Chapter

The Role of Endoscopic Ultrasound in Acute Cholecystitis

Cosmas Rinaldi A. Lesmana and Laurentius A. Lesmana

Abstract

Acute cholecystitis (AC) is one of challenging clinical conditions in biliary disorders as it can carry high morbidity and mortality. Gallstone disease is still the main cause of AC in clinical practice. Transabdominal ultrasound, abdominal CT scan and abdominal MRI are the standard diagnostic tools in AC, however, some obstacles can be found which are associated to the patient's factor, anatomy or anomaly of biliary system, the disease severity, and the operator. Cholecystectomy is still the primary choice management in AC condition, however, several issues need to be encountered, such as critically ill condition, sepsis, and patient's comorbidity. Percutaneous approach has become an alternative as it is considered as a simple procedure to be performed in clinical practice. Catheter dislodgement, the risk of bile leakage, and uncooperative patients have raised major concerns for this procedure. Another method, such as endoscopic approach has been studied as well and it seemed to have more advantage when compared to the percutaneous approach. Recently, endoscopic ultrasound (EUS) has been used as a combined diagnostic as well as therapeutic tools in managing biliary disorders. Recent evidences about the role of EUS approach for gallbladder drainage (EUS GBD) in patients who unsuitable for surgery have emerged in the past one decade. However, comprehensive evaluation before which approach is the best option is needed as expertise, cost, and patient's outcome prediction are the most important factors to be considered in the real clinical practice.

Keywords: acute cholecystitis, gallstone disease, surgical cholecystectomy, endoscopic ultrasound, gallbladder drainage

1. Introduction

Acute cholecystitis (AC) is one of challenging clinical condition due to acute inflammation of the gall bladder, where it can lead to severe and life-threatening condition. Gallstone disease is still the primary cause for AC, where it is estimated around 10–15% prevalence. Cholecystectomy is considered as the main choice of management in AC. However, there are many factors which involved in the management decision in clinical practice, such as early and late diagnosis of AC condition, whether it is mild, moderate, or severe, stone's location associated with the severity of inflammation and pain, bile duct inflammation (cholangitis), acute biliary pancreatitis, patient's comorbidity, and sepsis condition [1, 2]. Early diagnosis of acute cholecystitis is very important; however, it is not always possible as sometimes there is an incorrect time recognition by the patient or the family, the doctor's experience

with the patient's symptoms, the quality of simple diagnostic tool (trans-abdominal ultrasound), and the ultrasound image's expertise [3, 4].

2. Acute cholecystitis diagnosis and the role of endoscopic ultrasound

Three modalities have been used in common clinical practice in diagnosing AC, which are transabdominal ultrasound (US), abdominal computed tomography (CT) scan, and abdominal magnetic resonance imaging (MRI) with cholangiopancreatography (MRCP) [5]. Transabdominal US is considered as the easiest and fastest diagnostic tool to be performed bedside with very high sensitivity for gallbladder (GB) stone (cholelithiasis) detection, where gallstones can be identified more than 90% in AC. With this examination, it is very easy also to diagnose AC, confirmed by the abdominal-ultrasound pressure pain and thickening ("double layer") of the GB wall. However, this procedure has several limitations, such as obese patients, tiny stones detection, cystic duct evaluation, and it is still an operator dependent. In some specific conditions, such as liver cirrhosis patients, renal or heart failure patients, thickening of the GB wall can also be mistaken with AC condition [6, 7]. Abdominal CT scan has been shown to have higher sensitivity and specificity in detecting AC. This procedure also can be performed within a short time [8]. However, there are some issues related to this examination, such as radiation exposure, contrast-agent, and unidentified gallstone. A retrospective abdominal CT scan study by Bennet et al. (2001) showed that even though there were 91.7% sensitivity, 99.1% specificity, and 94.3% accuracy in diagnosis AC, however, it showed only 29.3% sensitivity, 96.0% specificity, and 64.1% diagnostic accuracy in EC [9]. In diagnosing acute gangrenous cholecystitis, abdominal CT and transabdominal US have low sensitivity. Another imaging, abdominal MRI is considered as a high-level imaging with high sensitivity for biliary system disorders. In AC, not only the increased of signal intensity and thickening of the GB wall signs need to be identified, but also other important factors, such as another possible cause associated with the thickened GB wall, impacted stone at the GB neck or cystic duct, and the GB abnormalities. These parameters' assessment is important assessment before surgery [10, 11]. A prospective study by Hakansson et al. (2000) on diagnostic value comparison between MRI and transabdominal US in patients with suspected of AC revealed that higher sensitivity was found in MRI for diagnosing AC. The MRI sensitivity and specificity were 88% and 89%, whereas it was only 65% and 89% for transabdominal US examination. In MRI based examination, it is easier to detect possible of impacted stone at the cystic duct [12]. Another retrospective study by Fayad et al. (2003) showed that functional method of MRCP increased the diagnostic yield of AC when combined with conventional MRCP method, where the positive predictive value was 100% [13]. In addition, a recent study by Orf et al. (2020) revealed that MRCP could differentiate AC patients with normal CBD caliber, dilated CBD, the cause, and associated anomalies [14]. However, several conditions, such as uncooperative patients, elderly patients, and claustrophobia patients are becoming the major concern.

