Section: Radiology

Original Research Article

CLINICAL SPECTRUM AND OUTCOMES OF ULTRASOUND-GUIDED INTERVENTIONS IN A TERTIARY CARE CENTER

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ABSTRACT

Background: Ultrasound (USG)-guided interventions have revolutionized minimally invasive diagnostic and therapeutic procedures by enabling real-time visualization, improving accuracy, and reducing complication rates. USG guidance improves overall clinical results, diagnostic yield, and procedural safety as compared to blind procedures. The purpose of this study was to assess the complication profile, technical success, clinical range, and diagnostic sufficiency of USG-guided treatments carried out in a tertiary care hospital.

Materials and Methods: This retrospective observational study was conducted in the Department of Radiology at MGM Medical College, Chhatrapati Sambhajinagar, Maharashtra, over a one-month period (01 July 2025 to 31 July 2025). Included were 122 patients who had different diagnostic and therapeutic treatments guided by USG. Hospital records were used to gather information on demographics, procedure type, technical success, diagnostic yield, and complications. Results were evaluated in terms of complication rates, diagnostic sample adequacy, and procedure success.

Results: Among 122 patients, 55.7% were males and 44.3% were females, with an age range of 1–82 years. Pleural tapping was the most commonly performed procedure (32.8%), followed by thyroid FNAC (13.9%), breast biopsy (9.8%), and lymph node FNAC (9.0%). Technical success was achieved in 99.2% of cases, with a diagnostic yield of 95.1%. No complications were observed in 93.5% of patients. Minor complications occurred in 6.5% of cases, predominantly localized pain (62.5%) and minor bleeding (37.5%). No major complications or mortality were reported.

Conclusion: High technical success, superior diagnostic reliability, and low complication rates are all demonstrated by USG-guided procedures. According to these results, they are safe, efficient, and considered standard practices in tertiary healthcare settings.

Keywords: Ultrasound-guided interventions, Minimally invasive procedures, Diagnostic yield, Technical success rate, Complication profile.

INTRODUCTION

Ultrasound (USG)-guided interventions have significantly transformed the landscape of minimally invasive diagnostic and therapeutic procedures across multiple medical specialties. Ultrasonography's real-time imaging capacity improves procedure accuracy and safety by precisely localizing vascular systems, fluid collections, pathological lesions, and other anatomical landmarks. Because of its mobility, absence of ionizing radiation, affordability, and capacity to offer dynamic vision of needle placement, ultrasound guidance has grown to be a crucial part of interventional radiology and bedside operations during the past several decades.[1,2]

Historically, surface anatomical features and clinical judgment were used to blindly execute a variety of treatments, including pleural tapping, ascitic tapping, abscess drainage, and even biopsies. Despite being

widely used, these blind procedures have a number of drawbacks and a higher risk of complications. Pneumothorax, hemothorax, hemoperitoneum, vascular damage, organ perforation, dry taps, repeated needle insertions, and infection were among the frequent side effects.[3,4] Blind ascitic tapping may need many efforts since the needle may not enter the fluid pocket, especially in situations of limited or loculated ascites. Such many punctures raise the danger of bleeding or intestinal perforation and provide more agony for the patient. The incorrect location of pleural fluid caused by blind pleural tapping can also result in lung damage or pneumothorax.[5]

Another instance where blind intervention may be dangerous is the placement of a chest pigtail catheter for empyema. Without imaging guidance, the catheter might damage intercostal arteries or accidentally reach the lung parenchyma, resulting in hemothorax or ongoing air leakage. On the other hand, ultrasound guidance minimizes problems by precisely determining the safest entrance location and enabling the identification of the liquid component of empyema.[6] The same idea holds true for percutaneous nephrostomy, percutaneous transhepatic biliary drainage (PTBD), and abdominal abscess drainage; in these procedures, real-time imaging guarantees the best route selection while avoiding important arterial structures and other organs.[7]

When compared to blind methods, USG-guided biopsies and fine needle aspiration cytology (FNAC) procedures also show better diagnostic yield and lower complication rates. Visualizing the lesion and verifying that the needle is positioned inside the target region improves sampling precision and reduces the number of insufficient specimens.[8] Additionally, by eliminating the need for many tries, ultrasound guiding shortens procedure times and enhances patient comfort. Due to the lack of real-time imagery, blind procedures are intrinsically more likely to result in complications. The operator only uses anatomical landmarks, which might differ from person to person or be skewed by medical conditions like obesity, ascites, or loculations. When compared to blind methods, studies have shown that ultrasound guiding dramatically lowers the risk of complications during thoracentesis, paracentesis, and central operations.[9,10] USG-guided operations are linked to low rates of significant complications and little morbidity when carried out by skilled operators under aseptic conditions.

