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Expanding Access to Bedside Diagnosis: Implementation of POCUS to Identify Gallstones in Rural Healthcare Settings

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ABSTRACT

Gallstones affect 10-15% of adults and are a common cause of right upper quadrant (RUQ) pain. Current literature increasingly supports point-of-care-ultrasound (POCUS) for biliary assessment, but its real-world implementation in low-resource environments remains underreported. Although ultrasound is the first-line diagnostic modality, access may be limited in rural settings. Handheld POCUS may help bridge this gap and provide rapid evaluation when cart-based systems are unavailable. A 71-year-old woman presented with one day of acute RUQ pain to a rural clinic. Physical examination demonstrated positive Murphy's and Lloyd's signs. Laboratory testing was unavailable. Bedside POCUS revealed multiple gallstones with posterior acoustic shadowing, gallbladder wall thickening, and a positive sonographic Murphy's sign, without biliary ductal dilation. Findings were most consistent with symptomatic cholelithiasis versus early cholecystitis. The patient received analgesia with symptomatic improvement and was discharged with expedited referral for cholecystectomy. This case highlights the utility of handheld POCUS in low-resource settings, supporting timely diagnosis and reducing barriers to care.

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Aim/Objective

To present a case demonstrating the utility of handheld point-of-care ultrasound (POCUS) devices in low-resource environments to contribute to the growing evidence of real-world implementation and expand bedside diagnosis of biliary disease.

Keywords: POCUS, Rural Medicine, Biliary Disease, Global Medicine, Ultrasound, Bedside Access

Introduction

Biliary disease is a common cause of abdominal pain worldwide. In the United States, an estimated 200,000 people are diagnosed with cholecystitis annually. Worldwide, it is estimated that 6% of people have gallbladder disease with high prevalence in South America and in female patients [1]. Biliary disease is associated with metabolic syndrome, obesity, and hyperlipidemia [2]. It can progress to biliary colic, bile duct obstruction, or acute pancreatitis, all of which can significantly increase the mortality rate of biliary disease [3].

In hospitals and clinics with advanced diagnostic resources, biliary disease is typically identified through a combination of patient presentation, physical exam, imaging, and laboratory testing. In low-resource settings, limitations in social funding, transport, childcare, affordability, and healthcare access can delay diagnosis and appropriate management of biliary disease. This delay prolongs the patient's pain, decreases their quality of life, and can lead to poorer outcomes.

POCUS is used as a diagnostic modality due to its high specificity and sensitivity for biliary disease. It is considered the gold-standard imaging modality to detect cholelithiasis, due to it being a non-invasive, relatively inexpensive, quick, and focused diagnostic tool. It can be conducted at the bedside with a portable ultrasound probe, making it useful in diagnosing hospitalized or non-ambulatory patients [4]. For detecting the presence of gallstones, the specificity of POCUS is 94% and the sensitivity is 93%, both with a 95% confidence interval (CI). This enables providers to rule in and out biliary pathology with higher confidence, minimizing delays in care due to misdiagnosis or lab and imaging restrictions [5].

In rural or global medical settings, due to the limitations in laboratory testing and potential language barriers, the presence of handheld ultrasound probes can help increase access to modalities that facilitate more accurate diagnosis [6]. Current literature explores the connection between POCUS and the diagnosis of biliary disease and discusses the utility of POCUS in improving health outcomes. More research is needed to explore this utility in the context of low-resource environments.

The diagnosis of symptomatic cholelithiasis is not uncommon; however, the novelty of the handheld Butterfly iQ3 portable ultrasound probe warrants the need for a case report. Rural environments present with different circumstances surrounding the diagnostic process, and many social barriers may be addressed through the use of handheld diagnostic devices. These devices

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are relatively inexpensive in comparison to cart-based imaging modalities and can be linked to an app on the scanner's phone or tablet, making accessibility easier. The apps typically do not require internet connection to scan, something that can be rare to find in rural areas. This can become an asset to low-resource health clinics, temporary clinic operations, and other settings where a bedside ultrasound scan can expedite diagnosis and ensure prompt care. The presence of bedside scans eliminates some of the reservations patients may have regarding the cost of imaging, the turn-around time to receive results, and the difficulties associated with organizing a visit to a facility with imaging capabilities that may be hours away. By addressing all of these concerns, the integration of POCUS in low-resource settings, especially rural locations, can lead to quicker diagnostic times and improved patient outcomes.

