What Is the Diagnostic Accuracy of Point-of-Care Ultrasonography in Patients With Suspected Blunt Thoracoabdominal Trauma?

TAKE-HOME MESSAGE

In patients with blunt trauma, a positive point-of-care ultrasonography result can identify thoracoabdominal injury with high specificity; however, a negative point-of-care ultrasonography result has inadequate sensitivity to reliably exclude injury.

METHODS

DATA SOURCES

Authors searched Ovid MEDLINE, PubMed, Ovid EMBASE, and the BIOSIS database from inception to July 15, 2017; evaluated reference lists of included studies for additional articles; and searched Google Scholar for additional studies.

STUDY SELECTION

Authors identified prospective or retrospective diagnostic cohort studies enrolling patients with blunt trauma (defined as any nonpenetrating force) to the abdomen or chest who underwent point-of-care ultrasonography as the primary imaging modality to screen for thoracoabdominal injuries and received predefined reference standard confirmatory testing: computed tomography (CT) scan, magnetic resonance imaging (MRI), laparotomy or laparoscopy, thoracotomy, or autopsy. Two authors independently assessed studies for eligibility and resolved disagreements through discussion with a third author.

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This review does not reflect the views or opinions of the US government, Department of Defense or its components, US Army, US Air Force, or SAUSHEC EM Residency Program.

Jestin N. Carlson, MD, MS, and Alan Jones, MD, serve as editors of the SRS series.

Editor's Note: This is a clinical synopsis, a regular feature of the *Annals'* Systematic Review Snapshot (SRS) series. The source for this systematic review snapshot is: **Stengel D, Leisterer J, Ferrada P, et al. Point-of-care ultrasonography for diagnosing thoracoabdominal injuries in patients with blunt trauma (review). Cochrane Database Syst Rev. 2018;12:CD012669.**

Results

Point-of-care ultrasonography performance in thoracoabdominal trauma.

Population	No. of Studies (No. of Patients)	Sensitivity (95% CI)	Specificity (95% CI)	LR+ (95% CI)	LR– (95% CI)
Overall	34 (8,635)	0.74 (0.65–0.81)	0.96 (0.94–0.98)	18.5 (10.8–40.5)	0.27 (0.19–0.37)
Adults/ mixed patients	24 (7,251)	0.78 (0.69–0.84)	0.97 (0.96–0.99)	—*	—*
Pediatric patients	10 (1,384)	0.63 (0.46–0.77)	0.91 (0.81–0.96)	6.9 (2.5–18.8)	0.42 (0.26–0.65)

LR+, Positive likelihood ratio; *LR–*, negative LR.
*LRs not reported within the Cochrane review for this patient population.

Authors included 34 studies (8,635 patients) from an initial 2,872 publications. The setting for half of the studies was the United States. Twenty-two studies were prospective, 10 were retrospective, 1 was

DATA EXTRACTION AND SYNTHESIS

Two authors independently used predefined standard procedures to extract data, and a third author resolved discrepancies. Authors then pooled data to estimate the diagnostic accuracy of point-of-care ultrasonography for detecting thoracoabdominal injury, including free fluid in the thoracic or abdominal cavity, retroperitoneum, pericardium, or mediastinum; organ injury (eg, splenic, other solid organ, hollow viscera, other organ laceration); vascular lesion (eg, dissection or rupture of aorta or other vessels); and other injuries (eg, pneumothorax).[1] Authors calculated sensitivity and specificity with 95% confidence intervals (CIs), positive and negative likelihood ratios, positive predictive value, negative predictive value, and the summary receiver operating characteristic (ROC) curve. Two authors independently used the Quality Assessment of Diagnostic Accuracy Studies–2 tool to assess methodological quality of studies.[2] Authors assessed heterogeneity visually by inspecting the coupled forest plots and plots of study results in the summary ROC curve space; they also assessed for possible sources of heterogeneity by adding single covariates to the bivariate random-effects model. Authors performed subgroup analyses based on patient age, reference standard (single CT versus CT plus laparotomy), injury anatomic location (abdominal versus thoracic), and injury pattern (free fluid or air only versus free fluid or air in addition to organ and vascular lesions). They conducted sensitivity analyses based on study risk of bias, the variable accuracy of imaging interpretation as reported by studies in which multiple investigators interpreted each study, and patient age.