Ultrasound guidance is becoming the norm for many interventional procedures in contemporary tertiary care practice. It increases overall clinical results in addition to safety and technical success. Since ultrasound guidance is used for a wide range of diagnostic and therapeutic procedures, it is crucial to assess the treatments' efficacy and complication profile in practical settings. Over the course of one month, the current study intends to assess the clinical spectrum, technical success rate, diagnostic yield, and consequences related to USG-guided treatments carried out in a tertiary care hospital.

MATERIALS AND METHODS

Study Design: The present study was conducted as a retrospective observational study**.**

Study Setting: The study was carried out in the Department of Radiology at MGM Medical College, Chhatrapati Sambhajinagar, Maharashtra, which is a tertiary care hospital.

Study Period: The study was conducted over a period of one month, from 01 July 2025 to 31 July 2025 (31 days).

Study Population: A total of 122 patients who underwent various ultrasound-guided procedures during the study period were included in the study population.

Inclusion Criteria

- Patients who underwent USG-guided procedures.
- Complete medical and procedural records available.

Exclusion Criteria

- Bleeding tendencies.
- Raised PT-INR.
- Patients on anticoagulant or antiplatelet drugs.

Procedures Included

- Abdominal pigtail catheter insertion
- Chest pigtail catheter insertion
- Percutaneous transhepatic biliary drainage
- Percutaneous nephrostomy
- Lung biopsy
- Liver biopsy
- Breast biopsy
- Aspiration
- FNAC
- Pleural tapping
- Ascitic tapping
- Prostate biopsy
- Suction and evacuation for missed abortion
- Check curettage for RPOC

Data Collection

Data were collected from hospital records including:

- Age and gender
- Indication for procedure
- Type of procedure
- Technical success
- Diagnostic adequacy
- Complications

Outcome Measures

1. **Technical Success:** Completion of procedure as planned.
2. **Diagnostic Yield:** Adequate sample for definitive diagnosis.

Complications: Classified as minor or major.

RESULTS

A total of 122 patients underwent ultrasound-guided procedures during the study period. Of these, there

was a small male majority, with 68 (55.7%) being male and 54 (44.3%) being female. Patients' ages ranged significantly from one year to eighty-two years, suggesting that ultrasound-guided therapies were carried out in all age categories, including adult, pediatric, and geriatric populations. This wide range of ages illustrates how adaptable and useful ultrasonic guiding is in a variety of therapeutic settings.

Table 1: Demographic Profile of Study Participants (N = 122)

Variable	Number (n)	Percentage (%)
Total Patients	122	100
Male	68	55.7
Female	54	44.3
Age Range	1–82 years	—

Table 2: Distribution of Ultrasound-Guided Procedures (N = 122)

Procedure	Number (n)	Percentage (%)
Pleural tapping	40	32.8
Thyroid FNAC	17	13.9
Breast biopsy	12	9.8
Lymph node FNAC	11	9.0
Abdominal pigtail (loculated ascites)	7	5.7
Chest pigtail catheter insertion	7	5.7
Ascitic tapping	7	5.7
Hepatic abscess pigtail	4	3.3
Prostate biopsy	4	3.3
Percutaneous nephrostomy	2	1.6
Lung biopsy	2	1.6
Breast abscess aspiration	2	1.6
PTBD	1	0.8
Liver biopsy	1	0.8
Hepatic abscess aspiration	1	0.8
Peripancreatic collection pigtail	1	0.8
Suction & evacuation / Check curettage	Included	—