Case Description

This case follows a patient presenting to a free clinic located in Tarapoto, San Martín, Peru. Tarapoto is a district with a population of around 80,000 people, with many of the population residing in villages 30-40 minutes outside of the main town. There is a greater metropolitan area surrounding the district, which has been rapidly expanding, but the rapidly increasing population has drastically complicated resource allocation. While Tarapoto has public and private healthcare facilities, specialized care is often limited, and patients must travel 900 kilometers (about 559.23 mi) to Lima to be evaluated. There are also very few sites with thorough imaging capabilities, including ultrasound, due to government funding barriers.

Through Global Medical Training, an organization that brings students, physicians, and resources into rural areas, mobile clinics were set up to expand healthcare access into these rural populations. These clinics operated without cost to the patients and were open to all individuals of the locale with the goal of allowing patients to bring forth health complaints and conveniently be evaluated near their homes.

A 71-year-old female presented to the clinic with one day of right upper quadrant (RUQ) pain. The patient rated the pain as 9/10, with pain radiating to her back. The patient had no significant past medical, surgical, or family history. She was not taking any medications and had no known allergies. She denied fever, nausea, vomiting, and urinary symptoms. On observation, the patient was visibly uncomfortable in the chair and restlessly shifted in her seat. Vital signs were stable at the time of presentation. From patient history, differential diagnoses included kidney, liver, pancreatic, biliary and stomach pathologies, with potential of referred pain from pelvic pathology. A focused abdominal physical exam was done and demonstrated a soft, non-distended abdomen without guarding or rebound tenderness. The patient had normoactive bowel sounds. Abdominal physical exam demonstrated a positive Murphy's sign. Findings also included a positive right-sided Lloyd's sign. Given these physical examination findings, biliary pathology moved up on our differential list.

Methods-POCUS Protocol

The clinic sites did not have on-site laboratory testing; hence, bedside diagnostic modalities were required to help inform our assessment and plan. We used the Butterfly iQ3 handheld ultrasound probe to evaluate her abdomen to guide our differential diagnosis. With the patient supine, the probe was used to scan the patient's entire abdomen, taking care to rule out alternative causes of RUQ pain, such as liver, kidney, and pancreatic pathology. Imaging revealed three mobile hyperechoic gallstones measuring approximately 1.5 cm each with posterior acoustic shadowing (Figure 1). Imaging also demonstrated gallbladder wall thickening measuring 5 mm. The patient displayed a positive sonographic Murphy's sign, tenderness elicited by positioning the ultrasound probe over the gallbladder, which caused the patient to stop breathing from the pain. No hepatic, renal, gastrointestinal, pulmonary, or pelvic pathologies were visualized on ultrasound, thus ruling out some of our differential diagnoses. Given the patient's absence of systemic symptoms (ex: fever) and absence of gallbladder obstruction on imaging, we considered acute cholecystitis a less likely cause of the patient's pain. These findings directed our differential diagnosis towards symptomatic cholelithiasis.

