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Original Article

Hydro-dissection: An Effective Intra-Operative Technique for Difficult Laparoscopic Cholecystectomies

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ABSTRACT

Hydrodissection, a technique used to treat nerve entrapments, involves injecting an anaesthetic, saline, or 5% dextrose in water to separate the nerve from the surrounding tissue. **Objectives:** To assess the efficacy of this technique in all patients undergoing difficult laparoscopic cholecystectomy in terms of operative time, haemorrhage, and intra-operative complications. **Methods:** A multicenter observational study was conducted at the department of surgery, PAF Faisal Hospital and Anis Bantva Trust Hospital Karachi. A total of 219 patients were included in this study who underwent laparoscopic cholecystectomy for symptomatic gall stones, with age ranging from 18-70 years, with intra-operative Cuschieri classification >1, using a non-probability sampling method. **Results:** This study included 219 patients from hospital records categorized as per intra-operative difficulty grading of Cuschieri from grade II-IV. The mean age of patients was 40.46 ±12.50 years, with an average duration of symptoms of 16.95 ± 8.73 days. There were 160 (73.1%) males and 59 (26.9%) females. About two-thirds of patients were admitted through the emergency department. The pre-operative and intraoperative diagnosis of patients was symptomatic cholelithiasis 76 (34.7%), acute on chronic cholecystitis (27.9%), chronic cholecystitis 57 (26.0%), empyema and mucocele gallbladder 11 (5%) each, and Gangrenous gallbladder 3 (1.4%) were recorded. **Conclusion:** This study showed a clear association of intra-operative complicated anatomy during laparoscopic cholecystectomy to its conversion to open cholecystectomy. Techniques of dissection are of significant importance to minimize injuries to vital structures.

INTRODUCTION

In this contemporary era, laparoscopic cholecystectomy (LC) is a gold standard procedure performed electively and in emergencies for symptomatic gall stones. The increased demand for laparoscopic is of a shorter hospital stay and fewer complications. However, a problematic gallbladder may lead to bile duct injury, increasing conversion into open/standard cholecystectomy [1]. The bile duct injury is the main complication of this surgical procedure. The incidence in open cholecystectomy has been documented at 0.2% compared to laparoscopic cholecystectomy, reported to be 0.1% -1.5% [2, 3]. The most common reason for bile duct injury is the misidentification of common bile duct as cystic duct or artery, and the importance of a "critical safety view" (CVS) has been guided by Strasberg et al. 2017 [4]. CVS comprises three components: gallbladder Hilum is devoid of connective tissue, just two structures accessing the gallbladder, and at least one-third of the gallbladder is mobilized from the cyst plate. Nevertheless, only about one-third of patients meet the CVS criteria [5]. A study reported that misidentification of structure in the Calot's triangle (92.7%) by the surgeons was the primary reason for bile duct injury leading to higher rates of morbidity following laparoscopic cholecystectomy [6]. Alfered Cuschieri (1990) proposed a classification

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stratifying the complicated laparoscopic cholecystectomy based on anatomic and intraoperative findings [7]. Numerous studies have shown adequate human tissue dissection using water jet streams in various medical and surgical procedures [8, 9]. In Laparoscopic cholecystectomies, where anatomy is not clear to dissect, hydro-dissection has shown promising results [10]. In 1998, Naude et al. reported that the hydro dissection technique during laparoscopic cholecystectomy reduces the chances of intraoperative hemorrhage, gallbladder rupture, stone spilling, and operative time [11]. We also believe that hydro dissection can effectively clear the obscure anatomy during laparoscopic cholecystectomy. Previously this technique is used fairly in cases where anatomy is obscure by adhesions and mostly in acute settings. However, no comprehensive data is available to show the superiority of this technique. This technique should be taught from the beginning of surgical training to achieve optimal outcomes of laparoscopic surgical procedures and avoid dreaded complications like bile duct injury. We set out to evaluate the efficacy of this technique in all patients undergoing difficult laparoscopic cholecystectomy in terms of operative time, haemorrhage, and intra-operative complications.