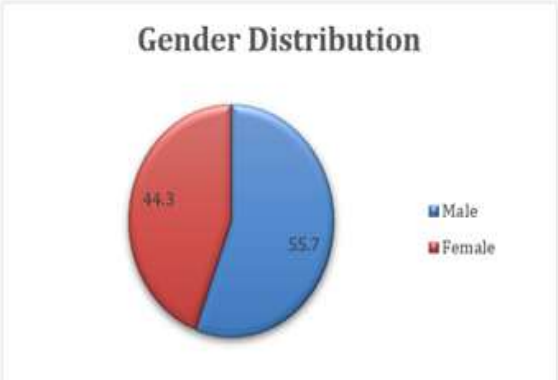

Figure 1: Gender Distribution

With 40 patients (32.8%), pleural tapping was the most common technique, underscoring the substantial burden of pleural effusion in the tertiary care context. 17 operations (13.9%) involved thyroid FNAC, 12 patients (9.8%) had breast biopsies, and 11 patients (9.0%) had lymph node FNAC. Seven patients (5.7%) had drainage treatments, including ascitic tapping, chest pigtail catheter insertion, and abdominal pigtail insertion for loculated ascites. Hepatic abscess pigtail (3.3%), prostate biopsy (3.3%), lung biopsy (1.6%), breast abscess aspiration (1.6%), percutaneous nephrostomy (1.6%), liver biopsy (0.8%), hepatic abscess aspiration (0.8%), and peripancreatic collection pigtail (0.8%) were among the other less frequently performed procedures. The study population also included suction and evacuation/check curettage procedures. The broad range of operations shows how ultrasonic guiding is becoming more and more important in both therapeutic and diagnostic treatments involving several organ systems.

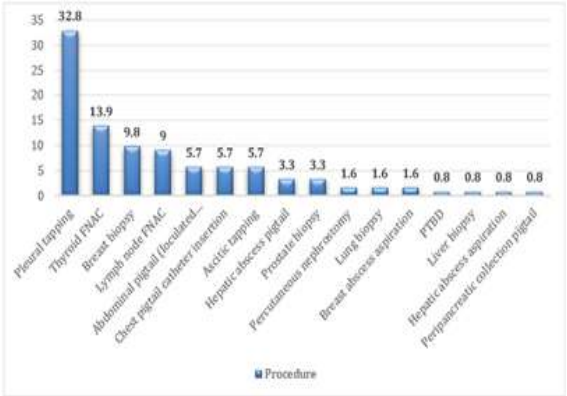

Figure 2: Distribution of Ultrasound-Guided Procedures.

Table 3: Overall Procedural Outcomes (N = 122)

Outcome Parameter	Number (n)	Percentage (%)
Technical Success	121	99.2
Technical Failure	1	0.8
Adequate Diagnostic Yield	116	95.1
Inadequate Sample	6	4.9

Only one case (0.8%) resulted in technical failure out of 122 procedures, with 121 cases (99.2%) achieving technical success. Six instances (4.9%) produced insufficient samples, whereas 116 cases (95.1%) had satisfactory diagnostic output. These results show that ultrasound-guided procedures have a very high success rate and great diagnostic reliability.

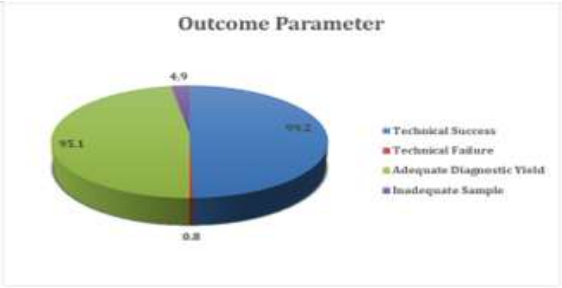

Figure 3: Procedural Outcomes.

Table 4: Complication Profile (N = 122)

Complication Type	Number (n)	Percentage (%)
No Complications	114	93.5
Minor Complications	8	6.5
Major Complications	0	0
Mortality	0	0

The vast majority of patients (114; 93.5%) had no problems. There were no serious problems or procedure-related deaths recorded, however 8 patients (6.5%) experienced minor issues.

