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A Clinical Study of Factors Influencing Conversion of Laparoscopic Cholecystectomy to Open Cholecystectomy

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Abstract
Background: *In this prospective study we identify the factors influencing conversion of laparoscopic cholecystectomy to open cholecystectomy and determining the rate of conversion of laparoscopic to open surgery.*
Methods: *A total of 50 patients presenting to Mediciti Institute of Medical Sciences with symptomatic gall stone disease without choledocholithiasis between july 2020 and july 2022 undergoing laparoscopic cholecystectomy were included in the study.*
Results: *In this prospective study, Total 50 laparoscopic cholecystectomies are performed of which Total cases converted to open procedure are 6 (12%). Reason for conversion are difficult anatomy , Bleeding and Common bile duct injury.*
Conclusion: *According to the present study, it has been shown that we still have a higher conversion rate comparing with literature in last 5 years. While many reasons have lead to conversion and influence conversion rate, the most important factor for conversion was dense adhesions. It is, therefore, mandatory to inform the patients about the possibility of conversion to open procedure at the time of taking consent for laparoscopic procedure. In conclusion, laparoscopic cholecystectomy is a safe and minimally invasive technique, with low conversion rate and the most common cause of conversion in our study was the presence of dense adhesions at Calot's triangle.*
Key words: *laparoscopic cholecystectomy, open cholecystectomy, anatomy, calot's triangle, bleeding.*

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I. INTRODUCTION

Gallstone disease are a common gastrointestinal illness in the general population which frequently requires hospitalization. The prevalence is around 11% to 36% . The treatment of choice for patients with symptomatic cholelithiasis is Laparoscopic cholecystectomy. Previously Open cholecystectomy was frequently performed but that has given way to a laparoscopic approach.The advantages of laparoscopic cholecystectomy are the avoidance of large incision, shortened hospital stay and earlier recovery.

The patients condition, the surgeon‟s level of experience, and technical factors can play a major role in the decision for conversion. Inability to define the anatomy and difficult dissection are the leading cause for conversion followed by other complications like bleeding.

The conversion rate for elective laparoscopic cholecystectomy is around 5%, whereas the conversion rate in the setting of complications like acute cholecystitis is around 30%.

The goal of this study was to determine the conversion rate and identify the factors responsible for conversion of laparoscopic cholecystectomy to open cholecystectomy. Hence, these findings will allow us to :-

1. To identify a patient's risk for conversion based on preoperative information leading to more meaningful and accurate preoperative counselling.
2. Improved operating room scheduling and efficiency.
3. Improve patient safety by minimizing time to conversion.

II. AIM AND OBJECTIVES

1. To identify the risk factors predictive of conversion of laparoscopic cholecystectomy to open surgery .
2. To determine the rate of conversion of laparoscopic cholecystectomy to open surgery.

III. MATERIALS& METHODS

Methods of data collection:

A total of 50 patients patients admitted in Mediciti institute of medical sciences presenting with symptomatic gall stone disease without choledocholithiasis between july 2020 and july 2022 were included in the study.

Every patient included in the study was subjected to the following assessments which were regarded as risk factors for laparoscopic cholecystectomy:

1. Patient's characteristics,
2. Complaints,
3. History ,
4. Clinical examination,
5. Radiological investigations,
6. Laboratory data and
7. Operative findings

Inclusion Criteria:

Adult patients above the age of 18 years.
Adults with Sypmtomatic Cholelithiasis
Adults with Acalculous Cholicystitis.

Exclusion Criteria:

Age < 18 years
Gall Bladder Malignancy
Adults with choledocholithiasis
Perforated Gallbladder
Patients unfit for General anesthesia

IV. RESULTS

A prospective study was carried out from july 2020 to july 2022 in the Department of General Surgery in 50 patients undergoing laparoscopic cholecystectomy. The patients belonged to various surgical units in Mediciti institute of medical sciences and full details of the patients were recorded in the proforma. Complete observations and analysis of all the parameters studies are as follows.

AGE INCIDENCE:

The mean age in this study was 44.56 years. The age group of the patients in this study ranged from 21 years to 79 years. The highest incidence is seen in the age group of 41-50 years.

Age Group	No. of Patients	Percentage (%)
21-30	8	16 %
31-40	13	26 %
41-50	15	30 %
51-60	10	20 %
61-70	3	6 %
71-80	1	2 %

Table 1: Age Incidence

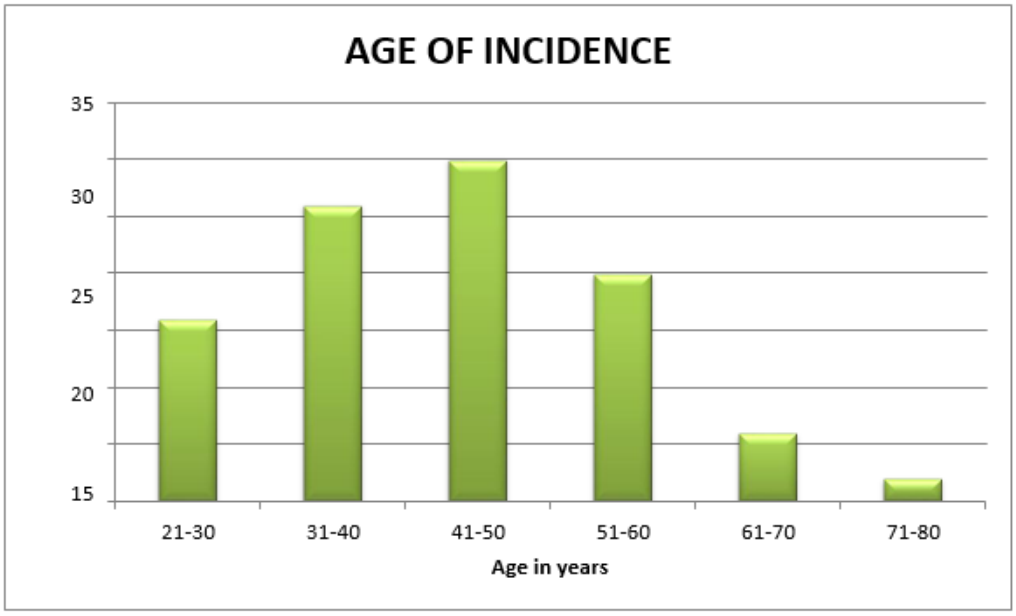


Fig 1: Graphical representation of age incidence

SEX INCIDENCE:

Gender	No. of Patients	Percentage (%)
Male	16	32%
Female	34	68%

Table 2: Sex Incidence

In 50 cases, 16 were males and 34 were females. The ratio of males to females 1:2. The datagiven above shows that gall bladder diseases have a higher incidence in female than in males.

