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Gall Bladder Wall Thickness as a Predictor for Laparoscopic Cholecystectomy Difficulties in Gadarif, Eastern Sudan

Sami E. E. Salah and Hawa Yahia

ABSTRACT

Background: **Laparoscopic cholecystectomy is a revolutionary change in the treatment of patients with gallbladder stones. Multiple studies have identified factors that are predictive of surgical difficulties including preoperative ultra-sonographic findings.**

Objective: **To determine the effectiveness of sonographic measurement of gall bladder wall thickness as a predictive factor for laparoscopic cholecystectomy difficulties in Gadarif Teaching Hospital, Sudan.**

Patients and methods**: This are a prospective, observational, analytical cross-sectional hospital-based study in which all patients who underwent laparoscopic cholecystectomy for gall stones disease and had a pre-operative sonographic measurement for GBWT in GTH in the year 2019 were included.**

Results: **110 cases were studied. The male to female ratio was 0.2: 1, the mean age was 35±3.8 years. Past history of the acute attack reported in 54 (48.2%) of the patients, history of ERCP was reported in 2 (1.8%) and the majority of patients 71 (64.5%) has no associated medical condition. Abdominal examination was normal in 69 (62.7%) of the patients, 35 (31.8%) patients showed positive Murphy's sign or other signs. Gall bladder thickening, as a predictor of difficulty, was normal of ≤ 3 mm in 69 (62.7%), mild (4-5 mm) in 34 (30.9%), moderate (6-7 mm) in 5 (4.5%), and severe > 7 in 2 (1.8%) of the patients. A significant association was found between GBWT and: duration of symptoms, the number of attacks, operative time and hospital stay, postoperative complication, and conversion to open cholecystectomy. Operative time was found to be associated with the experience of the operator (P-value < 0.05).**

Conclusion**: Pre-operative sonographic increasing gall bladder wall thickness is associated with difficult laparoscopic cholecystectomy in terms of postoperative complications, prolonged operative time, and conversion to open cholecystectomy even in expert hands.**

Keywords: Gadarif, Laparoscopy, Sudan, Ultrasound.

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I. Introduction

Laparoscopic cholecystectomy is a revolutionary change in the treatment of patients with gallbladder stones [1]. The first laparoscopic cholecystectomy worldwide was performed in 1985 [2] and it was introduced in Sudan by 1995 [3]. The procedure was introduced in Gadarif (Eastern Sudan) a decade later, in 2005, and since then, many surgeons and residence are practicing it as the most common laparoscopic procedure.

Transabdominal ultrasonography (US) is the initial imaging modality of choice as it is accurate, readily available, inexpensive, and quick to perform. The size of the gallbladder can be seen, the presence of stones or polyps determined, and the thickness of the wall measured. The significance of GBWT on sonographic measurement for diagnostic accuracy and surgical difficulties was documented before the era of laparoscopy [4]. Multiple studies have identified factors that are predictive of surgical difficulties including preoperative US findings. Among these factors is gallbladder wall thickness, which has been shown to be associated with increased risk of conversion to open procedure [5].

II. Patients and Methods

This is a prospective, observational, and analytic, cross sectional hospital-based study.

A. Study Area

The study was conduct in Gadarif Teaching Hospital in eastern Sudan. Gadarif State is at an altitude of 496 m above

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sea level, covering an area of 75,000 km^2, and lies between latitudes 14 and 16 north and longitudes 33 and 36 East with a population a little over 1.7 million residents. It is 410 km from the capital of Sudan on the Ethiopian border. GTH is a 170-bed public governmental tertiary care facility that serves as a referral center in Gadarif State. Laparoscopic surgery was introduced in 2006. The Surgical department, including orthopedics and plastic, is staffed with 8 consultants and specialists and 15 registrars (residents) enrolled in the national training program.

B. Study Requisite

Pre-operative sonographic measurement of gall bladder wall thickness was done to all study population as predictor of inflammation categorizing them into 4 groups according to GBWT [5]: Normal: 1–3 mm, Mild: 4–5 mm, Moderate: 6–7 mm, Severe: more than 7 mm.

C. Inclusion and Exclusion Criteria

All symptomatic gall stones patients underwent laparoscopic cholecystectomy in GTH in the year 2019 were included, excluding those whom their GBWT was not determined in the pre-operative US.

D. Sample Size

Was calculated using the formula:

$$n = Z \times Z \times (1-P) \times P \times D2.$$

where
Z = Value of 95% confidence interval, which is the normal standard deviation = 1.96,
P = prevalence of LC difficulties from the literature = 10.0 %.
D = difference in precision or estimate = 0.05 or 5%.