Table 5: Distribution of Minor Complications (N = 8)

Type of Minor Complication	Number (n)	Percentage (%)
Localized pain	5	62.5
Minor bleeding (<10 cc)	3	37.5
Total Minor Complications	8	100

Localized discomfort was the most frequent mild consequence (5 instances; 62.5%), followed by small bleeding (less than 10 cc; 3 cases; 37.5%). Every minor issue resolved on its own without the need for significant action. All things considered, the findings show that ultrasound-guided procedures have a very low risk of complications, a high procedural success rate, and an outstanding diagnostic yield.

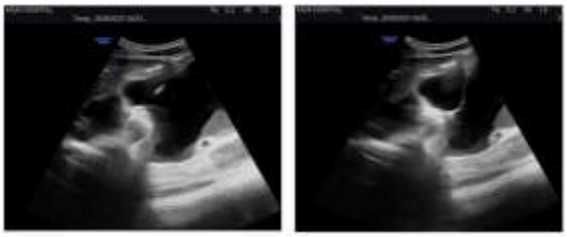

Image 1: USG guided abdominal pigtail catheter insertion for post-traumatic infected collection in epigastric region using over the wire or Seldinger technique

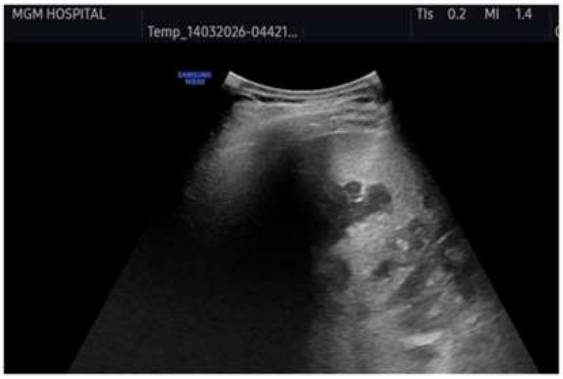

Image 2: USG guided pigtail catheter insertion for liver abscess

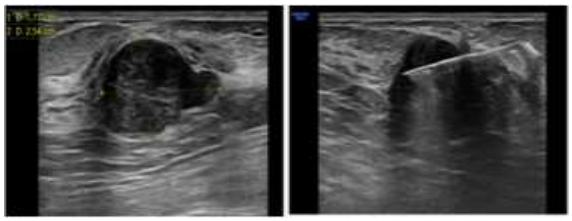

Image 3: USG guided Breast lesion biopsy using BARD max care biopsy gun

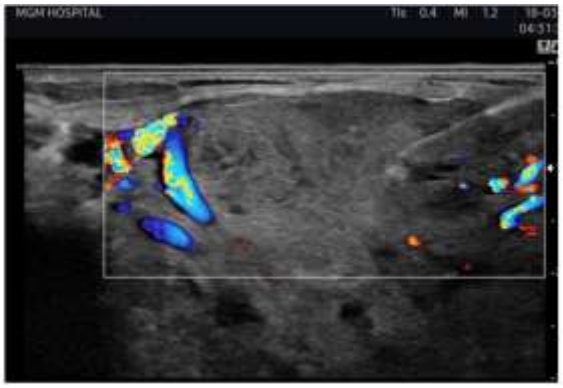

Image 4: USG guided FNAC of thyroid lesion safe guarding surrounding vessels

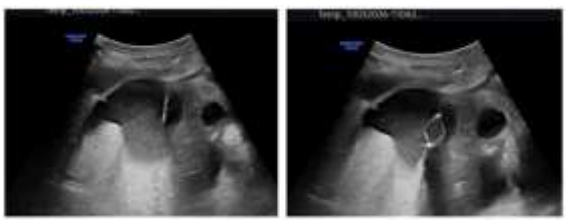

Image 5: USG guided malecot catheter insertion for thick, viscous and necrotic fluid collection as a sequele of necrotizing pancreatitis

