Section: General Surgery

Original Research Article

A STUDY OF THE ACCURACY OF DIAGNOSTIC ABDOMINAL PARACENTESIS IN SURGICAL EMERGENCIES

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Received *: 20/09/2025*
Received in revised form *: 05/11/2025*
Accepted *: 23/11/2025*

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DOI: 10.70034/ijmedph.2025.4.327

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (4); 1827-1832

ABSTRACT

Background: Abdominal emergencies require prompt diagnosis for their management. Diagnostic abdominal paracentesis (DAP) is one of the simple, rapid, and low-cost bedside tools in such cases. However, its accuracy in modern surgical practice remains to be explored. The current study aimed to evaluate the accuracy and clinical utility of DAP in surgical emergencies.

Materials and Methods: This prospective study was conducted in the department of General Surgery on 60 patients with suspected intra-abdominal pathology. DAP was performed using ultrasound guidance or blindly, depending on the case. The estimation of aspirate volume, characteristics, and diagnostic yield was studied and recorded. Sensitivity, specificity, positive predictive value, and accuracy were calculated and analyzed.

Results: DAP procedure results in successful aspiration in 86.7% of cases. It was mostly hemorrhagic, purulent, bilious, and of feculent aspirates, indicating the underlying pathology. Sensitivity and specificity were 8% and 95.5%, respectively, with an accuracy of 90% in the cohort. Patients experienced only minimal complications, including hematoma formation in 3.3% of cases. DAP expedited laparotomy in 82.4% of positives and avoided unnecessary surgery in 15%. False negatives were mainly due to dry taps or small-volume collections.

Conclusion: DAP is a safe, effective, and accurate diagnostic tool in the surgical abdominal emergency. It improves prompt decision-making, decreases unnecessary laparotomies, and is especially useful in resource-constrained settings. Ultrasound guidance also enhances the diagnostic yield and safety of ultrasound.

Keywords: Diagnostic Abdominal Paracentesis, Intra-abdominal pathology, Abdominal trauma, Laparatomies.

INTRODUCTION

Abdominal emergencies are a very common cause of surgical admissions and, in most cases, are clinically difficult because of the overlapping clinical features. However, it is important to diagnose these conditions quickly and accurately because delay can increase the risk of morbidity and mortality. Diagnostic abdominal paracentesis (DAP) is a simple, relatively non-invasive, and inexpensive procedure that has been used over the decades in the medical and surgical field to assess patients with possible intra-abdominal pathology.[1] Paracentesis is the process in which peritoneal fluid, typically from the lower abdominal quadrant, is aspirated percutaneously and followed by analysis of its biochemical, cytological, and microbiological parameters. It has mainly been used in the field of hepatology to assess ascites, especially in cirrhosis and malignancy.[2] Its use in surgical emergencies, such as blunt abdominal trauma or penetrating abdominal trauma, spontaneous bacterial peritonitis, and perforation of hollow viscus and intra-abdominal bleeding, is being studied increasingly.[3] The rapidity of paracentesis in bedside reporting is particularly beneficial in resource-limited settings where newer imaging modalities may not be easily accessible. In trauma, diagnostic peritoneal aspiration (or a variant of paracentesis) was a diagnostic modality used to detect the presence and location of hemoperitoneum

before the introduction of focused assessment with sonography for trauma (FAST) and computed tomography (CT) scans.[4] Although in most centers it has been superseded by modern imaging, it still has a role to play in emergency and rural hospitals where ultrasound or CT is not easily available. Here, the triage of patients can be addressed by means of paracentesis to make a decision on an urgent laparotomy.[5] DAP is useful in non-traumatic surgical emergencies, such as the presence of bile-stained aspirate, which could be due to gastrointestinal perforation. The presence of feculent material indicates colonic perforation. Similarly, hemorrhagic aspirates indicate ruptured ectopic pregnancy, splenic injury, or intra-abdominal bleeding because of other causes.[6] Microbiological cultures of ascitic fluid can confirm the diagnosis of peritonitis, and they can also guide the institution of appropriate antimicrobial therapy.[7] These results support the clinical usefulness of DAP as a point-of-care in the acute surgical environment. The accuracy of DAP is subject to multiple parameters, such as the experience of the operator, the quantity of fluid that is aspirated, the location of aspiration, and a prompt laboratory examination of the aspirate.[8] Research has demonstrated that paracentesis is capable of high sensitivity and specificity in identifying intra-abdominal pathology when used with clinical findings.[9] The complications are relatively low, and bleeding, infection, and visceral perforation are rare when the procedure is performed with care.[10] Since the burden of surgical emergencies in developing countries is increasing, there is a growing interest in evaluating the diagnostic accuracy and utility of DAP. It is particularly useful where radiological investigations are not easily assessable and DP can provide a rapid, inexpensive, reliable alternative to treat potentially life-threatening abdominal emergencies.[11]