Using the formula, sample size of 110 was obtained by simple random technique.

E. Questionnaire

Data was collected using a detailed and structured questionnaire which was filled by the operating doctor (self-administered).

F. Data Entry and Analysis

Data was analyzed using Statistical Package for the Social Science SPSS version 22.0 software. Dependent variable, percentage, mean, standard deviation and range are calculated. Binary logistic regression and one-way analysis of variance was use for analytic assessment. P values <0.05 was consider as statistically significant

G. Ethical Consideration

Ethics approval was obtained from the Ethics Committee of the Faculty of Medicine of Gadarif University (Reference number: GU/FM/REC Q3.1.19.01), and Sudan Medical Specialization Board Sudan. Written informed consent was obtained from each participant.

III. Results

The common tribal origin among the patients was eastern tribes 49 (44.5%), the majority 84 (76.4%) were unemployed housewives, highest percentage 43 (39.1%) not educated. Males were 17 (15.5%) and females were 93 (84.5%). Male to female ratio was 0.2: 1. The common age group was 31–40 years in 31 (28.2%). The mean age was 35±3.8 years (Table I).

The main presenting symptoms were right hypochondrial pain 98 (89.1%), dyspepsia 68 (61.8%), nausea and vomiting 44 (40%), jaundice and itching 3 (2.7%) `and fever and rigors in 3 (2.7%) patients. (Fig. 1).

TABLE I: Socio-demographic data

Variable	Result	N	%
Tribe	Northern	22	20.0
	Central	14	12.7
	Western	25	22.7
	Eastern	49	44.5
Total		**110**	**100.0**
Occupation	Not working	84	76.4
	Employee	13	11.8
	Worker	13	11.8
Total		**110**	**100.0**
Education	Not educated	43	39.1
	Primary	17	15.5
	Secondary	29	26.4
	University	21	19.1
Total		**110**	**100.0**
Gender	Male	17	15.5
	Female	93	84.5
Total		**110**	**100.0**
Age group	< 10 years	1	0.9
	11-20 years	3	2.7
	21-30 years	22	20.0
	31-40 years	31	28.2
	41-50 years	18	16.4
	51-60 years	15	13.6
	61-70 years	12	10.9
	71-80 years	7	6.4
	81-90 years	1	0.9
Total		**110**	**100.0**

The maximum duration of symptoms was 1-3 years in 41 (37.3%) of the patients (Fig. 2).

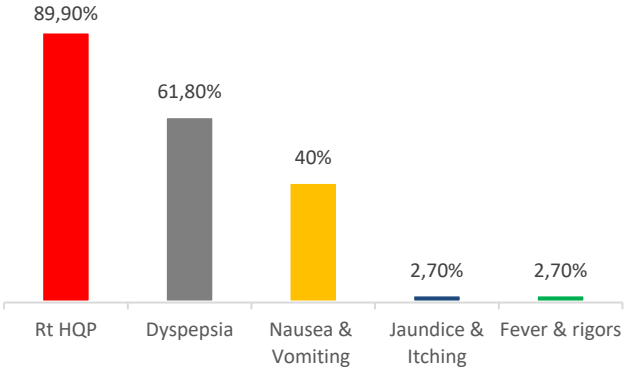

Fig. 1. Presenting Symptom.

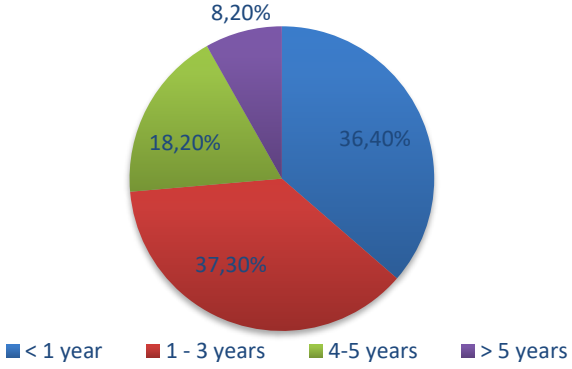

Fig. 2. Duration of Symptoms.

In majority of the patients 71 (64.5%) there was no associated condition, the reported conditions were hypertension 16 (14.5%), abdominal scar 6 (5.5%), diabetes 5 (4.5%), hypertension with diabetes 4 (3.6%), pregnancy 2 (1.5%), ovarian cyst 2 (1.8%), asthma 2 (1.8%), hypothyroidism 1 (0.9%) and Chronic lymphoid Leukemia in 1 (0.9%) patient.