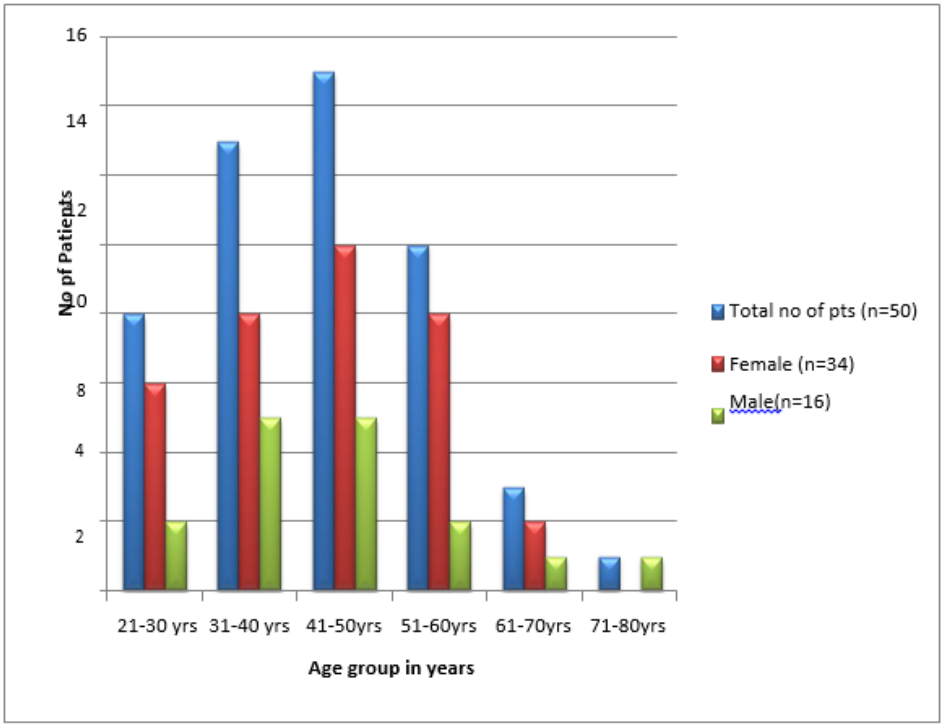
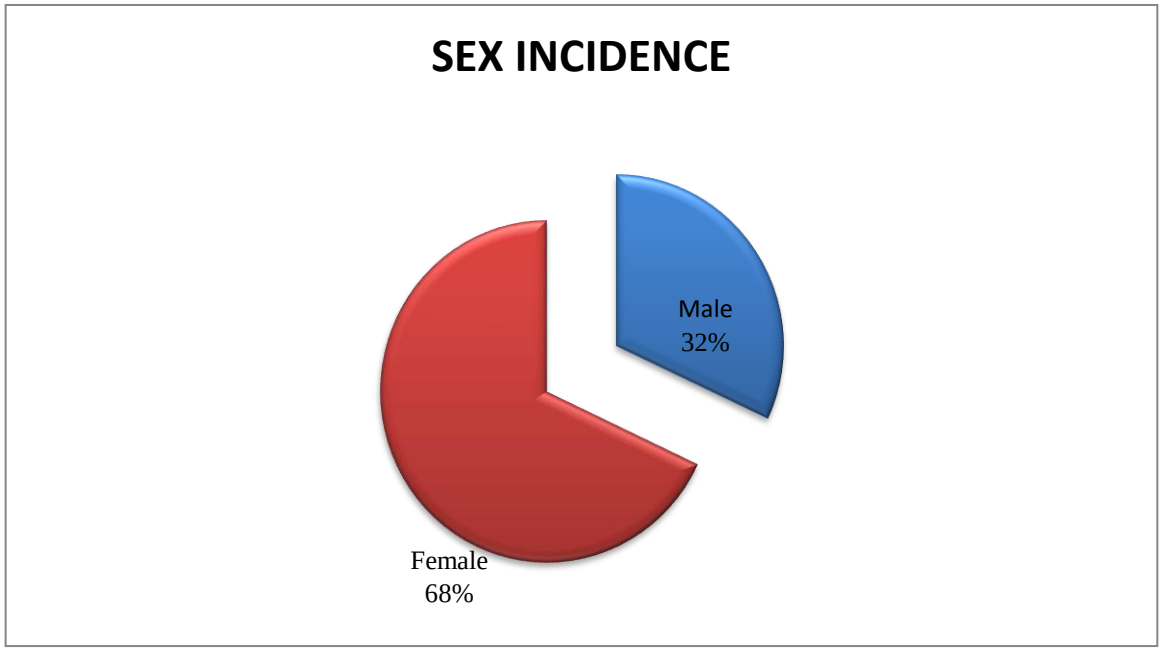


Fig 2: Graphical representation of sex incidence



SEX AND SURGERY OUTCOME:

SEX	No. of Patients	SURGERY OUTCOME			
		Successful		Converted	
		No. of Patients	Percentage	No. of Patients	Percentage
MALE	16	13	81.25	3	18.75
FEMALE	34	31	91.17	3	8.82

Table 3: Sex and Surgery Outcome

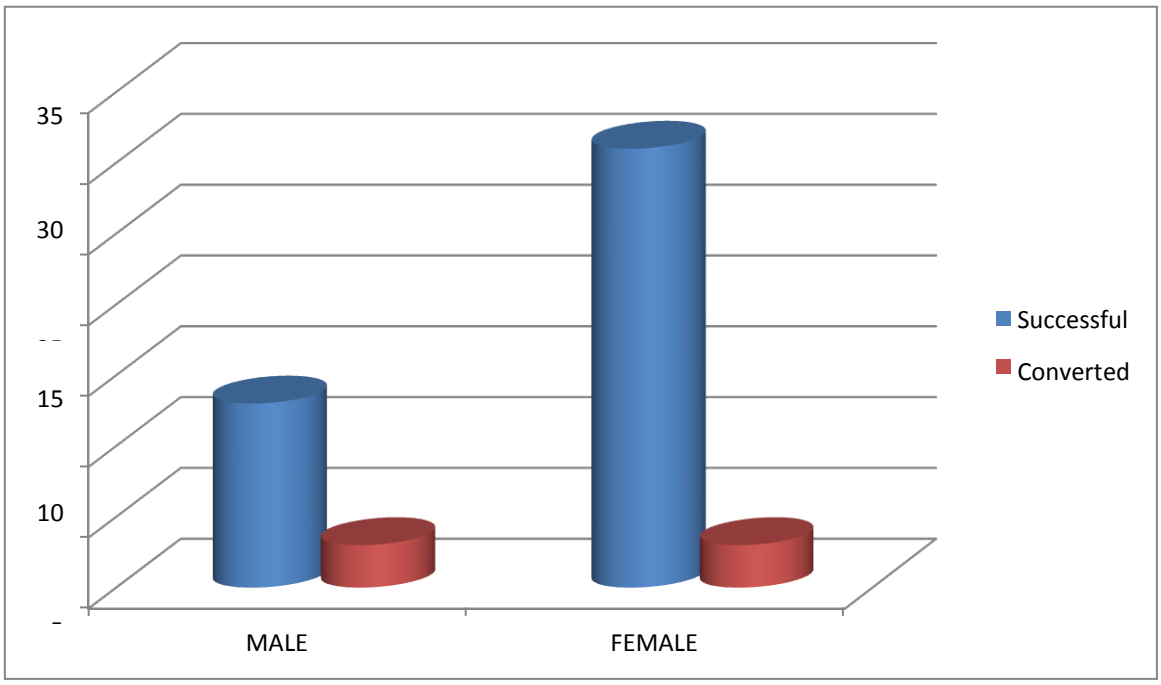


Fig 4 : Graphical Representation of Sex and Surgery Outcome

Among a total of 16 male patients, 3 were converted (18.75%) whereas among 34 female patients, 3 were converted (8.82%).

CLINICAL PRESENTATION:

Presentation	No. of cases	Percentage (%)
Epigastric pain	16	32%
Right Hypochondrium pain	30	60%

Table 4: Clinical Presentation

Out of 50 patients, 30 patients (60%) had a chief complaint of pain in the right hypochondrium, 16 patients (32%) presented with epigastric pain and the remaining 4 patients (8%) weresymptomatic (incidental cholelithiasis).

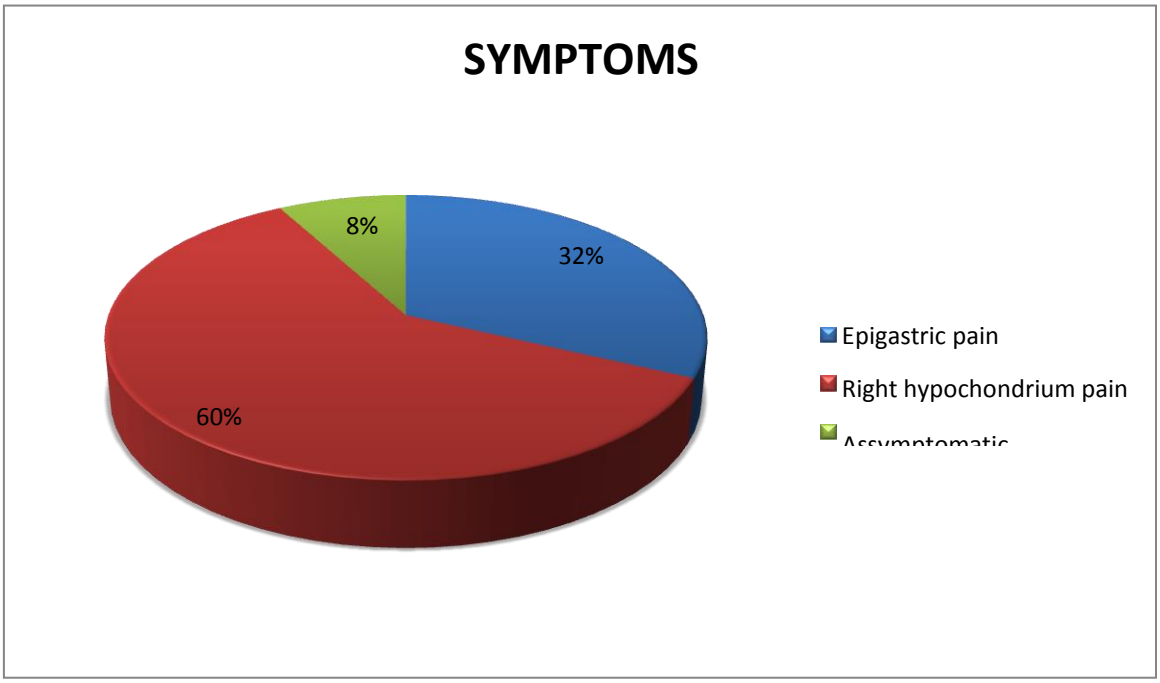


Fig 5: Graph showing clinical presentation

ASSOCIATED SYMPTOMS:

Symptom	No. of cases	Percentage (%)
Nausea	23	46%
Nausea + Vomiting	16	32%
Jaundice	4	8%

23 patients presented with nausea along with abdominal pain and 16 patients presented withnausea and vomiting. Jaundice was seen in 4 patients.

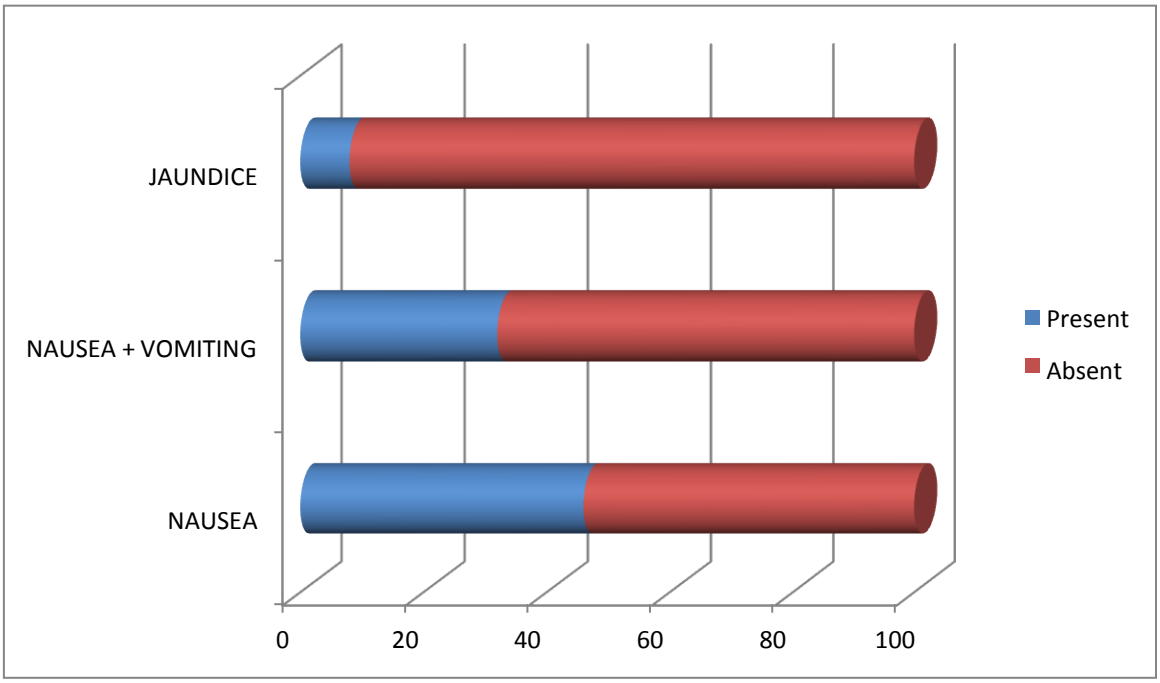


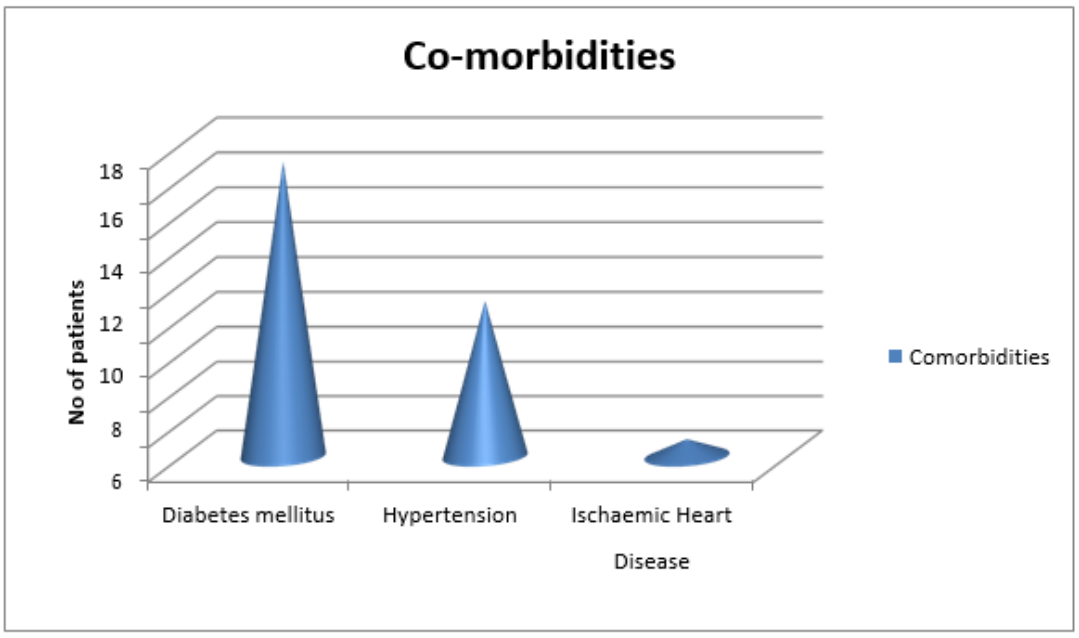
Fig 6: Graph showing associated symptoms

CO-MORBIDITIES:

Co-morbidity	No. of patients	Percentage (%)
Diabetes Mellitus (DM)	17	34%
Hypertension (HTN)	9	18%
Ischaemic Heart Disease (IHD)	1	2%

Table 7: Co-morbidities

34% of patients suffered from Diabetes mellitus whereas 18% of patients were Hypertensive.



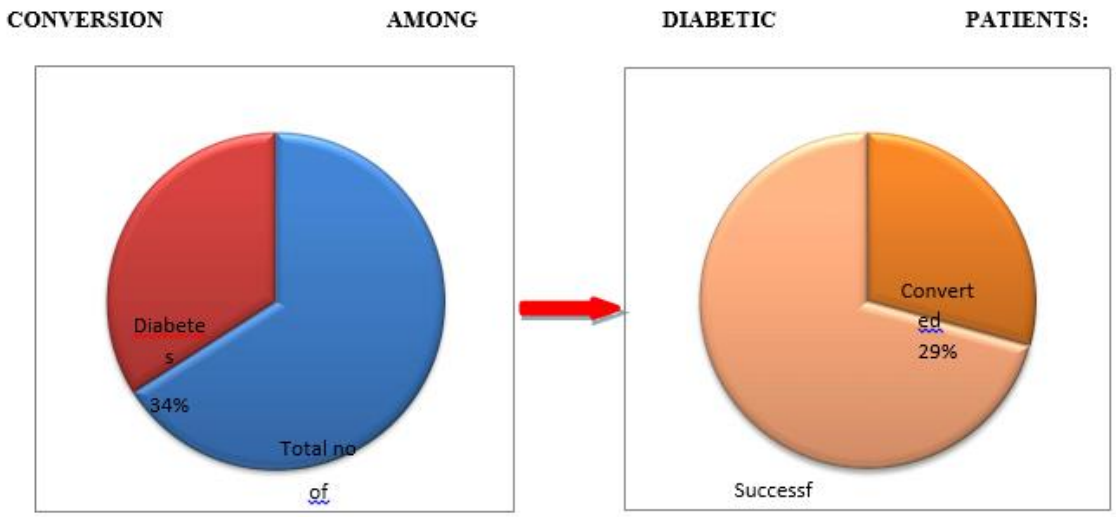


Fig 8: Graphical representation of conversion among diabetic patientsOut of total 17 patients who were diabetic, 5 patients underwent conversion (29%).