Endoscopic ultrasound (EUS) is considered to have more advantage in diagnostic view as the probe can be attached to the gastric or duodenal wall providing the closer biliary system images (**Figure 1**) [15]. Etienne et al. reported an emphysematous gallbladder which was successfully diagnosed through EUS procedure, where previous MRCP and contrast CT scan failed to get the diagnosis of AC [16]. It is already known that emphysematous cholecystitis (EC) is AC variant, where it is referring to acute gangrenous cholecystitis which can results in a fatal patient's outcome. The major drawback is that in most of moderate to severe AC cases with

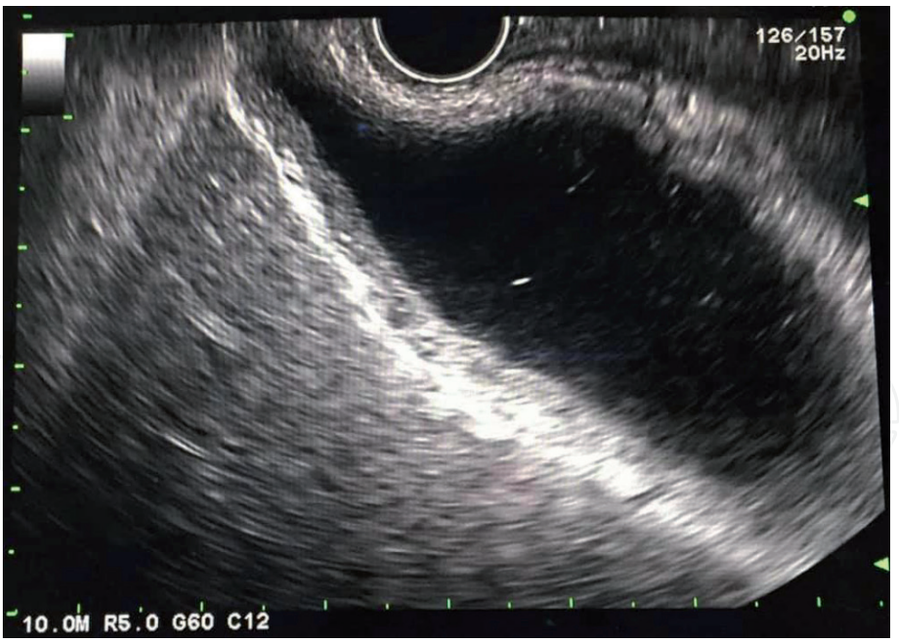

Figure 1.
EUS image showed acute cholecystitis condition. Endoscopy unit Medistra Hospital, Jakarta.

abdominal pain, the commonest diagnostic imaging to be performed is abdominal CT scan [17]. Whereas through MRI examination could have a comprehensive evaluation, including anomaly in biliary system anatomy and the obstructive and non-obstructive common bile duct stones, especially in patients who have experienced acute biliary pancreatitis, however, the cost and long procedure-time issue is still not placing abdominal MRI as the primary modality of choice in acute and severe conditions [18]. EUS has been well-known as an important diagnostic tool for GB abnormalities, stone detection, and especially to confirm the diagnosis of GB carcinoma. A technical review of EUS in GB assessment by Tanaka et al. (2021), it showed how using EUS can get better visualization for complete assessment of gallbladder until the cystic duct by ultrasound probe placement at the gastric anthral area and duodenal bulb [19]. Even though there is no specific paper on how to apply EUS in AC diagnosis, however, the close range of ultrasound probe, the possibility to have complete biliary system evaluation, and the pancreato-biliary connection would give a big advantage in the treatment decision as well as one-stop as well as one-step procedure (diagnostic-therapeutic) in most acute cholecystitis cases with regards to the possibility of surgical approach.