Following the increasing surgical emergency load in low- and middle-income nations, the interest in assessing the quality and usefulness of DAP as a diagnostic tool reemerges. DAP can offer a quick, cheap, and dependable way of identifying or ruling out potentially life-threatening conditions in the abdomen in settings where radiological investigation may not be available.[11] This research paper endeavors to determine the diagnostic accuracy of abdominal paracentesis in the case of surgery emergencies, and this will give credence to a stronger position of the diagnostic tool as a first-line diagnostic tool in acute care surgery. The current study was designed to evaluate the diagnostic accuracy of abdominal paracentesis in surgical emergencies, with assessment of its role as a diagnostic modality in the surgical unit.

MATERIALS AND METHODS

This prospective study was conducted in the Department of General Surgery, Dr Patnam Mahendar Reddy Institute of Medical Sciences, Hyderabad, Telangana. Institutional Ethical approval was obtained for the study. Written consent was obtained from all the participants of the study after explaining the nature of the study in the vernacular language. The study protocol adhered to STARD principles for diagnostic accuracy studies. Consecutive patients with an acute abdomen or suspected intra-abdominal pathology were selected for the study.

Inclusion Criteria

1. Age ≥18 years.
2. Males and females
3. Intra-abdominal, where DAP can influence immediate management, such as blunt/penetrating abdominal trauma, suspected hollow viscus perforation, spontaneous bacterial peritonitis in unstable patients, and unexplained acute abdominal distension with suspected hemorrhage.
4. Informed consent was obtained from the patient or a legally authorized representative.

Exclusion Criteria

1. Overt generalized peritonitis in a hemodynamically stable patient scheduled directly for imaging/surgery, where DAP would not alter management.
2. Localized skin infection at the puncture site.
3. Uncorrected coagulopathy with INR >2.0 or platelet count <50,000/μL (unless treating team-approved procedure).
4. Known pregnancy with planned obstetric management.
5. Refusal of consent.

A total of 60 patients were enrolled consecutively during the period of the study based on the inclusion and exclusion criteria. This pilot diagnostic cohort size (n=60) was chosen to provide precise estimates of sensitivity and specificity (expected precision ±10–12%) and to allow preliminary subgroup analyses (trauma vs non-trauma).

All patients underwent standard clinical assessment (history, examination), baseline laboratory evaluation, and imaging as indicated (upright chest/abdominal radiograph, FAST ultrasound, contrast CT when feasible). The reference standard for diagnosing clinically significant intra-abdominal pathology was defined hierarchically as follows: (1) operative findings at laparotomy/laparoscopy (gold standard), (2) contrast-enhanced CT evidence of bowel perforation, active intra-abdominal hemorrhage, or abscess requiring intervention, or (3) clinical course within 7 days demonstrating an outcome consistent with intra-abdominal pathology (e.g., progressive sepsis requiring operative management, confirmed spontaneous bacterial peritonitis by culture and PMN count). Reference-standard assessment was performed by clinicians blinded to the final DAP interpretation, where possible. Paracentesis technique and specimen handling: DAP was performed at the bedside by a surgical consultant following a standardized protocol. After aseptic preparation and local anesthesia,

aspiration was attempted from the lower quadrant (usually the right lower quadrant) using a 14–18 G needle and 20–50 mL syringe. If free fluid was not obtained by blind aspiration and FAST ultrasound identified a pocket, ultrasound-guided aspiration was performed.

Recorded procedural details: site, method (blind vs ultrasound-guided), volume aspirated, gross appearance (clear, cloudy/purulent, bilious, feculent, hemorrhagic), and immediate complications.