CONVERSION AMONG HYPERTENSIVE PATIENTS:

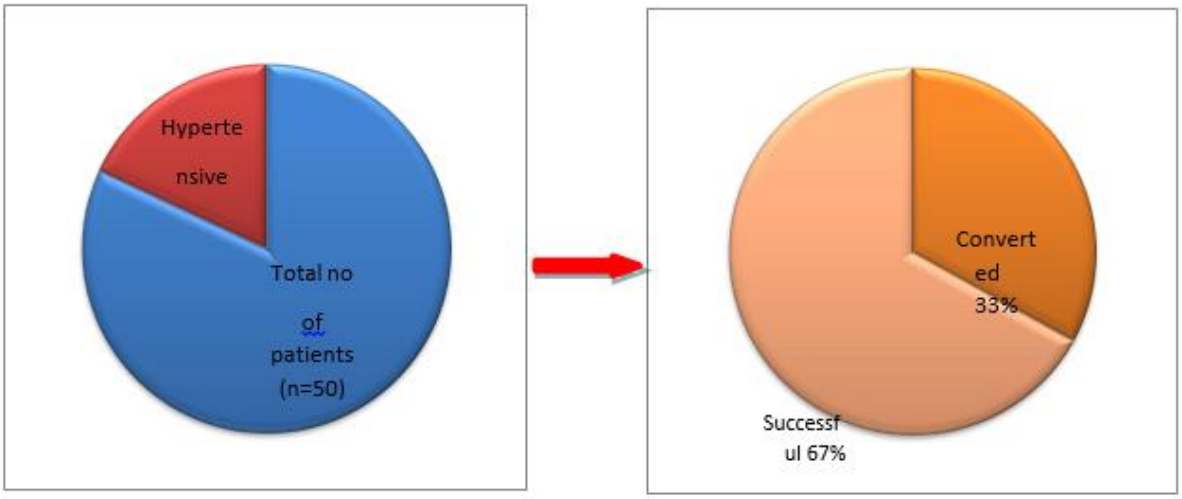


Fig 9: Graphical representation of conversion among hypertensive patientsOut of total 9 patients who were hypertensive, 3 patient underwent conversion (33%).

ULTRASOUND FINDINGS:

USG Finding	No. of cases	Percentage (%)
Single calculi	32	64%
Multiple calculi	18	36%
Peri-cholecyctic fluid	8	16%
GB Wall thickening	10	20%

Table 10: Ultrasound findings.

On ultrasound, single calculi were noted in 32 patients whereas remaining 18 patients had multiple calculi. Peri-cholecystic fluid and GB wall thickening was seen in 8 and 10 patients respectively.

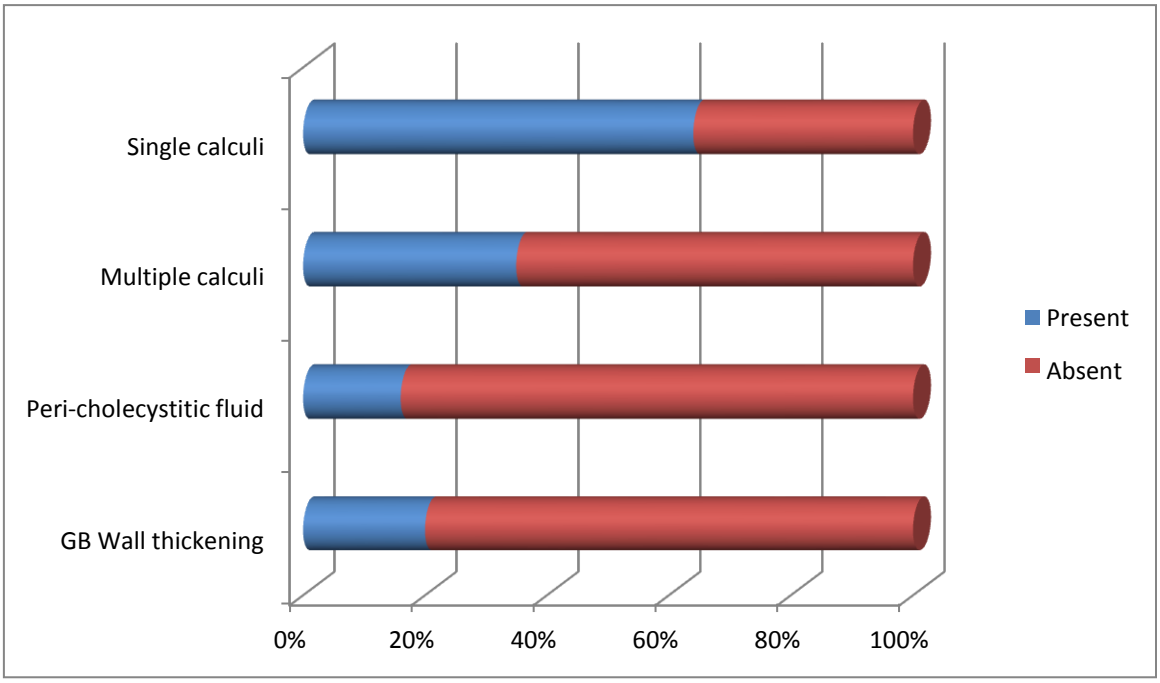


Fig 10: Graph showing ultrasound findings

CONVERSION IN PATIENTS WITH SINGLE CALCULI:

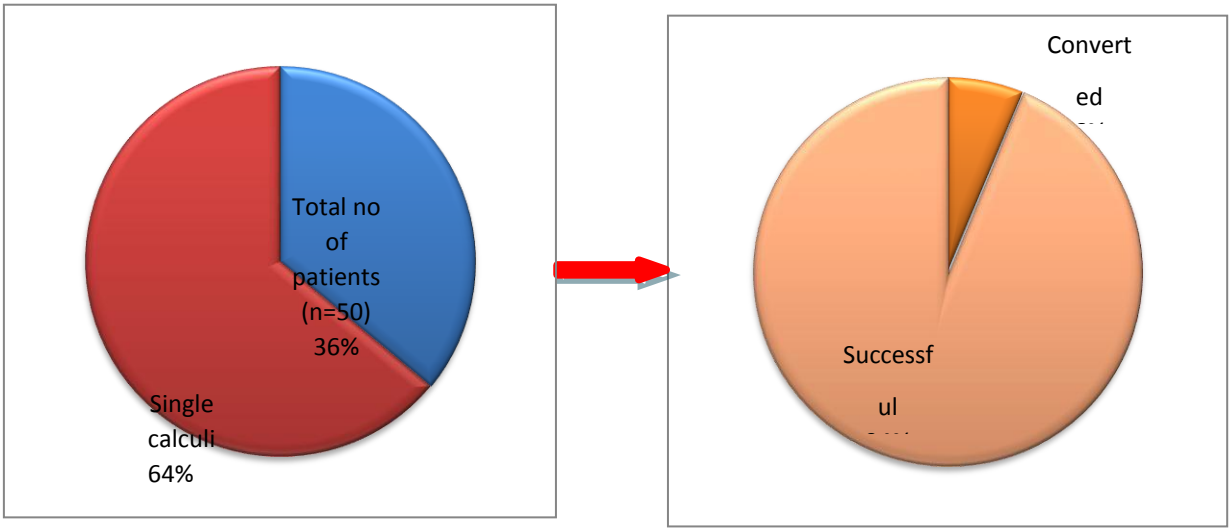


Fig 11: Graphical representation of conversion in patients with single calculiOut of total 32 patients who had single calculi, 2 patients underwent conversion (6.25%).