cross-sectional, and 1 was a cross-sectional validation study. Ten studies included only pediatric and adolescent patients, 2 included only adults, and 22 enrolled patients of all ages. Four studies evaluated thoracic trauma only. CT was the reference standard in 25 studies, and 7 studies used a combination of CT and laparotomy. Point-of-care ultrasonography demonstrated a sensitivity of 0.68 (95% CI 0.59 to 0.75) and specificity of 0.95 (95% CI 0.92 to 0.97) for abdominal trauma (Table). Sensitivity was 0.96 (95% CI 0.88 to 0.99) and specificity was 0.99 (95% 0.97 to 1.00) for thoracic trauma. For pediatric patients, point-of-care ultrasonography demonstrated lower sensitivity and specificity than for adults. Significant heterogeneity was present, and poor reporting in patient selection and reference standard domains limited judgment concerning bias. Only 5 studies had low risk of bias in all domains.

Commentary

Trauma is a significant cause of morbidity and mortality, with injuries to the thoracoabdominal region a major contributor to poor outcomes.[3,4] Patients with blunt trauma typically undergo diagnostic imaging because findings on physical examination are not sensitive or specific for diagnosing injury.[5] Although CT is considered the imaging test of choice in trauma, point-of-care ultrasonography can be performed during the initial patient evaluation and resuscitation and may expedite surgical intervention when results are positive. Use of point-of-care ultrasonography is particularly valuable for hemodynamically unstable patients or for those for whom radiation is harmful.[5-7] It may also be useful for triaging CT in the setting of limited resources and imaging capabilities. However, false-positive and -negative findings can potentially limit the utility of this modality for guiding further patient evaluation and management.

This meta-analysis sought to determine the diagnostic accuracy of point-of-care ultrasonography for detecting thoracoabdominal injury from blunt trauma.[1] Results suggest that positive point-of-care ultrasonography findings can guide treatment decisions with a specificity of 0.96 and may help to reduce the need for additional imaging during trauma assessment, specifically for thoracic trauma. However, for abdominal trauma and for pediatric trauma patients, negative point-of-care ultrasonography results do not exclude injuries (sensitivity of 0.68 and 0.63, respectively); hence, patients with negative point-of-care ultrasonographic examination results require further evaluation for injury. With a virtual population of 1,000 adult patients with median prevalence or pretest probability of thoracoabdominal injury of 28% as a basis, point-of-care ultrasonography would miss 73 injuries and yield false-positive findings for 29 patients. In a population of 1,000 pediatric patients with a median prevalence or pretest probability of 31%, point-of-care ultrasonography would miss 118 injuries and yield false-positive results for 62 patients.

Limitations of this meta-analysis include significant clinical variation across included studies in regard to patient and point-of-care ultrasonography factors, and there

was marked heterogeneity in regard to diagnostic accuracy estimates calculated across these studies. Studies differed in regard to point-of-care ultrasonography operator experience, training, and specialty. There were also differences in point-of-care ultrasonography probe and machine types. Many of the included studies were older and may have included operators with less point-of-care ultrasonography training and experience, as well as poor machine quality. These factors can significantly affect point-of-care ultrasonography accuracy. Original study underreporting impeded assessment of methodological quality of included studies, and only 2 studies described handling of inconclusive results.[8,9] Risk of bias was unclear in more than half of the studies in regard to patient selection and reference standard. All studies used CT alone or in combination with other reference tests. Authors restricted reference standards to predefined imaging or invasive testing; however, they were unable to evaluate diagnostic accuracy of point-of-care ultrasonography compared with MRI, laparoscopy, thoracotomy, or thoracoscopy as the single reference standard.

According to results of this meta-analysis, point-of-care ultrasonography can identify thoracoabdominal injury with high specificity in patients with blunt trauma. However, negative point-of-care ultrasonography results require further evaluation and monitoring in both adult and pediatric trauma patients. Further data are required to characterize the diagnostic accuracy of point-of-care ultrasonography based on operator experience and on probe and machine type, and in settings in which CT is not available.

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