Aspirate was sent immediately for:

1. Macroscopic description (blood, bile, feces, turbid).
2. Cell counts (total nucleated cells, differential; PMN count).
3. Biochemistry: protein, glucose, amylase, and bilirubin.
4. Microbiology: Gram stain and aerobic/anaerobic culture.
5. Hematocrit of aspirate if hemorrhagic (to estimate hemoperitoneum).

A positive DAP was prespecified as the presence of any of the following: grossly bloody aspirate with aspirate hematocrit >5% or gross hemoperitoneum, bile-stained or feculent fluid, purulent/turbid fluid, or cell count indicative of infection (PMN ≥250 cells/mm³) or culture positive for pathogenic organisms. A negative DAP was the absence of free fluid or retrieval of clear, low-cellular transudative fluid not meeting the above criteria. All procedures followed institutional infection control and safety protocols. Procedural complications (bleeding, visceral injury, infection) were recorded and managed per standard care.

Statistical analysis: All the available data were standardized as per case forms and entered in an MS Excel spreadsheet and analyzed by SPSS version 26 in Windows format. Continuous variables are presented as mean ± SD or median (IQR) as appropriate; categorical variables are presented as counts and percentages. Diagnostic performance of DAP was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), likelihood ratios, and their 95% confidence intervals. Categorical variables were calculated with the square test, and a two-sided p <0.05 was considered statistically significant.

RESULTS

[Table 1] shows the baseline characteristics of the study cohort. A critical analysis of the table shows that the median age of the population was 52 years, and the range was 38 – 67 years. Patients with standard findings were younger, with a median age of 48 years, as compared to those with intra-abdominal pathology, with a median age of 61 years. Overall, the cohort included 58.3% males and a higher proportion of positive findings in them, 63.2%. Blunt abdominal trauma was found in 25% of cases, while suspected perforated viscus was found in 30% of cases. Spontaneous peritonitis was found in 20%. Shock unexplained distension was in 16.7% of cases. Final diagnoses confirmed by laparotomy (53.2%) or CT (10%) accounted for all positive cases. While all negative cases (36.7%) were resolved through clinical course, highlighting the heterogeneity of presentations.

Table 1: Baseline Characteristics of the Study Cohort (N=60)

Characteristic	Overall (N=60)	Reference Standard Positive (n=38)	Reference standard negative (n=22)
Age (years) median [IQR]	52 [38 - 67]	48 [35 - 62]	61 [49 – 74]
Male sex n (%)	35 (58.3)	24 (63.2)	11 (50.0)
Clinical Presentation n (%)			
Blunt Abdominal Trauma	15 (25.0)	12 (31.6)	3 (13.6)
Penetrating Abdominal Trauma	5 (8.3)	5 (13.2)	0 (0.0)
Suspected Perforated Viscus	18 (30.0)	14 (36.8)	4 (18.2)
Suspected Spontaneous Bacterial Peritonitis	12 (20.0)	5 (13.2)	7 (31.8)
Unexplained Shock / Distension	10 (16.7)	2 (5.3)	8 (36.4)
Final Reference Standard Diagnosis n (%)			
Laparotomy findings	32 (53.2)	32 (84.2)	0 (0.0)
CT Diagnosis	6 (10.0)	6 (15.8)	0 (0.0)
Clinical course	22 (36.7)	0 (0.0)	22 (100.0)

The procedural aspects of DAP are summarized in [Table 2]. Aspiration was successful in 52/60 (86.7%), all failures being in blind procedures, and ultrasound guidance provided universal success. The quality of the fluid was of diagnostic value: hemorrhagic (34.6%) could indicate hemoperitoneum, purulent/turbid (23.1%), bilious (15.4%), and feculent (7.7%) aromas were a strong indicator of infection or perforation. In 19.2% of cases, clear serous fluid was found. The middle aspirate was 25 mL. There were a few complications (3.3%), two minor hematomas, and no visceral injuries were reported. It proves that DAP is safe and effective, specifically when ultrasound-guided.