CONVERSION IN PATIENTS WITH MULTIPLE CALCULI:

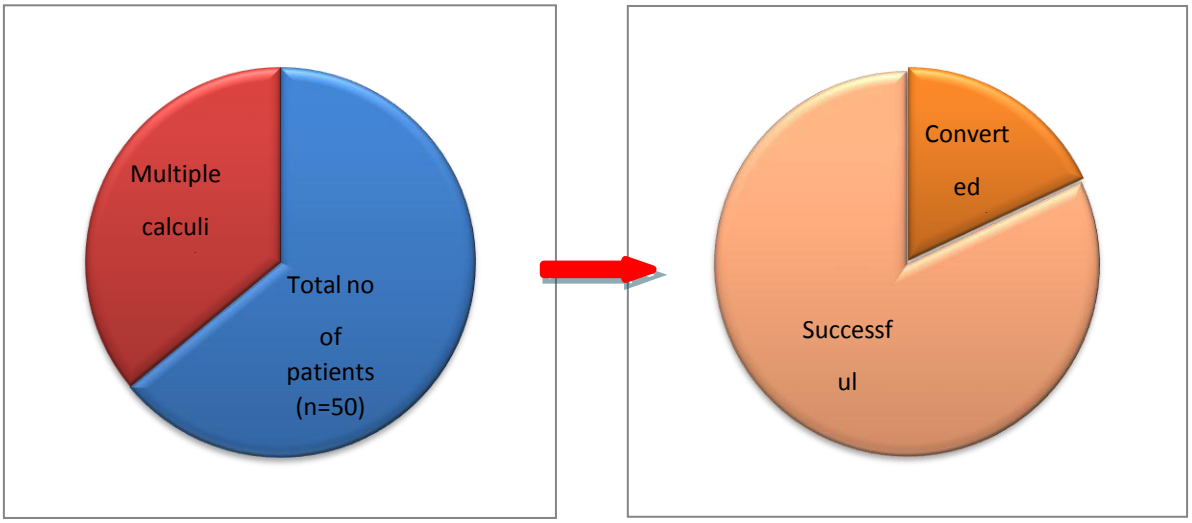


Fig 12: Graphical representation of conversion in patients with multiple calculi.

Out of total 18 patients who had multiple calculi, 4 patients underwent conversion(22%).

CONVERSION IN PATIENTS WITH PERI-CHOLECYSTIC FLUID:

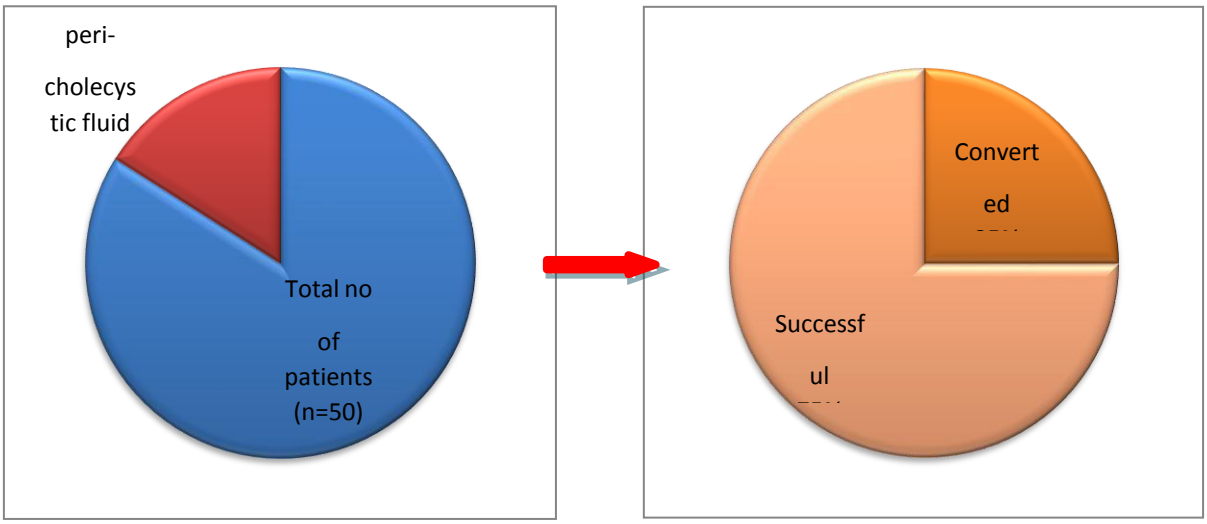


Fig 13: Graphical representation of conversion in cases with peri-cholecystic fluid. Out of 8 patients who had peri-cholecystic fluid, 2 cases underwent conversion (25%).**CONVERSION IN PATIENTS WITH GB WALL THICKENING:**

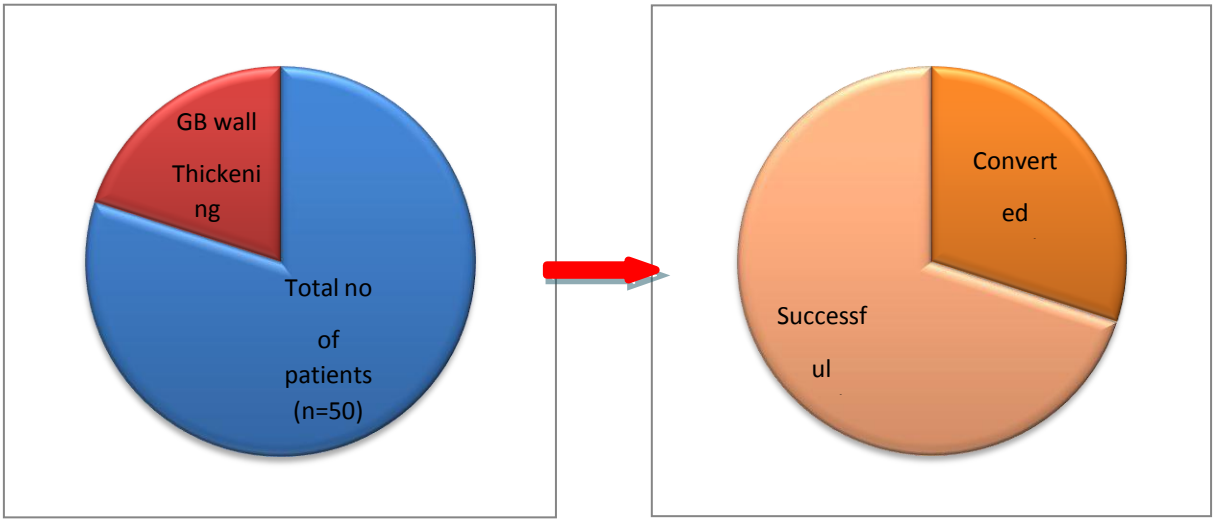


Fig 14: Graphical representation of conversion in patients with Gallbladder wall thickening.Out of 10 patients who had thickened GB wall, 3 patients underwent conversion (30%).

PRE-OPERATIVE DIAGNOSIS:

Indications	No. of Patients	SURGERY OUTCOME			
		Successful		Converted	
		No. of Patients	Percentage	No. of Patients	Percentage
Cholilithiasis	34	31	91.17	3	8.82%
Acute Cholecystitis	16	13	81.25	3	18.75%

Table 11: Pre-operative diagnosis.