Personal history of acute attack reported in 54 (48.2%) of the patients. The number of attacks was 2–5 attacks 24 (44.4%), single 22 (40.7%) and more than 5 in 8 (14.8%) of the patients. Personal history of ERCP was reported in 2 (1.8%) of the patients. (Table II).

TABLE II: PRESENTING HISTORY

History		N	%
Personal history of acute attack	Yes	54	48.2
	No	56	51.8
Total		110	100.0
Number of attacks	Single	22	40.7
	2 - 5 attacks	24	44.4
	> 5 attacks	8	14.8
Total		54	100.0
Personal history of ERCP	Yes	2	1.8
	No	108	98.2
Total		110	100.0

In abdominal examination 69 (62.7%) of the patients were normal, 35 (31.8%) showed Murphy's sign, and other signs are shown in Table (V). Total WBC was 4000–11000 in 71 (64.5%) of the patients, 4000 in 35 (31.8%) and above 11000 in 4 (3.6%). Liver function tests were normal in 75 (68.2%) of the patients, not done 32 (29.1%) and abnormal 3 (2.7%). Coagulation profile was normal in 70 (63.6%) of the patients, not done 38 (34.5%) and abnormal 2 (1.8%).

Gall bladder wall thickness was normal (1-3) in 69 (62.7%) of the patients, mild thickening (4-5) in 34 (30.9%), moderate (6-7) in 5 (4.5%) and severe > 7 in 2 (1.8%) (Fig. 4). The number of stone was multiple in 89 (80.9%) and single in 21(19.1%) of the patients. There was no impacted stone in 98 (89.1%) and impacted in 21 (19.1%) of the patients. The common bile duct caliber was normal in 109 (99.1%) of the patients and dilated in 1 (0.9%).

Operative time was less than 30 minutes in 53 (48.2%), 30–60 minutes in 46 (41.8%), 61–90 minutes 6 (5.5%), 91–120 minutes 3 (2.7%) and more than 120 minutes in 2 (1.8%) of the patients (Fig. 3). In the two cases who exceeded 120 minutes the cause was obscured anatomy. Conversion to open cholecystectomy was done for 1 (0.9%) patient indicated by obscured anatomy.

There were no reported complications in 97 (88.2%) of the patients, the complications were reported in 13 (11.8%) were: bleeding in 8 (7.3%), bile leak 3 (2.7%), port site infection 1 (0.9%) and respiratory complications 1 (0.9%). The duration of hospital stay was less than 1 day in 66 (60%) of the patients. Operator experience in laparoscopy was shown in (Fig. 4) as: expert 83 (75.5%), working 20 (18.2%), learning 5 (4.5%) and starting 2 (1.8%).

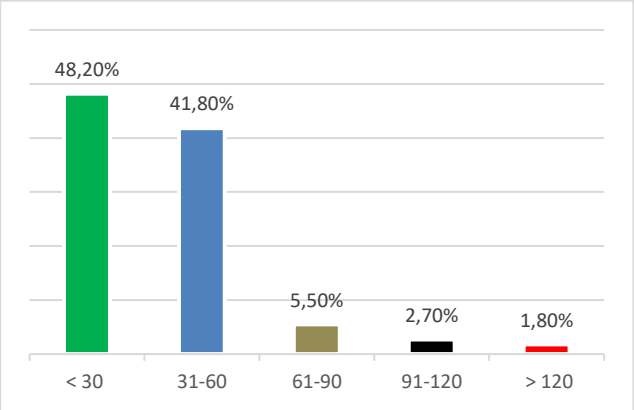

Fig. 3. Operative Time in Minutes.

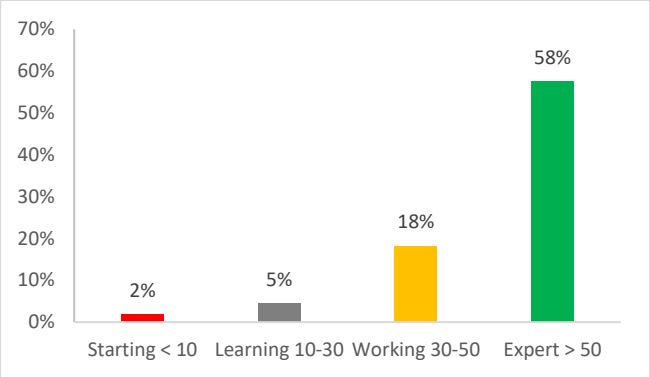

Fig IV: Operator Experience in LC

Significant association was found between GBWT, and other factors shown in Table III (P value < 0.05).

