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Impact of COVID-19 Pandemic on Management of Acute Cholecystitis in Singapore

Dear Editor,

The COVID-19 pandemic has brought about profound challenges in Singapore[1] with surgery drawing scrutiny due to the need to conserve personal protection equipment (PPE), ventilators, intensive care unit (ICU) beds as well as concerns of concurrent COVID-19 infection in surgical patients with reported mortality rate of up to 20%.[2]

Given the scarcity of resources and risks associated with concurrent COVID-19 infection in the surgical patient, international guidelines have recommended medical treatment for acute issues related to cholelithiasis that are normally treated surgically.[3] This stance has implications on the management of acute cholecystitis (AC) with meta-analyses demonstrating conclusive benefits of index admission early laparoscopic cholecystectomy (ELC) over interval delayed laparoscopic cholecystectomy (DLC) that include decreased total length of stay, decreased readmission for persistent pain and gallstone-related morbidity, earlier return to work, improved quality of life and increased cost-effectiveness.[4,5] The need to balance the surgical risk and resource considerations of acute cholecystitis with the obligations of delivering optimal outcomes and avoiding morbidity thus poses an ethical dilemma during this pandemic.

With the rapidly evolving pandemic coupled with different subspecialty surgeons managing AC in Singapore, opinions and practices may inevitably vary among institutions and surgeons. Resource and manpower constraints would also translate to changing practices on the ground. Thus, the aim of this study is to evaluate the impact of COVID-19 on the management of AC in Singapore.

An anonymous online survey was developed and disseminated across all seven public restructured hospitals in Singapore in April 2020 via electronic mail. Inclusion criteria was consultant specialist surgeons who perform laparoscopic cholecystectomy in Singapore. The survey was administered through an online platform, Google Forms (Google LLC, Menlo Park, California, USA). The survey includes questions on demographics of survey respondents, impact of the COVID-19 pandemic on management of AC, screening, use of PPE and questions on resident training.

Acute cholecystitis and the grading of severity were defined in accordance to the Tokyo Guidelines 2018.[6] Complicated cholecystitis was defined as gangrenous cholecystitis, emphysematous cholecystitis or cholecystitis with presence of abscess. There was a total of 51 respondents out of 73 administered surveys (69.9%). The institution, grade and subspecialty of respondents are summarised in Fig. 1. Screening and PPE use is summarised in Table 1. Most respondents perform targeted screening only for patients with respiratory symptoms for COVID-19 (88.2%) preoperatively. Only 51% of consultants would use N95 mask and goggles for COVID-19 negative patients. For COVID-19 positive patients, choice of PPE usage differs with 52.9% using powered air-purifying respirator (PAPR) and 47.1% using N95 mask with goggles.

Management of uncomplicated and haemodynamically stable complicated AC is summarised in Table 2. Majority of respondents perform ELC for uncomplicated AC (90.2%) but this decreased to 58.8% during the pandemic. Majority (70.6%) of respondents felt that testing all patients for COVID-19 will alter their management. Most respondents (92.2%) would perform ELC for haemodynamically stable complicated AC but this decreased to 66.7% during the pandemic. For patients requiring DLC for AC, the duration of interval cholecystectomy varies from less than 6 weeks to more than 3 months.

Regarding intraoperative conduct of laparoscopic cholecystectomy, there are 19.6% of respondents who do not use any filters intraoperatively. There are 51% of respondents who still bring residents through surgery. More respondents perform laparoscopic cholecystectomy with 1 assistant during the pandemic from 76.5% to 90.2%.

Laparoscopic cholecystectomy was first performed in Singapore in the early 1990s where only 6.5% of acutely inflamed gallbladder operated were ELC.[7,8] Today, more than 90% of surgeons surveyed in our study would perform ELC for AC. This is not surprising given the numerous benefits of ELC over DLC established in