METHODS

This multicenter observational study was conducted at the department of surgery, PAF Faisal Hospital/ Fazaia Ruth Pfau Medical College, Anis Bantva Trust Hospital, Karachi .The data were collected prospectively from the hospital database after approval from the institutional ethical committee, from 1st September 2021 to 28th February 2022 . Total 219 number of patients were included in this study who underwent laparoscopic cholecystectomy for symptomatic gall stones, with age ranging from 18-70 years, with intra-operative Cuschieri classification >1 was included in this study, using a non-probability sampling method. In contrast, those who were Cuscheiri grade I or associated with Common bile duct calculi were excluded. Demographic characteristics such as age, gender, diagnosis, intra-operative difficulty as per Cuschieri grading were extracted from the hospital record after approval from the ethical review committee of the hospital. All procedures were performed by qualified general surgeons in their department. Hydrodissection techniques were used in all cases and outcome variables including operating time, length of hospital stay, conversion to open cholecystectomy, other complications were recorded in the proposed proforma. The water stream under high pressure is called hydro jet in 1000ml saline bag with inflatable cuff around to create a pressure of 250 mmHg to 300 mmHg. Hydrodissection is a technique in which injection of 50 mL or more of saline between tissue spaces was injected to create an edematous area, allowing delineation of tissue planes to ease excision with fewer chances of bleeding [11]. The data iweres entered and analyzed using Statistical Program of Social Sciences ver. 20.0 (SPSS version 20.0). Mean with standard deviation, frequency, and percentages are calculated for continuous and categorical variables, respectively. Cross-tabulations were formulated. The Chi-square test and Fischer's exact test were run to determine any significant relationship/association. P-value <0.05 was considered significant.

RESULTS

This study included 219 patients from hospital records categorized as per intra-operative difficulty grading of Cuschieri from grade II-IV. The mean age of patients was 40.46 ±12.50 years, with an average duration of symptoms of 16.95 ± 8.73 days. There were 160 (73.1%) males and 59 (26.9%) females. About two-thirds of patients were admitted through the emergency department. The pre-operative and intraoperative diagnosis of patients was symptomatic cholelithiasis 76 (34.7%), acute on chronic cholecystitis (27.9%), chronic cholecystitis 57 (26.0%), empyema and mucocele gallbladder 11 (5%) each, and Gangrenous gallbladder 3 (1.4%) were recorded as shown in table 1.

Variables (n= 219)		Mean ±SD/Frequency (%)
Age (21-66 years)		40.46 ±12.50
Gender	Male	160 (73.1%)
	Female	59 (26.9%)
Duration of symptoms (days)		16.95 ± 8.73
Mode of Admission	OPD	58 (26.5%)
	ER	161 (73.5%)
Diagnosis (pre-operative + Intraoperative)	Symptomatic Cholelithiasis	76 (34.7%)
	Chronic Cholecystitis	57 (26.0%)
	Acute on chronic Cholecysitis	61(27.9%)
	Empyema Gallbladder	11 (5%)
	Mucocele Gallbladder	11 (5%)
	Gangrenous Gallbladder	3 (1.4%)
Duration of Surgery (minutes)		16.95 ± 8.73
Hospital stay (hours)		
Lap converted to open	Yes	17 (7.8%)
	No	202 (92.2%)

Table 1: Descriptive analysis of the data.

According to Cuschieri Grading of intraoperative difficulty, 110 (50.2%) patients were of Grade II, 87 (39.7%) were of Grade III, and 22 (10%) of patients were recorded as grade IV; as shown in figure 1.