On the other hand, operative time was also found to be significantly correlated to GBWT and the experience of the operator (P value < 0.05) (Tables IV and V).

TABLE III: CORRELATION BETWEEN GB WALL THICKNESS AND OTHER VARIABLES

	Normal < 3 mm	Mild 4-5 mm	Mod 6-7 mm	Sever > 7	P
Postoperative complications					
Non	64	28	5	0	0.001
Bleeding	4	4	0	0	
Bile leak	1	1	0	1	
Port site infection	0	1	0	0	
Respiratory	0	0	0	1	
Conversion					
Yes	0	0	0	1	0.018
No	69	34	5	1	
Number of attacks					
Single	13	8	1	0	
2 - 5 attacks	11	11	1	1	0.055
> 5 attacks	4	3	0	1	
Total	28	22	2	2	
Hospital stay					
< 1 day	43	22	1	0	
1 - 2 days	24	12	3	0	0.002
> 2 days	2	0	1	2	
Total	69	34	5	2	
Duration of symptoms					
< 1 year	27	11	2	0	
1 - 3 years	28	12	0	1	0.01
4 - 5 years	9	9	2	0	
> 5 years	5	2	1	1	
Total	69	34	5	2	

TABLE IV: CORRELATION BETWEEN OPERATOR LAPAROSCOPIC EXPERIENCE AND OPERATIVE TIME

Operative time	Operator Laparoscopic Experience							
	Starting (< 10)		Learning (10-30)		Working (30-50)		Expert (> 50)	
	N	%	N	%	N	%	N	%
< 30 min	0	0.0	1	20.0	10	50.0	42	50.6
31-60 min	1	50.0	3	60.0	7	35.0	35	42.2
61-90 min	1	50.0	0	0.0	0	0.0	5	6.0
91-120 min	0	0.0	1	20.0	2	10.0	0	0.0
> 120 min	0	0.0	0	0.0	1	5.0	1	1.2
Total	**2**	**100.0**	**5**	**100.0**	**20**	**100.0**	**83**	**100.0**

TABLE V: CORRELATION BETWEEN GALL BLADDER WALL THICKNESS AND OPERATIVE TIME

Operative time	GB wall thickness in (mm)							
	Normal (1-3)		Mild (4-5)		Moderate (6-7)		Severe (> 7)	
	N	%	N	%	N	%	N	%
< 30 min	37	53.6	15	44.1	1	20.0	0	0.0
31-60 min	29	42.0	14	41.2	3	60.0	0	0.0
61-90 min	2	2.9	2	5.9	1	20.0	1	50.0
91-120 min	1	1.4	2	5.9	0	0.0	0	0.0
> 120 min	0	0.0	1	2.9	0	0.0	1	50.0
Total	**69**	**100.0**	**34**	**100.0**	**5**	**100.0**	**2**	**100.0**

IV. DISCUSSION

The aim of the study was to develop an easy and practical method of assessing the risk factors of intraoperative difficulties and conversion from laparoscopic cholecystectomy to open technique.

In this study 110 cases of laparoscopic cholecystectomy were studied in which GBWT was measured by one sonographer, using a 3D ultrasound device, studied for prediction of operative difficulties in form of operative time, dissection of gall bladder from liver bed and dissection of Calot's triangle, conversion to open, post-operative complications and post-operative hospital stay. Other demographic and socioeconomic factors, past medical and surgical history, associated diseases, and operative experience in laparoscopy were also looked at.

Male to female ratio was 0.2:1, Majority of them were middle age, similar to most previous studies. Nidoni *et al*, in their study, also addressed statistically significant relation between rate of conversion to open and number of acute attacks [6]. As the case in our study, the number of acute attacks found to be significantly related to the increase in GB wall thickness.

Majority of patients had multiple stones which were not impacted, had normal gallbladder caliber and normal wall thickness; in contrast to Kulkarni and Kumar *et al* who stated that multiple stones increased surgeon's difficulty and impacted stone in gallbladder neck increased the conversion rate [7].