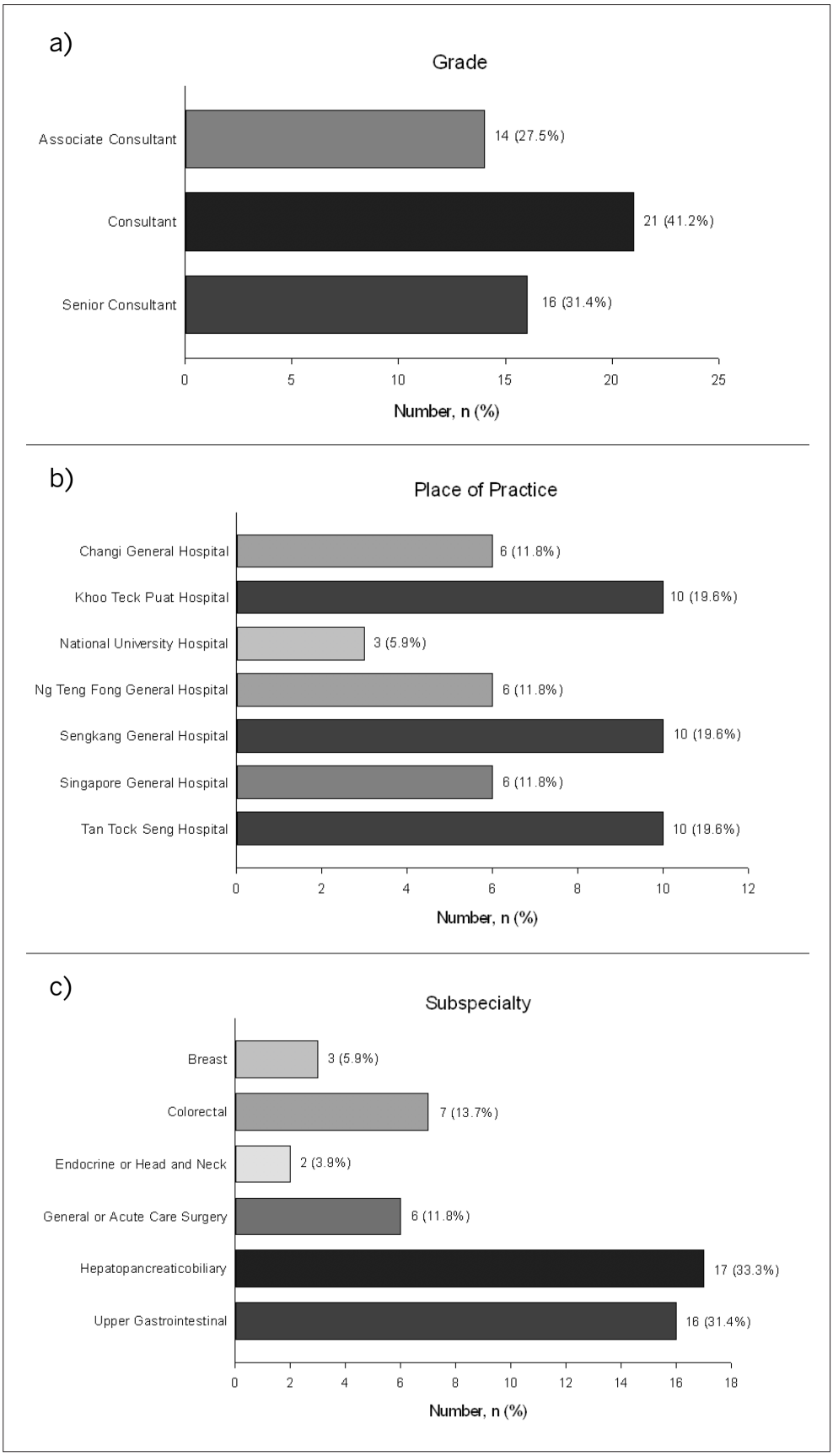

Fig. 1. Summary of (a) grade, (b) place of practice and (c) subspecialty of respondents

Table 1. Screening and use of personal protection equipment (PPE) in the COVID-19 pandemic

