



Original Contribution

Utilization of ultrasound for the evaluation of small bowel obstruction: A systematic review and meta-analysis



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ABSTRACT

Introduction: Small bowel obstruction (SBO) is a common presentation to the Emergency Department (ED). While computed tomography (CT) is frequently utilized to confirm the diagnosis, this modality is expensive, exposes patients to radiation, may lead to time delays, and is not universally available. This study aimed to determine the test characteristics of ultrasound for the diagnosis of SBO.

Methods: PubMed, CINAHL, Scopus, the Cochrane Database of Systematic Reviews, and the Cochrane Central Register of Controlled Trials were assessed for prospective trials evaluating the accuracy of ultrasound for the detection of SBO. Data were double extracted into a predefined worksheet and quality analysis was performed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool.

Results: This systematic review identified 11 studies comprising 1178 total patients. Overall, ultrasound was found to be 92.4% sensitive (95% CI 89.0% to 94.7%) and 96.6% specific (95% CI 88.4% to 99.1%) with a positive likelihood ratio of 27.5 (95% CI 7.7 to 98.4) and a negative likelihood ratio of 0.08 (95% CI 0.06 to 0.11).

Discussion: The existing literature suggests that ultrasound is a valuable tool in the diagnosis of SBO with a sensitivity and specificity comparable to that of CT. Ultrasound may save time and radiation exposure, while also allowing for serial examinations of patients to assess for resolution of the SBO. It may be particularly valuable in settings with limited or no access to CT. Future studies should include more studies in the Emergency Department setting, comparison of probe choices, and inclusion of more pediatric patients.

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1. Introduction

Small bowel obstruction (SBO) is a common Emergency Department (ED) diagnosis, which has been estimated to comprise 2% of all patients presenting with abdominal pain and result in 300,000 hospitalizations per year [1,2]. Small bowel obstruction occurs due to an impedance in the normal flow of intestinal contents, most commonly due to a mechanical obstruction or functional bowel etiology. The failure to diagnose a small bowel obstruction in a timely manner can result in significant complications. These include, but are not limited to, bowel ischemia, necrosis, and perforation [3]. Due to the ease of accessibility, plain film radiography (x-ray) is usually the initial imaging choice by practitioners for the evaluation of SBO. However, this imaging modality

is often non-diagnostic and has poor sensitivity and specificity [4]. Consequently, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound have been utilized as alternative diagnostic modalities for confirming the diagnosis of SBO [5,6].

While many practitioners utilize CT as the primary diagnostic tool for identifying SBO, CT is expensive, time-consuming, and exposes patients to high doses of radiation. Additionally, many locations may not have access to CT imaging. Therefore, researchers have increasingly investigated the utility of ultrasound for the diagnosis of SBO. This may have value in both the initial diagnosis, as well as serial assessments for resolution of the SBO, while saving time and reducing total radiation exposure to the patient.

We conducted a systematic review and meta-analysis to determine the diagnostic accuracy of ultrasound to detect small bowel obstruction. We hypothesized that ultrasound would be highly accurate in the detection of small bowel obstruction when compared with the gold standard as defined by the study. We also performed secondary analyses by study location (e.g. Emergency Department versus non-Emergency