In this study we have classified the cases according to GBWT in millimeters into 4 categories, more or less similar to the grading system of Roman SR *et al* [5]. We found that increasing GBWT is significantly related to complications and increase hospital stay. This was also reported Raman *et al* [5] and Nidoni *et al* [6] who precisely identify thickened gall bladder wall it by being more than 3 mm. Chand *et al* from Nigeria also recommended the use of preoperative US as a screening procedure [8].

Most of the patients were found to have normal wall thickness, with increased proportion of the mild wall thickness compared to the moderate and severe grades; this might be related to the decreased maximum duration of symptoms in the majority of the patients; significant proportion of patients had 2 to 5 acute attacks, less proportion had single attacks and only 8 patients had more than 5 attacks. Severity grades of acute cholecystitis as defined by the 2013 Tokyo Guidelines, are associated with an increased rate of conversion to open surgery, and difficult cholecystectomy, as stated by Asai *et al* most of them had normal TWBCs count [9].

In our study, the gall-bladder wall thickness ≥ 7 mm among our patients significantly ($p<0.05$) increased the risk of intraoperative difficulties and conversion. In two papers concerning elective laparoscopic cholecystectomies the threshold value was 4 mm [10], [11]. In contrast to other papers, we included only patients with chronic cholecystitis as intramural effusion in the course of acute calcular cholecystitis, which increases the GB wall thickness, would lead to wrong conclusions [12], [13].

Three of our patients had an abnormal liver function tests with common bile duct stones, 2 of them were sent for ERCP and came back for LC. For the third one we did laparoscopic common bile duct exploration and LC.

Most of our patients had less than one-hour operative time and only two patients exceed two hours due to obscured anatomy and 1 of them was converted to open surgery, this might be related to the fact that; most of the surgeries were done by expert surgeons and their availability when needed. We found significant relation between wall thickness and increase operative time this was also concluded by Shah AA, *et al*, conversion to an open procedure should not be viewed as a complication but seen as a well-educated decision made by an experienced surgeon to safely care for the patient [14].

Most of our patients had minimal post-operative complications and short hospital stay decreasing expenditure for health care provider. Ibnouf *et al* has concluded the successfulness of day case laparoscopic cholecystectomy in Sudan back in 2006 [15], which was also found to safe and feasible by Al-Qathani *et al* in their study in Saudi Arabia [16]. Fry et al from the USA in their Composite of Outcomes in Medicare showed that hospitalization exceeding 3 days (96 hours) incurs an added cost [17]. Harboe K. M. *et al* in the revision of the Danish National Guidelines for the Treatment of Gall Stones concluded that post-operative length of stay below 2 days (72 h) with no hospital readmission is an indicator of an uncomplicated cholecystectomy [18].

Majority of our patients has no associated conditions, from those who has, diabetes mellitus was found to have significant association with increasing wall thickness; that might be related to that poor glycemic control and presence of diabetic microangiopathy and autonomic neuropathy, as well as frequent bactibilia, are important conditions that predispose diabetics to advanced forms of acute attacks and so increasing wall thickness. This similar to what was found by Boerma D. *et al* [19].

In our study, neither the number of acute attacks, nor the conversion found to be significantly associated with increasing GBWT this is contrast to what Nidoni *et al* [6] found in their study where they reported statistically significant association between the rate of conversion to open and number of acute attacks. Majority of our patients who had multiple stones which were not impacted, had a normal GBWT; in contrast to Kulkarni and Kumar who stated that; multiple stones increased surgeon's difficulty and impacted stone in gallbladder neck increased the conversion rate [20].

Rate of conversion to open surgery in our study was within the lowest percentage, which is expected within this limited time frame of the study. Even comparing to a case series from Atbara, Northern Sudan, where W. E. Abdelrahim et al who got 5% conversion to open surgery concluding that subtotal cholecystectomy is safe and can reduce the rate of conversion to open surgery in difficult laparoscopic cholecystectomy [21].

Gall bladder wall thickness on pre-operative ultrasound remains at the top of the list among factors for conversion to open cholecystectomy explored in meta-analysis by Yang *et al* in 2014 [22] and Josephine Rothman *et al* in 2016 [23]. A recent prospective cohort study in 2020 identified GBWT of more than 4 mm as the top significant preoperative predictor of difficult LC [24].

V. Conclusion

Pre-operative sonographic measurement of gall bladder wall thickness can be used effectively as a predictor of difficult laparoscopic cholecystectomy. Increasing GBWT is associated with difficult laparoscopic cholecystectomy in terms of conversion to open, operative time, hospital stay and post-operative complications.

Recommendation: Severe wall thickness better to be operated by an expert surgeon.

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