Survey questions on screening and PPE use	Number of responses, n (%)
Was any patient referred for acute cholecystitis tested positive for COVID-19 BEFORE surgery at your hospital (percentage)?	
0%	45 (88.2)
1-5%	6 (11.8)
5-10%	0
>10%	0
Was any COVID-19 negative patient referred for acute cholecystitis later tested positive for COVID-19 at your hospital (percentage)?	
0%	42 (82.4)
1-5%	9 (17.6)
5-10%	0
>10%	0
Since the COVID-19 pandemic, how has your hospital changed its organization?	
My hospital is exclusively dedicated to COVID-19 patients	1 (2)
My hospital has restricted areas dedicated to COVID-19 patients	50 (98)
Do you routinely screen patients with acute cholecystitis for COVID-19 infection before surgery?	
Yes, all patients	6 (11.8)
No, only patients with respiratory symptoms or suspected with COVID-19 infection	45 (88.2)
Would you change your overall strategy (index admission early cholecystectomy vs delayed interval cholecystectomy) if you could test all patients?	
I already test all patients	1 (2)
Yes	36 (70.6)
No	14 (27.5)
Are there any changes in personal protective equipment during operation in COVID-19 NEGATIVE patients?	
No changes (surgical mask)	14 (27.5)
N95 Face mask	2 (3.9)
Goggles	0
Surgical mask and goggles	9 (17.6)
N95 mask and goggles	26 (51)
Powered air purifying respirator (RAPR)	0
Are there any changes in personal protective equipment during operation in COVID-19 UNKNOWN (not tested) patients?	
No changes (surgical mask)	10 (19.6)
N95 Face mask	3 (5.9)
Goggles	0
Surgical mask and goggles	6 (11.8)
N95 mask and goggles	32 (62.7)
Powered air purifying respirator (RAPR)	0
Are there any changes in personal protective equipment during operation in COVID-19 POSITIVE patients?	
No changes (surgical mask)	0
N95 Face mask	0
Goggles	0
Surgical mask and goggles	0
N95 mask and goggles	24 (47.1)
Powered air purifying respirator (RAPR)	27 (52.9)

Table 2. Management of acute cholecystitis before and during the COVID-19 pandemic

Comparison before and during the pandemic	**Before** Number of responses, n (%)	**During** Number of responses, n (%)
How many patients with acute cholecystitis are referred to your hospital in one month?		
< 5	0	7 (13.7)
5-10	10 (19.6)	15 (29.4)
11-20	26 (51)	22 (43.1)
>20	15 (29.4)	7 (13.7)
How many assistants do you require for laparoscopic cholecystectomy?		
2	12 (23.5)	5 (9.8)
1	39 (76.5)	46 (90.2)
Uncomplicated acute cholecystitis		
How do you manage UNCOMPLICATED acute cholecystitis (not gangrenous, emphysematous or presence of abscess) BEFORE COVID-19 pandemic?		
Non-operative management with antibiotics	0 (0)	9 (17.6)
Index admission early laparoscopic cholecystectomy	46 (90.2)	30 (58.8)
Delayed interval laparoscopic cholecystectomy	5 (9.8)	12 (23.5)
Did you change your attitude in the management of UNCOMPLICATED acute cholecystitis (not gangrenous, emphysematous or presence of abscess) during the COVID-19 pandemic?		
Yes, for all patients	NA	15 (29.4)
Yes, only in COVID+ patients	NA	21 (41.2)
Yes, only in COVID+ and untested patients	NA	2 (3.9)
No	NA	13 (25.5)
In percentage, how often is index admission **early** laparoscopic cholecystectomy used at your hospital (BEFORE COVID-19 pandemic) in patients with UNCOMPLICATED acute cholecystitis (no gangrenous, emphysematous or presence of abscess)?		
< 25%	2 (3.9)	NA
26-50%	8 (15.7)	NA
51-75%	22 (43.1)	NA
76-100%	19 (37.3)	NA
In percentage, how often is interval **delayed** laparoscopic cholecystectomy used at your hospital currently (DURING COVID-19 pandemic) in patients with UNCOMPLICATED acute cholecystitis (no gangrenous, emphysematous or presence of abscess)?		
< 25%	NA	21 (41.2)
26-50%	NA	22 (43.1)
51-75%	NA	6 (11.8)
76-100%	NA	2 (3.9)
Complicated acute cholecystitis		
How do you manage haemodynamically stable COMPLICATED (gangrenous, emphysematous or presence of abscess) acute cholecystitis?		
Non-operative management with antibiotics	3 (5.9)	15 (29.4)

