and American recent studies, the operative time in procedures performed by our residents is still quite long. Actually, in most theses countries, laparoscopic cholecystectomy is performed by residents since their PGY-2. [31;32;33;34]

The table below indicate the operative time duration of LC in different series:

Table 39: Operative time

Series	Year	Sample size	Operative Time in SS (min)	Operative timein residents (mins)	P value
D. Pariani et al. [32]	2014	569	66	84	0.003
S. Suuronen et al. [33]	2010	787	55	80	<0.001
Bencini et al. [34]	2008	342	50	67	<0.001
Kauvar et al. [41]	2006	562	67	88	<0.05
Koulas et al. [36]	2006	1370	49	57	0.12
Fahrner et al. [37]	2012	1747	75	88	0.001
Gifford et al. [31]	2015	1202	82	103	<0.001
Our Series	2016	433	61	96	<0.001

2. Intraoperative difficulties

Our study was executed in a Third Level Hospital.

For safety reasons, senior surgeons are assigned to surgeries with higher probability of complication.

Thus, the rate of intraoperative difficulties was higher in senior surgeons 15% versus 11% in residents, but with no significant difference between the two groups (P=0.156).

Classically, a sub-hepatic drain was inserted routinely in a cholecystectomy to prevent intra-abdominal abscesses, possible post-surgical bleeding, and biliary fistulas. Over the years, it has been demonstrated that the systematic use of a drain does not have any benefits, and many studies conclude that, in special circumstances (bleeding, signs of gallbladder inflammation, incidental opening, or suspected bile leak), and depending on the experience of the individual surgeon, the insertion of a drain may be of use. [42;43;44]

Owing to a judicious use of drainage, only 1 case of post-operative biloma were reported during 30th days following the surgery (<1%).

3. Conversion to laparotomy

The overall conversion rate was 8.1% (35/433). No difference was found between the rates of conversion in the operations performed by residents compared to thosecarried out by staff surgeons (8% *versus* 8.2%).

This result is in line with those reported in most of the studies in which the percentage of conversion varies from 2 to 15%.[31;32;33;34;35]

It is interesting to note that even the conversion rate is similar and not significant (P = 0.623) for both PGY-3, PGY-4 and PGY-5 (8% versus 9.4*versus* 6.5%), which contrasts with what has been reported by Kauvar et al. [41]that in their study shows that the conversion rate to laparotomy is significantly greater in the operations performed by residents in their last years of training performed by residents in their first three years (8.4% *versus* 3.7%). Kauvar study results were explained by the lack of supervision of senior trainees by senior surgeon and the selection of patients.

Table 40: Conversion rate

Series	Year	Sampler size	Conversion ratein SS	Conversion rate in residents	P value
D. Pariani et al. [32]	2014	569	2.7%	3.2%	0.700
Bencini etal. [34]	2008	342	3%	9%	0.060
Kauvar et al. [41]	2009	562	3.7%	8.4%	0.040
S. Lim et al. [45]	2006	800	10.7%	14.8%	0.284
Fahrner et al. [37]	2012	1747	1.2%	1.5%	0.300
Gifford et al. [31]	2015	1202	6.9%	9.2%	<0.001
Our Series	2016	433	8.2%	8%	0.538

IV. Complications

Surgeon experience is a predictor of the safe and efficient performance of LC. The occurrence of intraoperative and postoperative complication is an effective mean to evaluate that parameter.

The intraoperative and postoperative complications including biliary spillage, bleeding,common bile duct injury,parietal complications and jaundicewere found to be rare with no statistically significant differences between the two groups:

- Intraoperative complications : 2% in senior surgeons versus 3.8% in residents P=0.247
- Postoperative complications : 1.3% in senior surgeons versus 3.1% in residents P=0.223
- 5 Cases of biliary spillage in residents versus 0 in senior surgeons
- 5 Cases of bleeding in residents versus 2 in senior surgeon
- 4 Cases of common bile duct injury 0.9% (0.7% in SS versus 1% in residents) in line with Pariani (1.2%), Fahrner (1.2%) and Koulas (0.7%)
- The complications rate in residents was: 3.2% in PGY-3, 3.4% in PGY-4 and 4.6% in PGY-5 with no significant difference between the different levels