3. The role of interventional EUS in acute cholecystitis

Medical treatment, such as analgesic as well as antibacterial agents, as well as elective or emergency cholecystectomy are still the main recommendation in daily clinical practice with regards to the severity of AC condition. Laparoscopy recently has become the cornerstone in abdominal surgery because of shorter hospital stay, faster wound healing and less pain at surgical incision site. In the severe case, especially two major factors are identified, such as older age (elderly patients) and comorbidity (cardio-pulmonary problems, uncontrolled diabetes mellitus, advance liver and kidney diseases, and critically ill condition), surgical approach might not be performed in the real clinical practice. On the other hand, percutaneous approach (percutaneous transhepatic gallbladder drainage/PTGBD) has become an alternative in such of situations. It is a very easy procedure and can be performed

bedside, however, uncooperative patients, altered mental status, risk of infection and catheter dislodgement have raised major concerns [20]. Another method can be performed by ERCP technique by placing nasobiliary tube (NBT) or double pigtail plastic stent into the GB through cystic duct cannulation. Major limitations are normal common bile duct (CBD) cannulation and guide wire insertion to the cystic duct which sometimes is not easy to be performed, especially when there is an obstructed cystic duct [21].

EUS has been used widely for managing biliary disorders, such as EUS-guided biliary drainage (EUS BD) for malignant bile duct obstruction as well as a guide for impacted bile duct stone clearance [22]. In technical review by Rana (2021), the echoendoscope position at duodenal area as the same position where EUS BD is performed, is considered as the best location as it is the nearest location to the GB and cystic duct area. Step by step approach is needed to get the successful result even though sometimes it is not always possible. Stabilizing the scope position is the main key for minimize the complications risk. The next step approach is like EUS BD procedure, puncturing the GB with 19-G FNA needle, bile fluid aspiration, guide wire insertion, then followed by fistula track creation using cautery or non-cautery methods. The most crucial step is the stent delivery and deployed (**Figures 2** and **3**) [23]. A randomized controlled trial between EUS GBD and PTGBD by Jang et al. (2012) showed that both methods have similar technical success rate (97% vs. 97%), and there was not statistically significant in term of complications (p = .492) [24]. A systematic review and meta-analysis by Khan et al. (2016) on efficacy and safety of EUS GBD in AC, showing the technical and clinical success rate for transpapillary route was 83% and 93%, whereas transmural route (EUS GBD) technical and clinical success rate were 93% and 97%. The

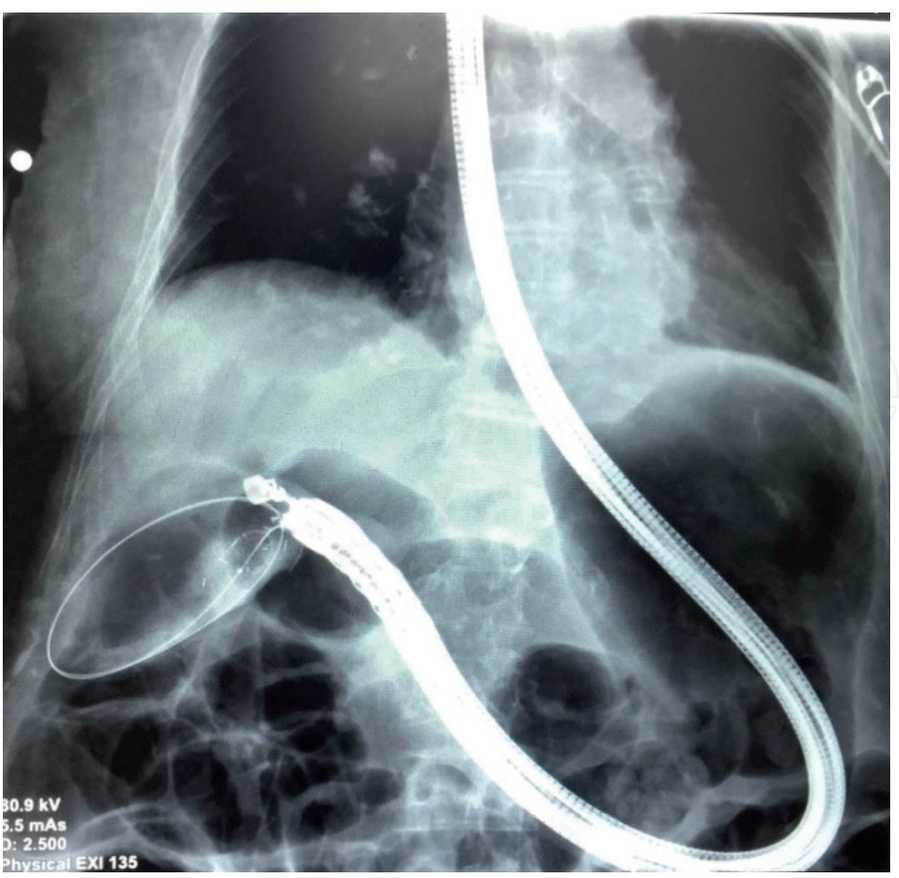

Figure 2.
Fluoroscopy image showed the lumen apposing metallic stent deployment inside the gallbladder. Endoscopy unit Medistra Hospital, Jakarta.