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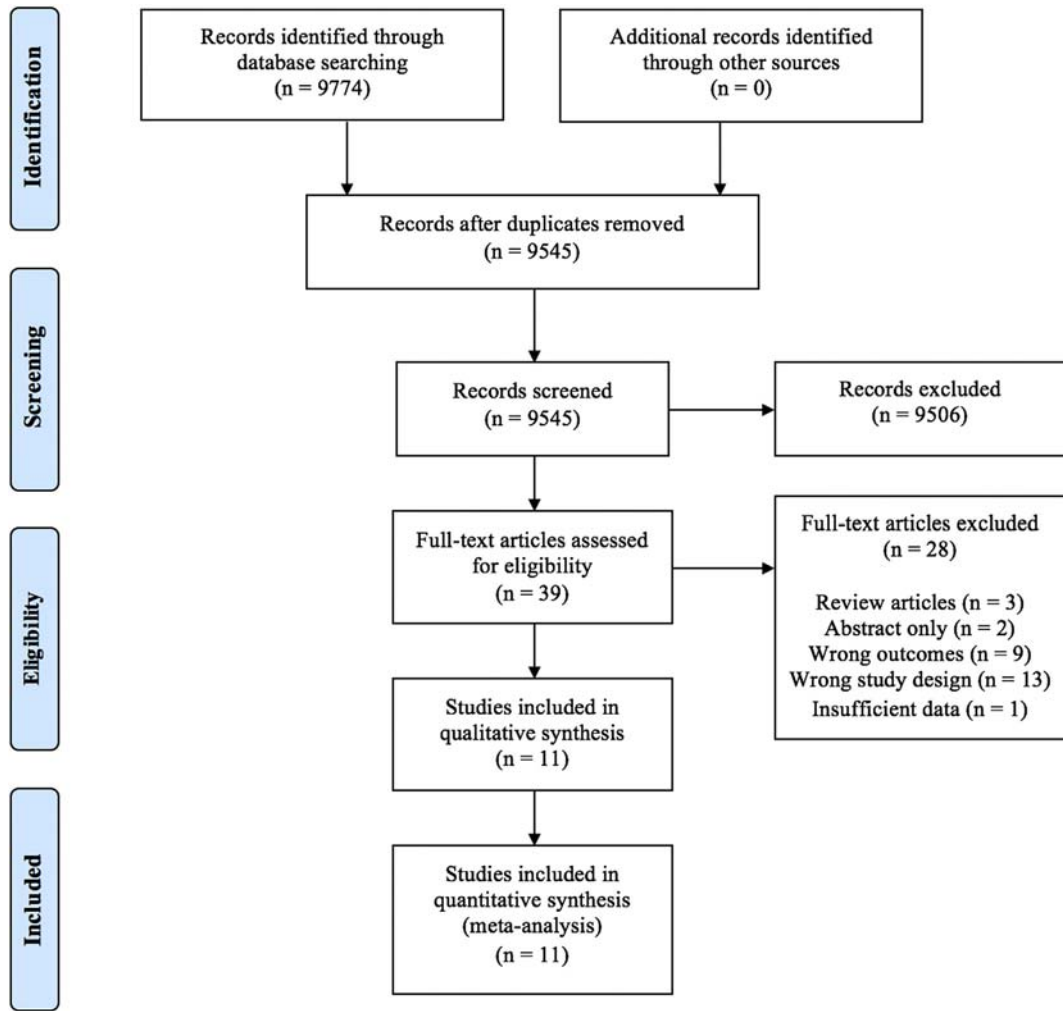


Fig. 1. PRISMA flow diagram.

Department) and sonographer type (e.g. Emergency Physician versus non-Emergency Physician).

2. Materials and methods

This protocol (#56555) was registered with and is available for review at the PROSPERO website (<https://www.crd.york.ac.uk/PROSPERO/>). Our study conforms to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for systematic reviews and was performed in accordance with best practice guidelines [7,8]. In conjunction with a medical librarian, we conducted a search of PubMed, CINAHL, Scopus, the Cochrane Database of Systematic Reviews, and the Cochrane Central Register of Controlled Trials to include citations from inception to March 17, 2017. Details of the search strategy are included in Appendix A. We reviewed the bibliographies of identified studies and review articles for potential missed articles. We also consulted with topic experts to help identify any further relevant studies.

Inclusion criteria consisted of all prospective, observational and randomized, controlled trials assessing the accuracy of ultrasound for detecting small bowel obstruction with sufficient data to develop a two-by-two table for sensitivity and specificity calculations. The gold standard was determined by the study definition, which included computed tomography (CT), enteroclysis, surgical diagnosis, discharge diagnosis, or clinical follow up. Exclusion criteria included retrospective studies, case series, and studies published in abstract format only.

Only articles written in languages spoken fluently by study authors (i.e., English or Spanish) were included. Prenatal assessments were also excluded. Two physician-investigators independently assessed studies for eligibility based upon the above criteria. All abstracts meeting initial criteria were reviewed as full manuscripts. Studies determined to meet the eligibility criteria on full text review by both extractors were included in the final data analysis. Any discrepancies were resolved by consensus with a third investigator.

2.1. Data collection and processing

Two physician-investigators independently extracted data from the included studies. The investigators underwent initial training and extracted data into a pre-designed data collection form. The following information was abstracted: last name of the first author, study title, publication year, total study population size, study country, study location, mean patient age, gender distribution, ultrasound machine, ultrasound probe type, ultrasound training protocol, ultrasound criteria for the diagnosis of small bowel obstruction, gold standard for diagnosis, generation of CT scanner (if applicable), study design, true positives, true negatives, false positives, false negatives, and number of indeterminate ultrasound scans. Studies were independently assessed for quality by two separate physician-investigators utilizing the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool. Any discrepancies were resolved by consensus with a third investigator.

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