The complications rate in our study tally with the results reported by other European and American series on the table below:

Table 41: Complications rate

Series	Year	Sample size	Complications Rate in SS	Complications Rate in residents	P value
D. Pariani et al. [32]	2014	569	4.7%	4.3%	0.700
Bencini et al. [34]	2008	342	6%	8%	0.780
Kauvar et al. [41]	2006	562	3.7%	3.7%	0.040
Koulas et al. [48]	2006	1370	2.9%	3.9%	0.110
Fahrner et al. [37]	2012	1747	2%	3%	0.400
Gifford et al. [31]	2015	1202	3.1%	3.2%	0.600
Our Series	2016	433	3.3%	6.9%	0.338

V. Mean hospital stay

The mean hospital stay was significantly longer in residents sampler comparing to senior surgeons sampler (3.09 versus 3.95) P<0.001.

Indeed, the higher rate of complications and drainage in residents'sampler required close and thoroughsurveillance, with on averageless than one more day hospital stay.

The overall mean hospital stay was 3.66 days, lining with Pariani[32] (3.4 days) and Bencini series [34](3 days)

Table 42: Mean hospital stay in days

Series	Year	Sampler size	Mean Hospital stay in SS	Mean Hospital stay in residents	P value
D. Pariani et al. [32]	2014	569	3.3	3.4	0.200
Bencini et al. [34]	2008	342	3	3	0.520
Koulas et al. [48]	2006	1370	1.3	1.5	0.330
Fahrner et al. [37]	2012	1747	4	5	0.600
Our Series	2016	433	3.09	3.95	<0.001

VI. Mortality

Despite the great number of patients who underwent laparoscopic cholecystectomy, we did not recorded any case of postoperative death.

Nevertheless, our results can be explained by the exclusion of urgent procedures and the fact that most patients were ASA I – ASA II.

This finding is comparable to those reported in the literature where studies show a mortality rate from 0to 0.6%.

Table 43: Mortality rate

Series	Mortality rate
D. Pariani et al.[5]	0.35%
Bencini et al.[8]	0%
Gifford et al.[2]	0.25%
Fahrner et al.[16]	0.6%
Our Series	0%

The extremely low rate of mortality and morbidity reveal the worthwhile implication of the whole medical staff to ensure an adequate management of difficult cases and providing decent medical health care.

CHAPTER VIII
CONCLUSION

Our study shows that LC can be performed by residents with comparably low intraoperative and postoperative morbidity and mortality as by senior surgeons. As expected, the duration of operation was longer in cholecystectomies performed by RS, with this difference being greatest in complicated operations. This fact is explained by the lower experience of RS in elective laparoscopic surgery before the operative time will decrease upon completion of the learning curve.

We demonstrate that in face of adequate patient volume, appropriate teaching, an adequate supervision of surgical residents and selection of patients, laparoscopic cholecystectomies performed by residents are equally safe and associated with a morbidity and mortality as low as cholecystectomies performed by senior surgeons on the basis of short-term outcome parameters.

The present study has shown that our structured training program for laparoscopic cholecystectomy effectively allows junior surgeons to learn the procedure without putting our patients at increased risk of its potentially serious complications. Nevertheless, a systematic introduction of VRT (Virtual Reality Training) programs may improve initial basic skills and minimize the risk of unexpected complications.

The quest to achieve optimum outcomes for patients may also require the introduction of new minimally invasive approaches for laparoscopic cholecystectomy (Mini Laparoscopic Cholecystectomy and Single Incision Laparoscopic Cholecystectomy) improving meanwhile residents' familiarity with emerging technics in laparoscopic cholecystectomy.

Abstract

-Title:

Effect of Resident Postgraduate Year on Outcomes after Laparoscopic cholecystectomy

- Keywords:

Laparoscopic cholecystectomy. Residents in training. Operative time. Complications. Patients' Outcomes.