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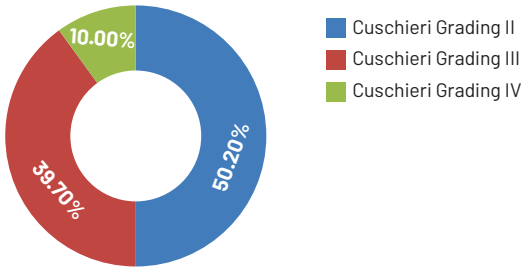

Figure 1: Frequency of intra-operative complex cases as per Cuschieri Grading

The mean duration of surgery was 75.82 ± 22.34 minutes. The Intra-operative complication in patients is recorded with bile leakage (10%) of cases, gallbladder injury in (12.3%), and common bile duct injuries (0.9%) of patients. Furthermore, the stratification of complications as per difficulty grading is shown in figure 2.

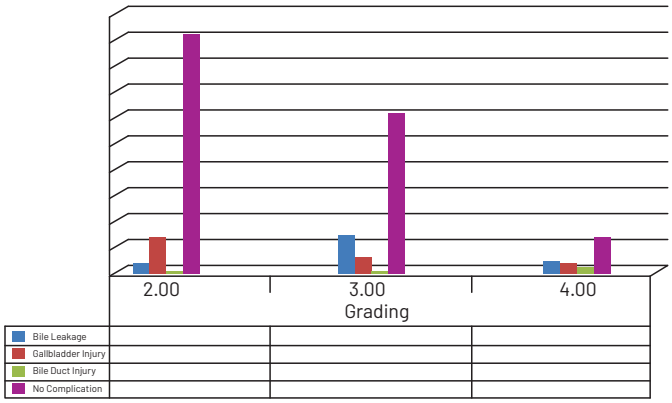

Figure 2: Stratification of intraoperative complications

Out of 219 patients, 202 (92.2%) patients were operated laparoscopically, and only 17(7.8%) patients were converted to open cholecystectomy. The conversion of the cases as per grading shows 50% of grade IV cases converted to open while remaining were treated laparoscopically. The Pearson's chi-square test shows a significant association of intra-operative difficulty with conversion to open cholecystectomy as shown in table 2.

Laparoscopic conversion into Open Cholecystectomy	Cuschieri Grading			p-value
	II	III	IV	
YES	0	7	10	< 0.00001.
NO	109	81	12	

Table 2: Association of conversion to open cholecystectomy with intra-operative difficulty

DISCUSSION

Laparoscopic procedures usually take longer than open, and intra-abdominal adhesions make it more challenging as anatomy is obscure. Hydro-dissection and hydro jet streams are documented to break adhesions and improvise visualization of anatomical planes to assist tissue dissection. Hydro-dissection has been used for the last 25 years for complex laparoscopic procedures, especially gallbladder [12, 13]. In our study, a total of 219 patients were included who were categorized according to intra-operative difficulty grading of Cuschieri. Our study concluded that obscure anatomy leading to intraoperative difficulty is more prevalent in males than females with an approximate ratio of 3: 1 as compared to other similar studies, which correlates with male preponderance in difficult laparoscopic cholecystectomy [14,15]. About 3/4th of the studied population were admitted through the emergency department with a frequency of preoperative and intraoperative diagnosis of symptomatic cholelithiasis (34.7%), acute on chronic cholecystitis (27.9%), chronic cholecystitis (26.0%), empyema gallbladder and mucocele gallbladder 5%, and gangrenous gallbladder (1.4%) respectively. Agarwal et al. studied preoperative risk factors associated with predictive difficult laparoscopic cholecystectomy revealed that repetitive attacks, prolong duration of symptoms, and male gender are associated with higher grades of adhesions and intra-operative difficulty [16]. In our study, the average time of symptoms was 16.95 ± 8.73 days which may be correlated with higher pain tolerance of the male gender compared to their counterpart. All patients underwent laparoscopic surgery using hydro-dissection or hydro-jet stream injection to clear the obscure anatomy, thereby facilitating dissection with a mean operative time of 75.82 ± 22.34 minutes comparable to other studies in the literature [14]. However, none has included difficulty grading as in our research and used hydro-dissection as a method of surgical dissection of difficult gallbladder. Hydro-dissection by either injecting saline in between tissue planes or using small jet propulsion techniques to separate adhesions from organs has been used in all open surgeries and laparoscopic surgeries. It is a way of blunt dissection to minimize damage to the organs and bleeding. We used 50 ml – 500 ml of warm normal saline in jet propulsion to break adhesions surrounding the Calot's triangle to improve better visualization and safe clipping of the cystic duct and the cystic artery, using a standard suction irrigation port. Following saline jet adhesion-lysis, we remove fluid from the peritoneal cavity to prevent complications associated with fluid overload and sepsis. Intra-operative complications such as common bile duct (CBD) injury in our study are recorded as 0.9% which is comparably lower than 1.4% in the literature [17]. The most challenging anatomy (Cuschieri grade IV) cases, which usually ended up in open cholecystectomy; however, in our observational study, about 50% of patients were managed laparoscopically. Hence, proving the importance of the hydro-dissection technique as a novel technique to improve surgical outcomes in difficult laparoscopic cholecystectomies by reducing complications and less dissection time. The