Table 2: Procedural Details and Complications of Diagnostic Abdominal Paracentesis (DAP)

Parameter	Overall (N=60)	Successful Aspiration (n=52)	Dry Tap (r=8)
Method of Aspiration n (%)			
Blind	45 (75.0)	37 (71.2)	8 (100.0)
Ultrasound-Guided	15 (25.0)	15 (28.8)	0 (0.0)
Gross Appearance of Aspirate (n=52) n (%)			
Hemorrhagic	18 (34.6)		
Purulent / Turbid	12 (23.1)		
Bilious	8 (15.4)		
Feculent	4 (7.7)		
Clear / Serous	10 (19.2)		
Volume Aspirated (mL), median [IQR] 25 [15 – 40]			
Complications n(%)	2 (3.3)		
Minor hematoma	2 (3.3)		
Visceral injury	0 (0.0)		

[Table 3] gives the performance of abdominal paracentesis for the accuracy of DAP. Sensitivity was 86.8% (95% CI: 72.7- 94.3), showing the high rate of detection of true positives. The specificity was higher at 95.5% (95% CI: 78.2–99.8), which showed that the low false positive rates. The positive predictive values were 97.1% and the negative predictive value was 80.8% which were strong for clinical utility. The likelihood ratios also confirmed a strong diagnostic utility (positive LR = 19.1; negative LR = 0.14). Overall, the accuracy was 90%. Dry taps were considered negative tests, which reduced the sensitivity slightly. These findings establish DAP as a reliable diagnostic tool for intra-abdominal pathology, especially in resource-limited emergency settings.

Table 3: Diagnostic Performance of Abdominal Paracentesis for Significant Intra-Abdominal Pathology

Diagnostic Measure	Value (%)	95% Confidence Interval
Sensitivity	86.8	(72.7 - 94.3)
Specificity	95.5	(78.2 - 99.8)
Positive Predictive Value (PPV)	97.1	(85.1 - 99.9)
Negative Predictive Value (NPV)	80.8	(61.9 - 91.9)
Positive Likelihood Ratio	19.1	(2.7 - 134.1)
Negative Likelihood Ratio	0.14	(0.06 - 0.31)
Overall Accuracy	90.0	(79.9 - 95.3)
*Performance calculated considering dry taps (n=8) as a negative test result.		

[Table 4] depicts values of DAP against the Reference Standard. A critical analysis of the table showed that out of 60 patients, 33 were true positives and 21 were true negatives, yielding strong agreement. The single False Positive was a patient with cirrhotic ascites and a high cell count but negative cultures whose condition resolved with antibiotics, adjudicated as a negative reference standard. The five False Negatives included three dry taps in patients with small-volume hemoperitoneum and two patients with isolated hollow viscus perforations with initially non-diagnostic aspirates. This highlights the point that while DAP is highly accurate, its diagnostic yield may be limited by small fluid volumes or atypical presentations.

Table 4: Cross-Tabulation of Diagnostic Abdominal Paracentesis (DAP) Results Against the Reference Standard

	Reference Standard Positive	Reference Standard Negative	Total
DAP Positive	33 (True Positive)	1 (False Positive)	34
DAP Negative	5 (False Negative)	21 (True Negative)	26
Total	38	22	60

[Table 5] shows the impact of DAP on Clinical Management. Nearly half the cohort (46.7%) underwent emergency laparotomy based on positive aspirates, highlighting its role in rapid decision-making. In addition, empiric antibiotics were initiated in 25% of patients, although only a minority (11.8%) of these had positive aspirates. Importantly, DAP prevented unnecessary laparotomy in 9 cases (15%), where negative aspirates supported conservative management. In only 13.3% did the test not alter the method of management. The median time to decision-making was 45 minutes overall, and only 35 minutes among DAP-positive cases, underscoring its effectiveness in accelerating critical surgical decisions.