- Introduction:

Laparoscopic cholecystectomy is a mini-invasive procedure in which the gallbladder is removed by laparoscopic techniques. Cholecystectomy has always been an essential part in the training program of surgical residents in Morocco. Since the introduction of the laparoscopic technique in the early 2000s in our institution, laparoscopic cholecystectomy (LC) has become very soon the gold standard in gallstones disease procedures. Increasing numbers of LCs are being performed by residents under supervision.

-Purpose of the study:

The primary aim of our study was to analyze whether the laparoscopic cholecystectomy performed by surgeons in training is a safe procedure by comparing the same operation performed by trainees and staff surgeons in term of perioperative and postoperative complications, length of hospital stay, morbidity and mortality.

-Patients and methods:

This is a cross-sectional retrospective study, reviewing the charts of all patients who underwent laparoscopic cholecystectomy from 01/01/2011 to 31/12/2014 at

department of abdominal surgery at University Hospital Hassan II of Fez. Patients were divided into 2 groups: LCs performed by senior surgeon vs LCs performed by trainees.

-Results:

Our study included 433 patients. 34% of procedures were performed by senior surgeons and 66% were performed by resident trainees. The mean age was 49 years with a women prevalence (sex-ratio=0.17). 30% of patients were suffering from associated comorbidities. All patients had undergone abdominal ultrasound and only 18% CT scan. Operative time was significantly longer in residents' group comparing to senior surgeons group (96 min vs 61 min) P<0.001. The overall intra- and postoperative complications rate was respectively 3.1% and 2.5%, with no significant difference between the two group (P=0.368 and P=0.223). Conversion to open laparotmy was required in 8% of cases in each group (P=0.538). The mean length of hospital stay after surgery was significantly longer in patients operated by residents (P<0.001). We didn't notice any case of mortality in both groups. The analysis of subgroup of trainees residents didn't show any repercussion on patients' outcomes. The duration of procedure and conversion rate decrease as laparoscopic experience increase.

- Conclusion:

Our study shows that laparoscopic cholecystectomy performed by residents is a safe procedure. The longer operative time in resident procedures may be filled by the introduction of VRT (Virtual Reality Training) programs, providing an adequate experience in virtual reality situations.

Résumé

-Titre:

Effet de l'implication des résidents en formation sur les résultats des cholécystectomies laparoscopiques.

- Mots-clés:

cholécystectomie laparoscopique. Formation résidents. Temps opératoire. Complications. Résultats.

- Introduction:

La cholécystectomie laparoscopique est une procédure mini-invasive durant laquelle la vésicule biliaire est enlevée par des techniques laparoscopiques. La cholécystectomie a toujours été un élément essentiel dans le programme de formation des résidents en chirurgie au Maroc. Depuis l'introduction des techniques laparoscopiques au début des années 2000 dans notre institution, la cholécystectomie laparoscopique (LC) est rapidement devenue le gold-standard dans le traitement chirurgical des calculs biliaires.

-But De l'étude:

L'objectif principal de notre étude était d'analyser si la cholécystectomie laparoscopique réalisée par des chirurgiens en formation est une procédure sûre en comparant les résultats chirurgicaux des résidents et les chirurgiens séniors en termes de complications peropératoires et postopératoires, la durée de l'hospitalisation, de morbidité et mortalité.

- Patients et méthodes:

Il s'agit d'une étude transversale et rétrospective. Les dossiers de tous les patients chez qui on a réalisé une cholécystectomie laparoscopique du 01/01/2011 au 31/12/2014 au département de chirurgie viscérale au CHU Hassan II à Fès ont été revus. Les patients ont été divisés en 2 groupes : Patients opérés par des chirurgiens sénior et d'autres opérés par des résidents.