Table 2. Management of acute cholecystitis before and during the COVID-19 pandemic (Cont'd)

Comparison before and during the pandemic	**Before** Number of responses, n (%)	**During** Number of responses, n (%)
Index admission early laparoscopic cholecystectomy	47 (92.2)	34 (66.7)
Delayed interval laparoscopic cholecystectomy	1 (2)	1 (2)
Index admission open cholecystectomy	1 (2)	1 (2)
In percentage, how often is index admission laparoscopic cholecystectomy usually performed at your hospital in patients with haemodynamically stable COMPLICATED acute cholecystitis (gangrenous, emphysematous or presence of abscess)?		
< 25%	2 (3.9)	12 (23.5)
26-50%	13 (25.5)	12 (23.5)
51-75%	17 (33.3)	18 (35.3)
76-100%	19 (37.3)	9 (17.6)
What is the interval duration that you would perform delayed interval laparoscopic cholecystectomy?		
6 weeks	43 (84.3)	15 (29.4)
8 weeks	6 (11.8)	13 (25.5)
3 months	2 (3.9)	18 (35.3)
>3 months	0	5 (9.8)
Did you change your attitude in the management of haemodynamically stable COMPLICATED acute cholecystitis (gangrenous, emphysematous or presence of abscess)?		
Yes, for all patients	NA	7 (13.7)
Yes, only in COVID+ patients	NA	19 (37.3)
Yes, only in COVID+ and untested patients	NA	4 (7.8)
No	NA	21 (41.2)
Intraoperative approach		
How do you / will you operate on patients with cholecystitis (if patients are operated on) in COVID-19 UNKNOWN (not tested) patients?		
Laparoscopic surgery with specific devices for protection and smoke evacuation	NA	36 (70.6)
Laparoscopic surgery without specific devices for protection and smoke evacuation	NA	10 (19.6)
Laparoscopic surgery, but I do not have devices for pneumoperitoneum/smoke evacuation	NA	5 (9.8)
Laparoscopic surgery, but hospital policy does not allow it	NA	0
Prefer open surgery	NA	0
Not applicable	NA	0
How do you / will you operate on patients with cholecystitis (if patients are operated on) in COVID-19 POSITIVE patients?		
Laparoscopic surgery with specific devices for protection and smoke evacuation	NA	39 (76.5)
Laparoscopic surgery without specific devices for protection and smoke evacuation	NA	2 (3.9)
Laparoscopic surgery, but I do not have devices for pneumoperitoneum/smoke evacuation	NA	0 (0)
Laparoscopic surgery, but hospital policy does not allow it	NA	1 (2)
Prefer open surgery	NA	7 (13.7)

Table 2. Management of acute cholecystitis before and during the COVID-19 pandemic (Cont'd)

Comparison before and during the pandemic	**Before** Number of responses, n (%)	**During** Number of responses, n (%)
I will not operate on COVID-19 positive patients during the pandemic	NA	2 (3.9)
If laparoscopic cholecystectomy is performed, do you use any filter system?		
Yes, for all patients	NA	23 (45.1)
Yes, only in COVID+ patients	NA	12 (23.5)
Yes, only in COVID+ and untested patients	NA	6 (11.8)
No	NA	10 (19.6)
If any evacuation system with filters is used, which type of device do you use?		
Commercially available	NA	34 (66.7)
Commercially available with filtration connected to a container with water	NA	0
Commercially available with filtration connected to a sealed container	NA	14 (27.5)
Homemade	NA	2 (3.9)
Homemade with filtration connected to a container with water	NA	0
Homemade with filtration connected to a sealed container	NA	1 (2)
Do you still bring residents through laparoscopic cholecystectomy for acute cholecystitis during the COVID-19 pandemic?		
Yes	NA	26 (51)
No	NA	25 (49)

NA: Not applicable

meta-analysis and Cochrane reviews.[4,5] Thus, the need to rationalise resources and postpone surgeries in this pandemic poses a clinical equipoise with regards to the management of AC.