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hydro-jet technique is superior to the diathermy, blunt or sharp dissection. Moreover, it becomes difficult to use diathermy hemostasis within tissues saturated with saline. Temperature and volume need to be monitored carefully to avoid hypothermia. Hydrodissection is another form of saline/water tissue dissection where a one off fixed amount of saline/adren- aline solution is injected into adherent tissues to create water logging, leading to separation of tissues along bloodless natural planes (figure 3) [13]. The disadvantages are that there is no pressure or jet and the flow is not continuous. According to a previous investigation the HD techniques feasibility in a porcine study was valid but failed in human study for showing routine efficacy, simple cholecystectomy. The HD group had quicker and cleaner dissections in the operating field [18]. Other studies suggested that HD technique could be utilized in laparoscopic cholecystectomy. HD used in laparoscopic cholecystectomy of 55 patients were categorized into different groups depending on the determination of surgical difficulty level using Cuschieri Scale [19]. The anatomy of all patients were clearly and effectively visualized as demonstrated by their results. Sharp dissection was needed in some patients for complete procedure. According to a previous study conducted on 133 patients underwent laparoscopic cholecystectomy using HD reported that liver cirrhosis could be dissected by retrograde and prograde dissections [20]. Another study found a decrease in occurrence of GB damages, blood loss, and dissection times [21]. In Multi-Stream Saline Jet (MSSJ), we use physiological normal saline that is readily available and inexpensive. It cleanses body systems, di- lutes any blood, encourages hemostasis, and is readily absorbed. Dissection is faster, because one can visualize anatomical bloodless tissue planes more readily.

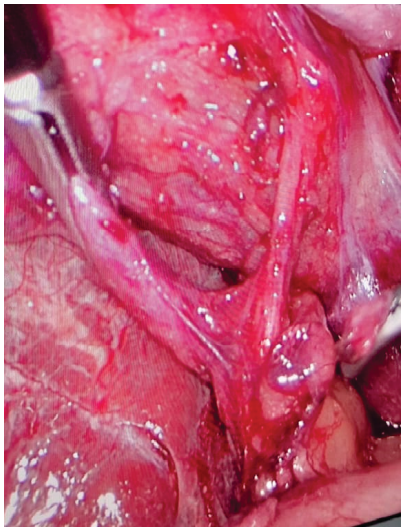

Figure 3: Critical view of safety Hydrodissection

CONCLUSIONS

This study shows a clear association of intra-operative complicated anatomy during laparoscopic cholecystectomy to its conversion to open cholecystectomy. Techniques of dissection are of significant importance to minimize injuries to vital structures. Hydro-dissection is proved to be a safer and effective technique to overcome the complex anatomy, thereby limiting complications.

Conflicts of Interest

The authors declare no conflict of interest

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