-Résultats:

Notre étude a inclus 433 patients. 34% des procédures ont été effectuées par les chirurgiens séniors et 66% ont été réalisées par les résidents. L'âge moyen dans notre série était de 49 ans avec une prédominance féminine (sex-ratio= 0.17). Tous les patients avaient bénéficié d'une échographie abdominale et seulement 18% d'un scanner abdominal. Le temps opératoire était significativement plus important chez les résidents par rapport aux chirurgiens seniors (96 min vs 61 min) P=<0.001. Le taux global de complications intra- et postopératoire était respectivement de 3,1% et 2,5%, sans différence significative entre le groupe des résidents et des chirurgiens séniors (P=0.368 and P=0.223). La conversion en chirurgie ouverte était nécessaire dans 8% des cas dans chacun des groupes (P=0.538). La durée moyenne d'hospitalisation après la chirurgie était significativement plus longue chez les patients opérés par les résidents. Aucun décès pour cause médicale n'a été reporté. L'analyse du sous-groupe des résidents n'a montré aucune répercussion sur les résultats des patients, même si le temps opératoire et la durée moyenne de séjour à l'hôpital diminuaient proportionnellement à l'année de formation.

- Conclusion:

Notre étude montre que la cholécystectomie laparoscopique réalisée par les résidents est une procédure sûre. Le temps opératoire plus allongé résidents peut être raccourci par l'introduction de la VRT (formation de réalité virtuelle), fournissant une expérience adéquate dans les situations de réalité virtuelle.

ملخص

- العنوان: أثر مشاركة الجراحين المقيمين على نتائج استئصال المرارة بالمنظار

- الكلمات الأساسية : استئصال المرارة بالمنظار. تدريب المقيمين. مضاعفات. نتيجة. مدة العملية.

- مقدمة: استئصال المرارة بالمنظار هو الإجراء الذي تم من خلاله إزالة المرارة عبر تقنية التنظير، ويعتبر استئصال المرارة عن طريق المنظار عنصرا أساسيا في برنامج تدريب الأطباء المقيمين في الجراحة في المغرب. منذ إدخال هذه التقنية في مؤسستنا في أوائل 2000، أصبحت هذه التقنية الأكثر استعمالا في الجراحة الحشوية.

- أهداف الدراسة: كان الهدف الرئيسي من دراستنا تحليل ما إذا كان استئصال المرارة بالمنظار التي يقوم بها الجراحون المتدربون فيها عواقب بالنسبة للمرضى عن طريق مقارنة نتائج العمليات من حيث المضاعفات ومدة العمليات ونسبة التحول إلى الجراحة المفتوحة وعدد أيام الإقامة في المستشفى، الاعتلال والوفيات.

- طريقة الدراسة: هذه دراسة تحليلية استعادية، تعرضنا لفحص سجلات جميع المرضى الذين خضعوا لجراحة استئصال المرارة بالمنظار من 2011/01/01 إلى 2014/12/31 في قسم الجراحة الباطنية في المستشفى الجامعي الحسن الثاني بفاس. قدم المرضى إلى مجموعتين حسب الجراح: الجراحون المعتمدون # الجراحون المتدربون.

- النتائج: شملت دراستنا 433 مريضا. تم تنفيذ 34٪ من العمليات من طرف الجراحين المعتمدين، و 66% من طرف الجراحين المتدربين. كان متوسط العمر 49 عاما مع سيادة أنثوية (ذكر/انثى = 0.17). كان معدل المضاعفات أثناء وبعد العمل الجراحي 3.1٪ و 2.5٪ على التوالي، عدم وجود فرق بين المجموعتين. مع (P=0.368 و P=0.223)

8% من العمليات تطلبت التحول إلى الجراحة المفتوحة في كلا المجموعتين. متوسط الإقامة في المستشفى بعد الجراحة كان أطول عند المرضى الذين تم علاجهم من طرف الأطباء المقيمين. أخيرا لم يتم ملاحظة أي حالة وفاة. بالنسبة لدراسة نتائج الجراحين المقيمين حسب السنة التدريبية، فلم يلاحظ أي تأثير بالنسبة للاعتلال و الوفيات المرضى، مع تحسن مدة العمليات و مدة الإقامة في المستشفى مع مرور سنوات التدريب.

- الخلاصة: أظهرت دراستنا أن استئصال المرارة بالمنظار التي يقوم بها الأطباء المقيمون هو إجراء آمن بالنسبة للمرضى.

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