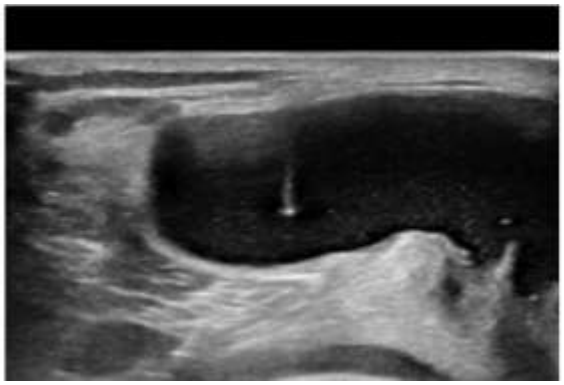

Image 6: USG guided neck abscess drainage

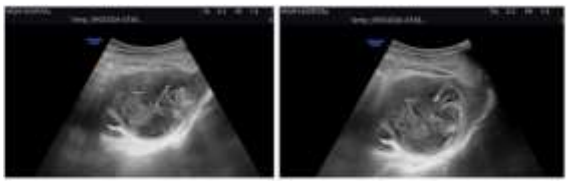

Image 7: USG guided chest pigtail catheter insertion for empyema

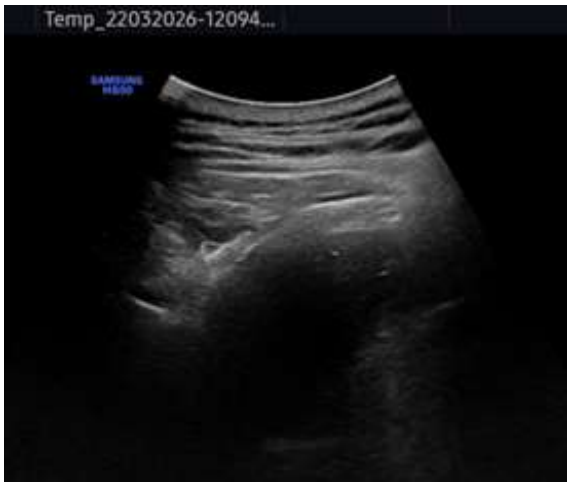

Image 8: USG guided pleural tapping

DISCUSSION

The present study evaluates the clinical spectrum and outcomes of ultrasound (USG)-guided interventions performed over a one-month period in a tertiary care center. A total of 122 procedures were analyzed, demonstrating excellent technical success, high diagnostic yield, and minimal complication rates. In accordance with current interventional ultrasonography recommendations and evaluations, the results provide strong support for the expanding role of USG-guided treatments as safe, efficient, and resource-efficient diagnostic and therapeutic tools.[1,2] The demographic distribution [Table 1] showed that patients ranged considerably in age from 1 to 82 years, with a little male majority (55.7%). This wide range of ages illustrates how adaptable USG-guided treatments are for use with children, adults, and senior citizens. The versatility and safety profile of ultrasound guiding, which have been highlighted in modern interventional radiology practice, are highlighted by the ability to carry out treatments safely across a range of age groups.[1]

Pleural tapping is the most often performed intervention (32.8%), followed by thyroid FNAC (13.9%), breast biopsy (9.8%), and lymph node FNAC (9.0%), according to the procedural distribution [Table 2]. A substantial burden of pleural effusion patients in the tertiary care context is suggested by the prevalence of pleural tapping. Compared to blind thoracentesis, ultrasound guidance has been demonstrated to dramatically lower the risk of pneumothorax and dry taps during pleural operations.[4,11] As evidenced by recent image-guided biopsy studies, the increased frequency of FNAC and biopsy procedures highlights the value of real-time imaging in enhancing sampling accuracy and lowering insufficient specimens.[8]

The usefulness of USG guidance is demonstrated by drainage methods such ascitic tapping (5.7%), chest pigtail insertion (5.7%), and abdominal pigtail insertion for loculated ascites (5.7%). Blind ascitic tapping is linked to pain for the patient, bowel perforation risk, and repetitive needle insertions, particularly in minor or loculated ascites. Safe needle trajectory planning and accurate fluid pocket identification are made possible by ultrasound. Similarly, precise entrance into the liquid component of empyema while avoiding the lung parenchyma and intercostal arteries is made possible by chest pigtail insertion performed under USG supervision. Research has repeatedly shown that using ultrasonic guidance during such drainage treatments improves procedural accuracy and reduces complication rates.[3,6]