Despite pandemic-specific guidelines recommending medical treatment of gallstone related issues,[3] 58.8% of surgeons in our study would still perform ELC for uncomplicated acute cholecystitis. The need for possible longer length of stay for pain control and observation for development of complications related to failure of medical treatment may be a consideration for proponents of ELC. This should be balanced with the counterargument of operating on the asymptomatic or presymptomatic COVID-19 patient and exposing the patient to risk of respiratory complications and need for ICU admission. Clearly, there is no 'one size fits all' guideline that is appropriate for every situation, and ultimately the decision to operate lies in the discretion of the surgeon taking into consideration the disease prevalence and infection control measures in the country and community.

Currently, the indications for testing patients for COVID-19 prior to surgery would include patients with active respiratory tract symptoms or patients belonging to a high-risk group such as an individual residing in a dormitory. Beyond that, routine preoperative COVID-19 screening has yet to be advocated in Singapore. Routine preoperative screening may be an option to consider for ELC with the American College of Surgeons (ACS) recommending rapid testing for COVID-19 infection through real-time reverse transcriptase polymerase chain reaction (RT-PCR) testing to be considered for all patients undergoing planned surgery.[9] This is plausible given that uncomplicated AC is a semi-emergency and therein lies the window of opportunity for testing and turnaround of test results if the patient is haemodynamically stable. Currently, 11.8% of surgeons in our study perform routine preoperative

screening for COVID-19 with 70.6% of surgeons claiming that their management strategy may alter if it was possible for them to routinely test all patients going for surgery. This approach would however also be influenced by the COVID-19 diagnostic testing capability and turnaround times of each institution.

The choice of PPE in COVID-19 positive patients is also another interesting area that our study has found surgeons split in equal proportions between the use of N95 masks and goggles versus PAPR. There have been some concerns regarding the ability of N95 masks to prevent inhalation of particles in surgical smoke given that N95 masks filter particles larger than 0.3μm, while generated particles range from 0.07 to 0.42μm, and the size of COVID-19 (SARS-Cov-2) virus ranges from 0.06 to 0.14μm.[10] This should however be taken in the context of the laparoscopic setup being a closed-circuit and containment environment with regulated inflow and outflow of gas that can be further mitigated by the application of commercial Ultra Low Particulate Air (ULPA) filters that have been quoted to filter 99.999% of particles greater than 0.05μm if it conforms to the standards of the Association of periOperative Registered Nurses (AORN). Currently 19.6% of surgeons in our study do not use any filter system and should reconsider for COVID-19 positive cases.

Interestingly, there are also 13.7% of surgeons in our study who would prefer to perform open cholecystectomy for COVID-19 patients. The debate over the safety of open versus laparoscopic approach specific to the pandemic is a controversial topic that is constantly evolving. A study by Zheng et al. (2020)[11] definitely seems to suggest greater risk associated with laparoscopy pertaining to electrocautery-induced aerosolisation and creation of surgical plume whereas guidelines from Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and Royal Australasian College of Surgeons (RACS) state that little or no evidence favors for or against the specific use of open over laparoscopic approach.[12,13]

The need to minimise the number of essential personnel and exposure in the operating room is one that is articulated by both SAGES and ACS.[12,14] This is also reflected in our study with the number of surgeons performing laparoscopic cholecystectomy with one assistant increasing from 76.5% to 90.2% before and during the pandemic respectively. Furthermore, only 51% of consultants bring residents through cases during this period, which would inevitably impact residents' training and experience. The potential loss of operating time has prompted the use of realistic virtual surgical simulation in an attempt to mitigate this problem.[15] More importantly, the temporary loss in opportunities for technical skills is compensated by the acquisition of values and principles of prioritisation and ethics learnt in this pandemic that will contribute to the overall holistic growth of the surgical resident.

We acknowledge the limitations of our study being the time frame in which this survey was performed. With the escalating case numbers in Singapore due to the recent explosion of COVID-19 in migrant worker clusters, this may influence the practices and strategies of surgeons on the ground. Furthermore, the respondent rate of this survey is limited at 69.9% but there is tradeoff in the high multicenter responses obtained that enables us to sample the practices across all major public institutions in Singapore.

The challenges and impact of COVID-19 on AC management in Singapore is evident from our survey. With this collaborative survey reflecting local practices during this crisis, we hope that this will pave the way for future multicenter studies to corroborate perception with clinical data on the management of AC both during COVID-19 and in peacetime.

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