Table 5: Impact of Diagnostic Abdominal Paracentesis on Clinical Management

Impact on Management	All Patients (N=60) n (%)	DAP Positive (n=34) n (%)
Expedited Decision for Laparotomy	28 (46.7)	28 (82.4)
Initiation of Empiric Antibiotics	15 (25.0)	4 (11.8)
Avoided Unnecessary Laparotomy	9 (15.0)	0 (0.0)
No Change in Management Plan	8 (13.3)	2 (5.9)
Time to Decision (minutes) median [IQR]	45 [30 - 75]	35 [25 - 50]

DISCUSSION

The current study was designed to evaluate the diagnostic accuracy and clinical utility of diagnostic abdominal paracentesis (DAP) in cases with suspected abdominal emergencies presenting to the surgical unit. Overall, our findings show that DAP was a safe, rapid, and effective procedure, and the diagnostic accuracy of DAP was about 90% which had a considerable impact on the decision of patient management, particularly in deciding to approach surgically or put on conservative treatment. The baseline characteristics of our cohort showed that a substantial number of cases were younger patients and had standard reference findings. The older group of patients was more likely to have abdominal pathologies. This distribution demonstrates that age-related comorbidities may exist in elderly patients, and unexplained distension and spontaneous bacterial peritonitis can mimic surgical pathology. Studies in this field have previously found that diagnostic uncertainty in older patients is common because of overlapping clinical features at presentation. [12,13] In this study, we found the overall success of DAP aspiration was high at 86.7% of cases. Most notable was the fact that all the negative aspirations were in cases where blind procedures were carried out. This showed that ultrasound-guided paracentesis increased the success rates. This demonstrates the importance of point-of-care imaging in raising the yield of procedures. Previous studies also observed that ultrasound-guided paracentesis can lead to a considerable decrease in the risk of dry taps and a higher quality of diagnosis, particularly in patients with low-volume ascites or loculated collections. [14,15] In addition, there were only two small hemorrhages, which supports the idea that DAP is a safe procedure provided that it is done with proper precautions. The diagnostic accuracy of our study was compared to other similar studies done in the past. The sensitivity (86.8%) and specificity (95.5%) were within the range of previously reported values for DAP in trauma and infectious peritonitis. [16-18]

The large PPV (97.1) indicates that positive aspirate is almost always associated with clinically significant intra-abdominal pathology, whereas the slightly lower NPV (80.8) indicates a possibility of false negatives in cases with little fluid or isolated hollow viscus perforations. False negatives were mainly caused by dry taps and non-diagnostic aspirates in cases of perforation, which is consistent with previous findings that DAP is safest in the presence of adequate free fluid. [19,20] Cross-tabulation with the reference standard found that there was only one false positive in a cirrhotic patient with sterile high-cell fluid. This underlines a weakness in DAP: the inability to distinguish between sterile inflammatory exudates and infectious or traumatic ones. However, the overall diagnostic yield is low, and thus such misclassifications are infrequent. Among the clinically most important outcomes of our research, perhaps, we should mention the significant effect of DAP on decision-making. Almost half of the patients (46.7%) received expedited laparotomy directly due to positive aspirates, and unnecessary laparotomy was prevented in 15% of negative results. In addition, median decision-making time decreased in DAP-positive cases to as little as 35 minutes, which highlights the importance of this bedside test when dealing with emergency surgical pathways. Previous descriptions of trauma sites and resource-restricted settings also highlighted the idea that prompt paracentesis can reduce time to intervention, lower morbidity, and maximize resource utilization. [21-23] Overall, our research findings support that DAP is an economical diagnostic modality in the cases of surgical emergencies. Although not without limitations (especially in situations with small or focal fluid), its safety, speed, and precision ensure it forms a foundation of early decision-making, particularly in resource-limited settings where optimal imaging might not be right away. The future studies should be directed at incorporating DAP with universal ultrasound guidance and its predictive value in conjunction with biochemical investigations of aspirates.

CONCLUSION

Diagnostic abdominal paracentesis (DAP) is a safe, quick, and relatively accurate procedure in the assessment of abdominal surgical emergencies. It was also found to be very sensitive, specific, and accurate with fewer complications in this study. DAP had a great influence on clinical management through faster decision-making of surgical operations, the use of antibiotics, and the prevention of unnecessary laparotomies. Despite the observed cases that had false negatives in cases of small-volume or loculated collections, the use of ultrasound guidance enhanced the success of the procedure. Being an easy and effective method of work, with cost-effectiveness and diagnostic accuracy, DAP is a valuable procedure that should be used at the bedside, especially in a resource-constrained environment, and be part of the first steps of patient management in case of suspected intra-abdominal pathology.

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