Overall, the results of the procedure were quite positive [Table 3]. With just one technical failure and a 99.2% technical success rate, almost all processes were carried out as planned. Just 4.9% of the samples were insufficient, resulting in a diagnostic yield of 95.1%. This high yield is consistent with previous research and is the result of skilled operators, well-chosen patients, and real-time needle insertion visualization. Ultrasound guidance guarantees precise lesion targeting and higher adequacy rates than blind approaches, which are more likely to experience sampling mistakes and insufficient specimens.[5,12]

The safety profile of USG-guided procedures is further reinforced by the complication profile. [Table 4] indicates that 93.5% of patients had no problems. Crucially, neither serious problems nor death occurred, and only 6.5% experienced mild issues. The safety benefit of ultrasound guiding over blind methods is highlighted by the lack of serious adverse events such organ perforation, hemothorax, or substantial bleeding. When compared to landmark-based methods, meta-analyses have shown that image-guided surgeries dramatically lower major complication rates.[8,12]

Localized discomfort (62.5%) and mild bleeding less than 10 cc (37.5%) were seen among the minor effects [Table 5]. These didn't need much

management because they were self-limiting. There were no reports of pneumothorax, severe bleeding, or infection from the surgery. This low proportion of complications further confirms that USG-guided procedures are almost completely risk-free when carried out by skilled professionals under aseptic measures, as evidenced by recent safety data.[11] Ultrasound has a number of other benefits over procedures guided by CT or fluoroscopy. It avoids radiation exposure, lowers patient travel concerns (particularly for critically sick patients), is affordable, and enables bedside accessibility. These advantages are especially pertinent in environments with limited resources, when prompt decision-making and effective resource use are essential.[1,2]

Due to the lack of real-time imagery, blind procedures are intrinsically more likely to result in complications. Techniques based on anatomical landmarks may not work well in patients with loculated collections, deformed anatomy, or obesity. On the other hand, USG guidance enables ongoing needle advancement monitoring, nearby vascular structure identification, and catheter insertion confirmation. The available data clearly favors using ultrasound-guided methods wherever possible to replace blind procedures.[8,11]

The extension of USG-guided procedures in tertiary care facilities is encouraged by this study, especially in high-volume settings where procedural safety and effectiveness are crucial. Nonetheless, it is necessary to recognize some restrictions. The short period of one month could not accurately reflect long-term patterns, and the retrospective methodology restricts causal inference. Furthermore, the majority of the processes were operator-dependent, which might have an impact on generalizability. All things considered, the current study demonstrates that ultrasound-guided therapies are extremely effective, diagnostically accurate, and linked to little side effects. They can optimize healthcare resources and greatly enhance patient outcomes if they are adopted and expanded.

CONCLUSION

The present study demonstrates that ultrasound-guided interventions are highly effective, safe, and reliable procedures in a tertiary care setting. The versatility of ultrasound guiding was demonstrated during the one-month trial period by the effective completion of a broad range of diagnostic and therapeutic procedures across various age groups. Given the clinical burden of pleural effusion in tertiary institutions, pleural tapping became the most often performed operation. The accuracy and dependability of real-time ultrasound viewing are confirmed by the total technical success rate of 99.2% and diagnostic adequacy of 95.1%. Crucially, the risk of complications was low, with no significant problems or death and just 6.5% of mild issues. These results support the safety benefit of ultrasound guided over blind methods.

Real-time needle viewing, avoiding nearby critical structures, cost-effectiveness, bedside accessibility, and radiation-free operation are only a few advantages of ultrasound guiding. Its regular use greatly improves procedure efficiency and patient safety in high-volume tertiary care facilities. Consequently, wherever possible, ultrasound-guided procedures need to be regarded as the gold standard of care, especially in situations where the goal is to maximize therapeutic results while lowering procedural risks.

Limitations of the study

1. Because of the study's retrospective methodology, it was difficult to determine causal linkages.
2. Because the trial only lasted one month, it might not have captured long-term patterns or seasonal differences in procedural patterns.
3. Although sufficient, the sample size was restricted to a single tertiary care facility, which could have an impact on generalizability.
4. Operational success and complication rates could have been impacted by operator reliance.
5. There was a lack of long-term follow-up information on delayed problems or results.

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