Out of 50 patients, 34 patients presented with a diagnosis of Cholelithiasis of which 3 cases were converted (8.82%), and 16 patients presented with acute cholecystitis of which 3 underwent conversion (18.75%)

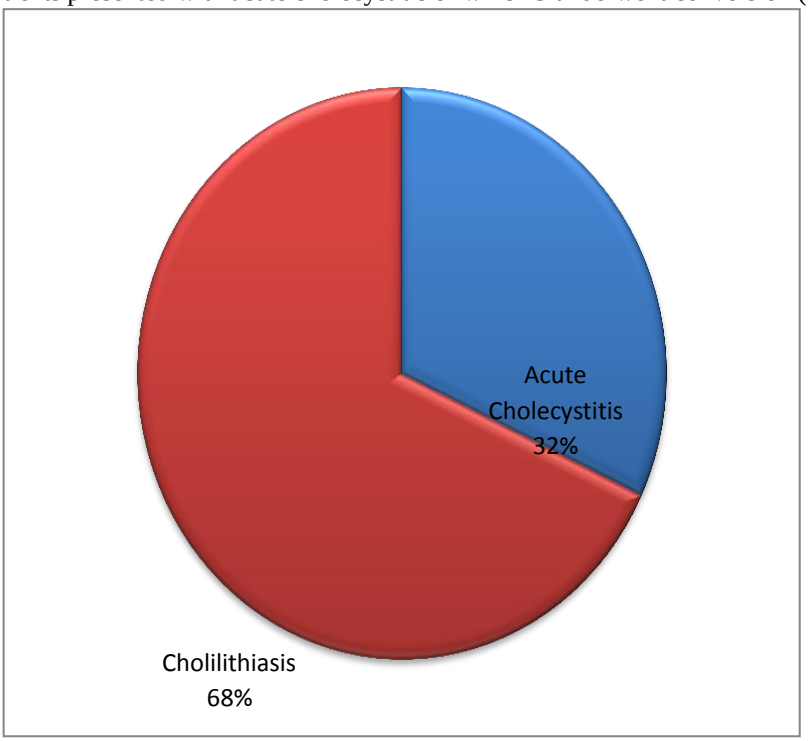


Fig 14: Graphical representation of pre-operative diagnosis.

DURATION OF SURGERY:

Duration of surgery	No. of cases	Percentage (%)
Less than 70 min	10	20%
70 to 110 min	34	68%
More than 110 min	6	12%

Table 12: Duration of surgeryThe average duration of surgery was 80.7 min.

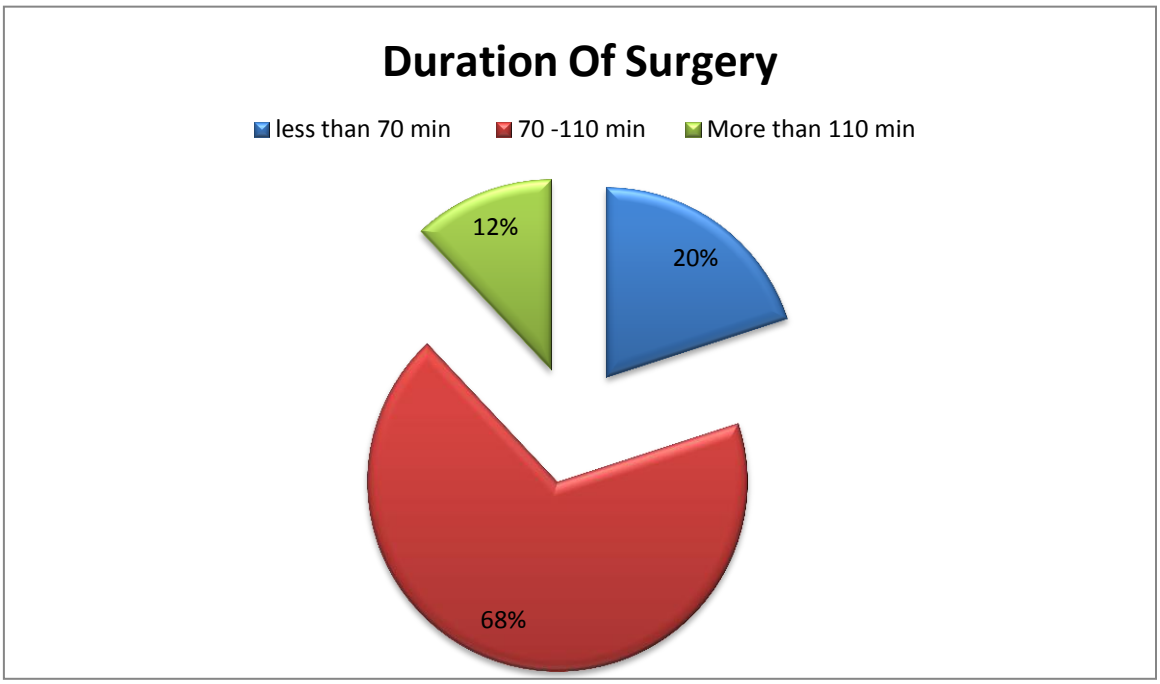


Fig 15: Graphical representation of duration of surgery.

DURATION OF POST-OPERATIVE HOSPITAL STAY:

Duration of Post-operativehospital stay	No. of cases	Percentage (%)
Upto 5 days	6	12%
5 - 6 days	38	76%
7 days and more	6	12%

Table 13: The duration of post-operative hospital stay.

Average duration of post-operative hospital stay was 5.7 days. 6 patients were discharged by 5 days post-operatively, 38 patients stayed for 5-6 days and the remaining 6 patients stayed for more than 7 days. Average duration of post-op stay in successful cases was 5.1 days and in converted cases it was 8.7 days.

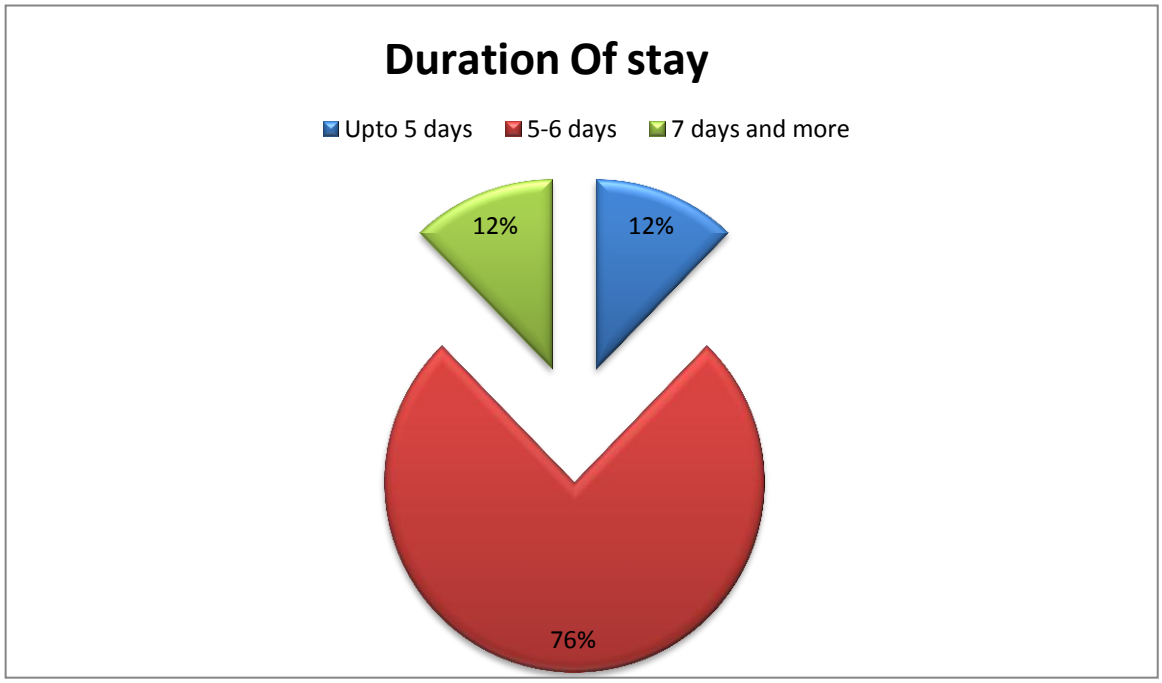


Fig 16: Graphical representation of post-operative hospital stay.

REASONS FOR CONVERSION:

Total laparoscopic cholecystectomies performed – 50Total cases converted to open procedure – 6 (12%).