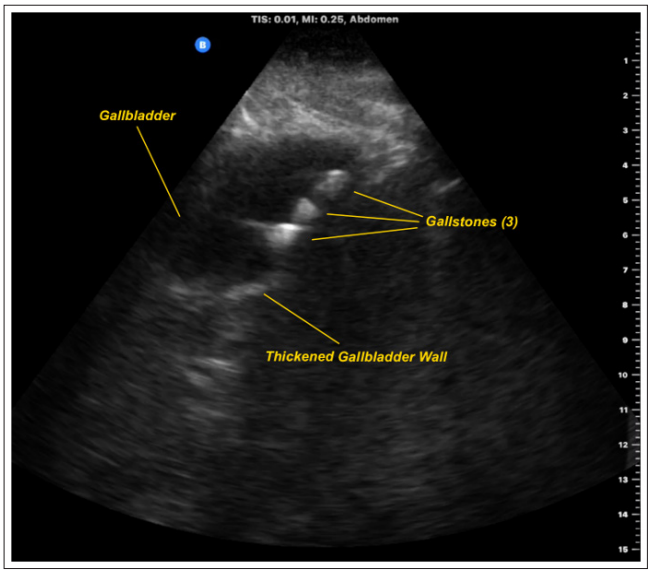

Figure 1: Labeled Capture of Gallbladder Scan

Results

Using symptomatic cholelithiasis as our primary diagnosis, we created a plan for the patient that included analgesics, patient education, and a referral. To address the patient's pain, she was prescribed ibuprofen and given her first dose while in the clinic. We were able to reassess her, as she was waiting for a family member to be evaluated in the clinic. We verified that her pain had improved after analgesic administration. She was then provided comprehensive patient education about her presenting symptoms, including dietary changes she could consider making to help alleviate some of her symptoms. Lastly, a referral to gastroenterology was set up at the closest regional referral center for anticipated cholecystectomy.

Discussion

This case highlights the utility of handheld POCUS in rural settings. It supports timely diagnosis, reduces barriers to care, and demonstrates potential to improve clinical decision-making in rural settings. Low-resource settings often require extensive diagnostic capability from mobile healthcare clinics such as this one, but they can also be a difficult setting to practice medicine. The lack of laboratory and imaging diagnostics may restrict the provider's assessment of a patient's symptoms, as these modalities allow physicians to more accurately rule in or out pathology with relative confidence. Further, patients from low-resource settings often lack the amenities to get testing and lab work done. They also face social barriers, including the cost of diagnosis, transportation requirements, potential loss of income or scrutiny from missing work, and potentially taking on the additional cost of childcare.

For a one-time cost of an ultrasound probe, the Butterfly iQ3 demonstrates utility in enhancing the diagnostic capability in rural settings by allowing providers to rule out pathology and narrow down their differential diagnoses by considering other abdominal pathologies as less likely. The convenience of being able to do the scan at the patient's bedside eliminates travel time and secures faster diagnosis with greater confidence.

Limitations and Future Applications

- **Restricted follow-up:** due to the temporary nature of our clinic operations, there was no follow up with the patient after her referral to see what the outcome was.
- **Sample size:** this commentary is a single case report, limiting the generalizability of this study to more populations. Combined with the limited follow-up, we are unable to establish a causal relationship between the utility of handheld POCUS and improved outcomes of biliary disease.
- **Lack of training:** for the utility of ultrasound in these settings, it requires trained individuals to be present to conduct the ultrasound studies and interpret the findings. In this case, the presence of ultrasound-trained medical students and supervising physicians allowed for the diagnosis of acute cholelithiasis; however, in the absence of trained individuals, a clinic may not be able to conduct ultrasound studies to assist with bedside diagnosis.
- **Image Quality:** handheld probes usually have decreased image quality compared to larger, higher-resolution models with reduced portability. In emergent situations, the handheld probes may miss something diagnostic due to the image quality; however, this does not decrease their value in supplementing traditional physical exams and history taking when diagnosing patients in low-resource environments.

Studies have demonstrated improved health outcomes from ultrasound as a diagnostic modality for biliary disease. Others have linked ultrasound to rural or emergency environments, but there is little research connecting POCUS, biliary disease, and rural settings together, highlighting the need for further exploration. This research supports purchases of handheld ultrasound probes as another diagnostic tool, not unlike stethoscopes, for temporary healthcare operations. This study also facilitates discussion around the need for more extensive ultrasound training for healthcare providers to help expedite the assessment process. All this can lead to improved patient outcomes in low-resource settings and provide greater access to those who need it most.

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