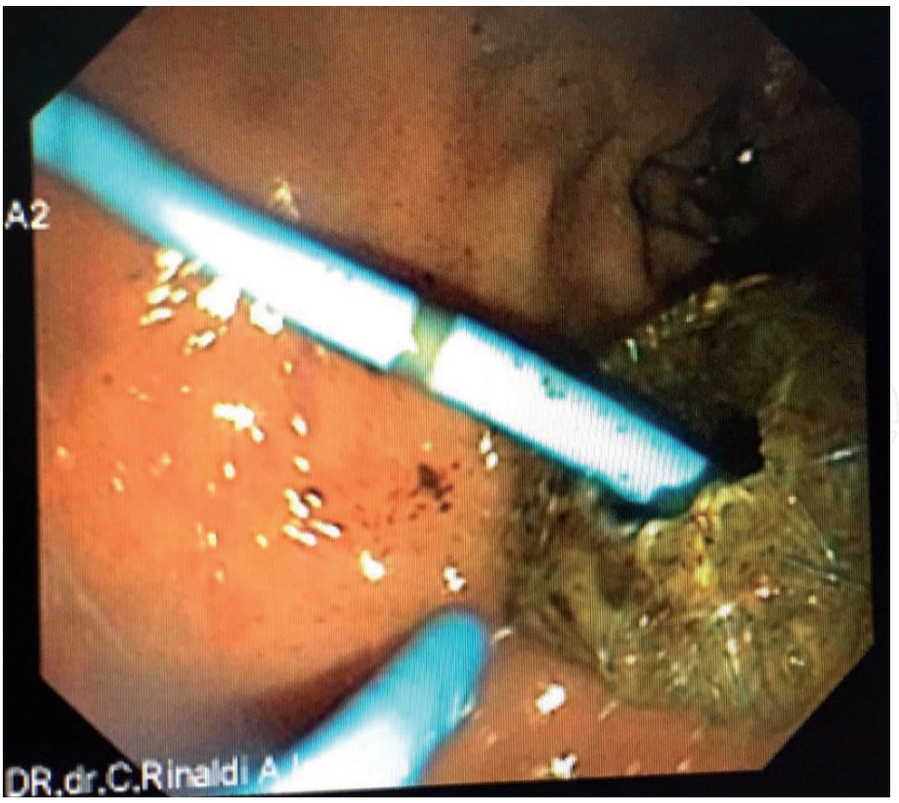

Figure 3.
Endoscopy image of gallbladder drainage with LAMS through the duodenal site. Endoscopy unit, Medistra Hospital, Jakarta.

comparison difference was 10% ($p < .001$) and 4% ($p = .01$). In Endoscopic versus percutaneous methods, recurrent cholecystitis was found more in percutaneous approach than in endoscopic approach [25]. Another study by Tyberg et al. (2016) also shown similar technical success rate between EUS GBD and PTGBD methods [26]. An international multicenter study on EUS GBD in patients who were at high risk for cholecystectomy, showed that the technical and clinical success rate were 95.3%and 90.8%. However, the unplanned events related to the procedure was found higher in non-AC cases than in AC cases with regards to the operator's procedure experience volume [27]. Another retrospective study showed that EUS GBD and percutaneous approach were similarly effective in achieving gallbladder drainage [28]. Recently, there has been a propensity score analysis retrospective study by Teoh et al. (2020) looking at the comparison between EUS GBD and laparoscopic cholecystectomy (LC) for AC, where the result showed the technical success rate was 100% vs. 100%, whereas clinical success rate was 93.3% vs. 100%. After the propensity score matching was done on several factors which might be different from the inclusions' criteria, and there was evidence that two patients died in the EUS GBD group due to aspiration pneumonia and uncontrolled sepsis, however, these events not related to the procedures itself and not statistically significant when compared to the LC group. This study suggested that EUS GBD can be the first approach for patients who are not willing to undergo the surgical approach as well as an alternative in patients who are not fit for surgery. There is no significant difference in the patients' outcome based on 30-day adverse events, recurrent biliary infections, or the need for reintervention [29]. However, there are some major issues which still need to be counted in real clinical practice before it would be recommended in the real clinical practice guideline, such as the cost, operator's experience, multi-disciplinary team approach availability, risk, and complications [30].

4. Conclusions

EUS has a big role in AC condition, where it can be an alternative to patients who are not suitable for surgery. However, a larger study is needed to confirm the previous findings and the patient's long-term outcome. Comprehensive clinical assessment is still the most important thing to do before deciding which is the best method to be performed.

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