Reason for conversion	No. of cases	Percentage %	
Difficult anatomy due to:			
- Dense adhesions of Calot‟s triangle	3	50%	66.6%
- Anatomical variation	1	16.6 %	
Bleeding from:			
- Calot‟s triangle (Cystic artery)	2	33.3%	33.3%
- Injury to right gastric artery	0	0%	
Common bile duct injury	0	0%	

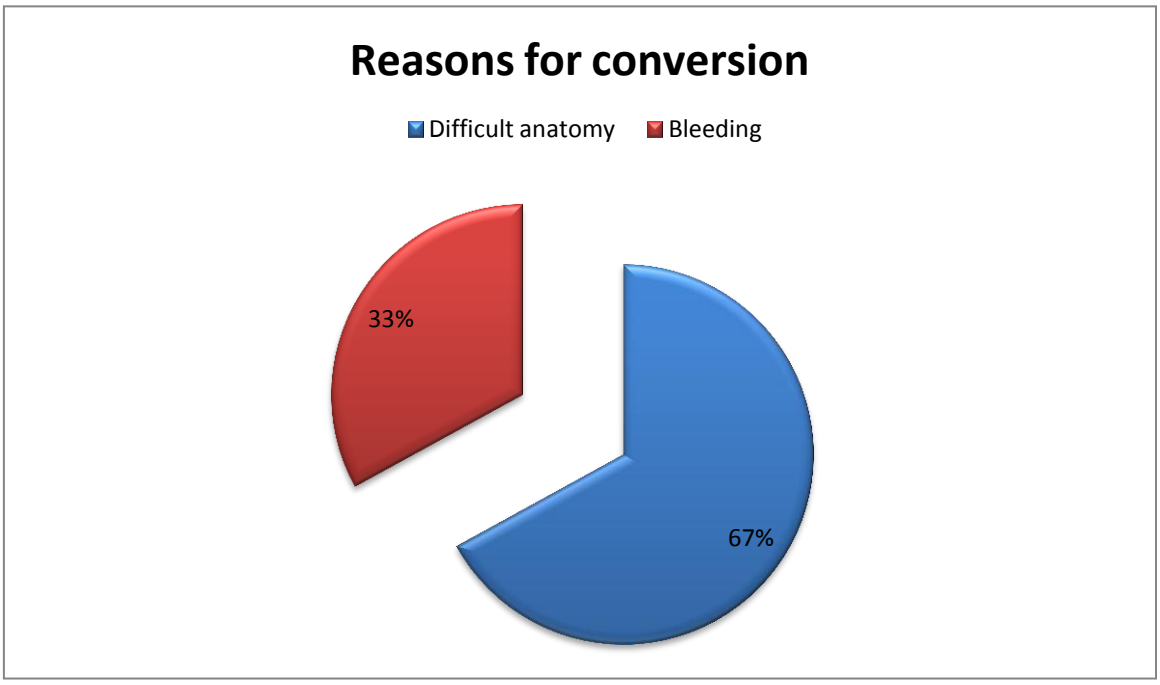


Fig 17: Graphical representation of reasons for conversion.

V. DISCUSSION

Cholelithiasis is a very common disease entity. Complications of cholelithiasis are frequent and serious and this has made this disease as one of the most important surgically correctable diseases.

Open cholecystectomy has been the gold standard treatment for gallbladder diseases for more than 100 years since Carel Johann Langenbuch performed the first open cholecystectomy in 1882 [6]. The first laparoscopic cholecystectomy was performed in human in 1987 by Dr. Philip Mouret. It has become the new gold standard treatment and almost replaced open cholecystectomy for the treatment of gallstone disease [6]. The first laparoscopic cholecystectomy was performed in India at the JJ Hospital, Mumbai in 1990, followed by few months later in Pune by Dr. Jyotsna Kulkarni.

It is important to keep in mind that conversion from laparoscopic surgery to open surgery is not seen as a complication, but rather a matter of sound surgical judgment as safety of the patient is of foremost importance.

Age incidence

It is said that gallbladder disease affects all ages, however they were more common in the 3rd,4thand 5th decades of life as 76% of the cases in our study belonged to these decades.

Maximum incidence was seen in the 41-50 years age group i.e, 15 patients (30%) followed bythat in 31-40 years i.e, 13 patients (26%).

All the 50 patients were planned for elective laparoscopic cholecystectomy. 6 out of the 50patients i.e, 12 % were converted to open cholecystectomy.

Maximum patients converted were in the age group of 41-50 years i.e., 4 patients (26.6%)followed by the age group of 51-60 years 2 (20%)patients.

Similar peak incidence in the 4th and 5th decade have been reported by workers like Thomas B Hugh et al [68] and R Schmitz et al [69].

Sex incidence

The main sufferers of gallstone disease in our study were females as compared to males. Out of total 50 cases, 34 (68%) were females and 16 (32%) were males,which are very much similar to the study observed by Frazee et al [70] and U.Berggren et al [71] .The reason for high incidence in females could be that pregnancy and child birth have a direct influence on biliary tract disease, acting by bile stasis , weight gain and consequently hypercholesteremia.

In a series of 6380 patients undergoing laparoscopic cholecystectomy by Singh Kuldip et al (1992-2005) 2250 were males 6147 . In another series undergoing patients of laparoscopic cholecystectomy by Singh Kuldip et al [6] (1993-2004) 2124 were males (34.5%) and 4023 were

females (65.4%) with an average age of 48.6 years (range 22-84 years) (35.2%) and 4130 were females (64.7%) with an average age of 49 years (range 22-84years).Thus our study coincides with both the studies of Singh Kuldip et al.

In our study, 18.75% males required conversion as compared to 8.82% females; this was similar to Brodsky et al [72] ,Ibrahim et al [50], and Al Salamah [64] also found the male gender as a significant determinant for conversion to open cholecystectomy. Lim et al [60] reported 16.6% conversions in males vs 8.2% in females whereas Gharaibeh et al [73] reported 24% conversion rate in males vs. 4% in females.

The reason for the higher conversion rates in male patients remains unexplained. It has been observed that the male patients have more intense inflammation and fibrosis, resulting in a more difficult dissection of the Calot‟s triangle and through the plane between the liver and GB.

Symptomatology

Out of 50 operated patients, 30 patients (60%) presented with a chief complaint of pain in the right hypochondrium, 16 patients (32%) presented with pain in the epigastrium and remaining 4 patients (8%) were asymptomatic and were detected incidentally.

Co-morbidities

In a study between 1993 to 2000 by Adbikardid Bedirli, Erdogan M. Sozuer et al [74], conversion from laparoscopic to open cholecystectomy was required in 19 of 678 non diabetic patient group (2.8%) and 13 of 184 patients in diabetic group (7.1%). They concluded that laparoscopycholecystectomy in diabetic patients is associated with a higher conversion rate and more morbidity than that in non diabetic patients.

In our study of 50 cases of laparoscopic cholecytectomy, conversion from laparoscopic to open cholecystectomy was required in 1of 33 patients in non diabetic group (3%) and 5 of 17 patients in diabetic group (29%).Hence there is a correlation in both the studies.

In a study from 1997 to 2001 by Raza syed Ahsan, Tayeb M et al [67], out of 73 patients who were converted 20 were hypertensive (27.4%) and out of 146 patients who underwent successful laparoscopic surgery 29 were hypertensive (19.9%).
In our study, out of 6 converted patients 3 were hypertensive (50%) and out of 44 successful laparoscopies 6 were hypertensive (5%).
So according to our study there is a higher risk of conversion in hypertensive patients.

Ultrasonography:
Ultrasonogram is the best initial, non-invasive, economical and an easily available investigation. In our study, 10 out of 50 patients showed a thickened gall bladder wall on ultrasonography, ofwhich 3 patients (30%) were converted. Out of the remaining 40 patients in whom the gall bladder wall was not thickened, 3 patients (7.5%) were converted.
In a study by Pawan lal et al [75], they have found a significant correlation between the gall bladder thickness and conversion from laparoscopic to the open procedure (sensitivity 41.18%) and a positive predictive value of 70 which similar with reports of other studies by Alponat A et al [76] , Daradkeh et al [55], Santambrigo R et al [78], Jansen S et al [77] and Chen RCet al [79].
In another study by Tayeb M et al [67], 58% of the patients with thickness of the gallbladder wall more than 3mm were converted from laparoscopic to open cholecystectomy, suggesting that gall bladder thickness is a good predictive factor for conversion to open surgery. Our findingcoincides with these studies.

Pre-operative diagnosis

In a study a retrospective analysis by Chahin F [80] over a period of 3 years of 557 patients who have undergone laparoscopic cholecystectomy; 88 of the patients had acute cholecystitis. The author concluded that conversion rates were around 22% in patients with acute cholecystitis when compared to 5.5% of patients with chronic cholecystitis.
In our study of 50 patients, 16 patients (32%) had acute cholecystitis, out of which 3 patients (18.75%) were converted.
According to Ohri Ashish ,Singh Kuldip[6]; within 72 hours of the symptoms the tissue planes areinflamed and edematous but are easier to dissect, having no adhesions at all. After 72 hours, the tissue becomes more friable and becomes more risky to dissect till after 3-4 weeks time when theinflammation has subsided and fibrosis sets in.
In a study by Koo KP et al [81], the author experienced that in acute cholecystitis, laparoscopic cholecystectomy has a high conversion rate if delayed for more than 72 hours.
Previous acute cholecystitis results in scarring and fibrosis of the GB, and causes dense fibrotic adhesions that makes laparoscopic dissection difficult. Gall bladder wall thickness is related to inflammation and fibrosis that follows previous attacks of acute cholecystitis, and thus it mayreflect difficulty in delineating the anatomy during surgery.

Duration of surgery:

The average duration of surgery in our study was 80.7 mins. The average duration of surgery inother studies are as follows-

Series	**Duration of surgery**
Axe ROS et al [86]	93 minutes
Sooper et al [85]	95 minutes
Bart M Redemaker [84]	78 minutes
Ravimohan SM et al [83]	46.8 minutes
AJ Karayiannakis et al [82]	105 minutes

Table 15: Average duration of surgery in other studies.

The mean duration of surgery in our study in converted cases was 117.5 min and successfullaparoscopic operated was 80.7 min.
In a study from 1997 to 2001 by Raza Syed Ahsan ,Tayeb M et al [67], the mean duration ofsurgery in cases converted was 2.4 hours and successful laparoscopic surgery was 1.3 hours.

Period of hospital stay:

The period from day of surgery to discharge is taken as period of hospital. The total period of post-operative hospital stay in our study was around 5.1 days.

Compared to our study, the study by U. Berggren et al [71] and Roohul-Muqim et al [87] reported apost-operative stay of 1.8 days and 2.06 days respectively which is much shorter than seen in ourstudy.

The reason for the longer hospital stay in the hospital could be because most of our patients werefrom rural and poor background who insisted on staying till sutures were removed and therefore majority of cases discharged after a week even though many of the patients could have been discharge much earlier.

Conversion to open procedure:

Conversion to open procedure is considered a major morbidity of laparoscopic cholecystectomy as it loses its supremacy over open cholecystectomy once the conversion takes place. The conversion rate in our study was 12% and this is similar to the conversion rate of 2.6% to 14% reported in most studies.

In 3 cases(50%) out of the 6 cases, conversion was enforced due to dense adhesions in the calots triangle , 1 case (16.6%) due to variation in anatomy. Another 2 cases (33.3%) were converted to open procedure due to uncontrollable bleeding in the calots triangle due to injury to the cystic artery. Conversion to open cholecystectomy was required to achieve successful and complete hemostasis, as they could not be controlled laparoscopically.

Study	Place	Year	No. ofcases	Conversionrate
This study	India	2014	50	12%
Balsara & Shah [91]	India	1994	100	10%
Masoom Raza et al [88]	Karachi	2006	118	11.1%
Guraya et al [63]	Saudi Arabia	2004	549	2.9%
Butt et al [58]	Lahore	2006	300	4%
Saeed Hadi et al [92]	Yemen	2009	709	8.3%
Magee et al [61]	UK	1996	149	10.0%
Cheema et al [90]	Lahore	2001	75	16.0%
Tayeb et al [67]	Karachi	2005	1249	7.5%
Tan et al [89]	Australia	2006	202	4.2%
Vecchio et al [57]	USA	1998	114005	2.2%
Lim et al [60]	Singapore	2005	443	11.5%
Dholia et al [56]	Larkana	2005	100	8.0%
Ishiazaki et al [53]	Japan	2006	1179	7.5%
Tarcoveanu et al [59]	Romania	2005	6985	3.2%

Table 16 compares our conversion rate with some other major published similar work.

Making a comparative comparison of conversion rate with other studies as shown in the table above shows the rate of conversion is quite high (7.5-16%) amongst studies from Asiancountries, whereas studies from USA, Europe and Australia shows a decline in their conversionrates (2.6-4.2%).

The laparoscopic technique has been remarkably improved and understood with the passage of time and with experience, thus making the conversion rate remarkably low of 1-6% [93]. In our study, the conversion to open procedure was required in 6 patients with conversion rate of 12%. This rate is comparable to results of most international studies that were published in early years of laparocscopic cholecystectomy (2-15%) [6,55,76,94-97], but remains some what higher than those results recently reported in last five years (1-6%) [6]. This may be due to the fact that there is differences in the institutional and individual practice as well as experience of operating team.

Difficult anatomy at the Calot's triangle accounted for more than half of conversions (66.6%); the reasons for obscured anatomy were due to acute inflammation causing dense adhesions (50%) and aberrant anatomy (16.6%).Ibrahim et al[50], Al Salamah[64] and Bingener et al[65] also found difficult anatomy as the most common reason for conversion to open procedure observed in 41.5%, 48.5% and 50% of the patients respectively. According to our study we observed that individual anatomy was obscured primarily due to dense

adhesions (50%) and aberrant anatomy (16.6%) .
Waseen Memon et al [98] and Saeed Hadi et al [92] claimed that the most common cause of conversion was frozen Calot‟s triangle which was observed in our study also. Frozen Calot‟s triangle is defined as dense adhesion around the Calot‟s triangle. Al-Saigh et al [100] and Meshikhes et al [99]from Saudi Arabia reported a conversion rate of 11% in their study, the commonest cause of conversion being difficult anatomy.

VI. CONCLUSION

- The present study of 50 patients has shown that gallstone diseases were more common in females than to males with a ratio of 1:2 (68 % females and 32% males).
- The most common age of presentation of gallstone diseases is 41-50 years (30% of the patients presented in this group).
- Most of the patients (60%) presented with pain abdomen of the right hypochondrium as the chief complaint.
- Diabetic patients have shown a higher rate of conversion than non-diabetic patients i.e, 5 out of 17 patients (29%) as compared to 2 out of 33 non diabetic patients (6%) got converted. Thus diabetes is one of the important factors.
- Ultrasonography is the most economical, simplest, easiest and an initial tool for the evaluation of gallstone diseases.
- Patients with thickened gallbladder wall had a higher rate of conversion i.e, 3out of 10 patients with a thickened gallbladder wall (30%) had to be converted. This was one of theimportant parameter.
- Patients who presented on admission with acute cholecystitis had a higher conversion rateto open procedure as compared to those who presented with only cholelithiasis.
- The mean operation time was 80.7 minutes.
- The average duration of post-operative hospital stay was 5.7 days.
- The main cause for conversion from laparoscopic cholecystectomy to open procedurewas difficulty in identifying the anatomy at the calots triangle as a result of dense adhesions (66.6%) followed by bleeding in the Calot's triangle (33.3%) .
- Laparoscopic cholecystectomy is a safe and reliable surgery. With growing experienceby the surgeons in laparoscopic technique, complications and conversion rate can be brought down to a minimum.
- According to the present study it has been shown that we still have a higher conversion rate comparing with literature in last 5 years. While many reasons have lead to conversion and influence conversion rate, the most important factor for conversion was dense adhesions. It is, therefore, mandatory to inform the patients about the possibility of conversion to open procedure at the time of taking consent for laparoscopic procedure.
- In conclusion, laparoscopic cholecystectomy is a safe and minimally invasive technique, with low conversion rate and the most common cause of conversion in our study was the presence of dense adhesions at Calot's triangle.

VII. SUMMARY

This is a prospective study of 50 cases of laparoscopically operated patients in Department of General Surgery, Mediciti institute of medical sciences in the period from july 2020 to july 2022.

Out of 50 patients studied, 6 cases were converted to open cholecystectomy i.e, 12 %. conversion to laparoscopic procedure was more common in diabetic patients.

Patients presenting on admission with acute cholecystitis had a higher rate of conversion. Ultrasound findings suggestive of a thickened gallbladder wall is a good indicator of conversion.Therefore ultrasonography can predict difficult laparoscopic cholecystectomy and thus the likelihood of conversion to open surgery.
The main reason for conversion from laparoscopic cholecystectomy to open procedure was difficult anatomy due to dense adhesions.
Conversion from laparoscopic cholecystectomy to open procedure should not be visualized as a complication but rather it should be considered a reflection of sound surgical judgment in difficult cases.

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