

Outcomes of Percutaneous Ultrasound-guided Splenic Procedures: A Retrospective Observational Study from a Tertiary Care Centre in Southern India

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ABSTRACT

Introduction: Data on image-guided percutaneous procedures of the spleen are limited, particularly for infectious lesions.

Aim: To evaluate the complication rate of percutaneous ultrasound-guided splenic procedures.

Materials and Methods: A retrospective observational study was conducted in a tertiary care centre in Southern India. Data from all consecutive patients who underwent ultrasound-guided splenic procedures from January 2008 to October 2023 were analysed. Information was extracted from digital radiology reports, images, inpatient records, outpatient records and blood investigation reports. Complications were categorised according to standardised guidelines. Descriptive statistics for categorical data were reported. Pearson Chi-square test were used to assess associations between categorical variables. Statistical Package for the Social Sciences (SPSS) software version 21.0 was used.

Results: A total of 312 patients were included, with mean age of 42.2±15.8 years. Of these, 212 (68%) were males and

100 (32%) were females. There were 259 diagnostic procedures: 125 (40.1%) Fine Needle Aspiration Cytology (FNACs), 18 (5.8%) biopsies and 116 (37.2%) aspirations. Fifty-three procedures were therapeutic: 52 (16.7%) drainages, and 1 (0.3%) percutaneous injection of sclerosant. The overall complication rate was 22 in 312 patients (7.1%, with 95% CI of 4.7% to 10.4%). As per the Society of Interventional Radiology (SIR) Clinical Practice Guidelines classification, six patients (27.3%) had Category-A complications with small perisplenic haematomas, three patients (13.6%) had Category-B complications, 10 patients (45.5%) had Category-C complications and two patients (9.1%) had Category-D complications. One patient (4.5%) died during the postoperative period (Category-F complication). No patients had SIR Category-E complications.

Conclusion: Percutaneous ultrasound-guided procedures were safe and efficacious in this patient cohort, which predominantly consisted of individuals with infectious diseases and exhibited a low mortality rate.

Keywords: Complication rate, Postprocedural bleed, Spleen, Society of interventional radiology classification

INTRODUCTION

It can be challenging to diagnose and identify the aetiology of disorders of the spleen since splenic lesions could have varied presentations and causes. Disorders of the spleen can range from splenomegaly to focal or diffuse lesions. They may have congenital, traumatic, inflammatory, vascular, haematologic, or neoplastic causes, which cannot be reliably distinguished based on imaging features [1,2]. The diagnosis and treatment of splenic lesions, with splenectomy, can have significant complications [3]. Hence, diagnostic percutaneous image-guided interventions, such as FNAC, biopsy and percutaneous aspiration, along with therapeutic interventions such as drainage procedures, can play a crucial role in the management of splenic lesions. However, splenic procedures are less frequently performed, especially when there is multiorgan involvement, due to the high complication rates anticipated, particularly from haemorrhage [3]. Since procedures involving the spleen are not as common, literature on splenic interventions is scarce compared to those on interventions involving other solid organs [4-7].

A systematic review of image-guided splenic FNACs and biopsies revealed that the major complication rates following procedures performed on the spleen with 18G or smaller needles are comparable to those of biopsies from other solid organs, such as the liver or kidney [8]. Common complications include haemorrhage and pain, with rare instances of fatal outcomes. Other possible complications include injury to the left pleura, resulting in pneumothorax or pleural effusion,

and injury or perforation of the colon. Factors such as the number of needle passes during the procedure, size of the lesion, proximity to the splenic hilum, and preexisting coagulopathy are thought to be associated with higher complication rates [8]. However, safe parameters for these factors remain undefined. In terms of diagnostic and therapeutic utility, splenic FNACs and biopsies have shown a high diagnostic yield in patients with malignancies [8]. Splenic drainage procedures have a high success rate, ranging from 60 to 100% [9-11]. Splenic aspiration procedures have demonstrated a high diagnostic yield for infections in a study with a small sample size [12].

Existing literature predominantly focuses on splenic interventions performed by interventional radiologists, with an emphasis on oncology patients. The available data on splenic interventions mostly pertain to splenic FNACs and biopsies performed in patients with known or suspected malignancy [8,9,13]. Although splenic lesions from infectious causes are prevalent and relevant in tropical regions, including India, percutaneous splenic interventions among patients with suspected infectious diseases are not adequately represented in the literature. Consequently, there is limited understanding of complications and outcomes in these patients. Additionally, data on splenic drainage procedures and aspirations, commonly performed in cases of suspected splenic abscesses, are scarce.

To address this gap in research, enhance our understanding, and develop strategies for safe and effective splenic interventions, the

present study was conducted with an aim to evaluate the complication rate of percutaneous ultrasound-guided splenic procedures.

MATERIALS AND METHODS

This retrospective observational study was conducted at the Department of Radiology, Christian Medical College, a tertiary care hospital in Southern India. The study received approval from the institutional review board and ethics committee (Approval No: 11775, dated 07/01/2019).

Inclusion and Exclusion criteria: The study included all consecutive patients who underwent ultrasound-guided percutaneous splenic procedures between January 2008 and October 2023 and had documentation recorded on the Radiology Information System (RIS). There were no exclusion criteria. Data analysis was done in January 2024.

Data were retrieved from the RIS, and the inpatient and outpatient charts, blood investigation reports, radiology reports and images were reviewed. Records indicated that patients had been screened and accepted for splenic intervention, and informed consent for the procedure had been obtained. Preprocedural assessments, such as imaging, haemoglobin levels, platelet counts, bleeding parameters (Prothrombin Time or PT and activated Partial Thromboplastin Time or aPTT) and serum creatinine, had been done.

Periprocedural blood product transfusions had been administered as necessary in individuals with abnormal bleeding parameters. Blood products were transfused preprocedure in the following scenarios: patients with haemoglobin <8 gm/dL; patients on oral anticoagulants with prolonged PT and International Normalised Ratio (INR) >1.5; patients not on oral anticoagulants with PT prolonged >4 seconds above the upper range of normal; APTT above normal range with abnormal factor assay; platelet count <50,000.

Sedation and local anaesthesia had been administered before the procedure, with the patient typically in the lateral decubitus position. The procedures had been chosen according to the discretion of the attending radiologist using standard procedural techniques. All procedures, including diagnostic procedures such as FNAC, biopsy, and aspiration, as well as therapeutic interventions such as drainage and percutaneous injection of sclerosant, were performed under real-time ultrasound guidance. FNAC samples were collected by passing a needle ranging in size from 18G to 25G through the splenic lesion. A pathology technician confirmed sample adequacy during the procedure, and the samples were sent for cytology and, occasionally, culture sensitivity. Biopsies were obtained with an 18G needle using a co-axial technique. Aspiration procedures involved fluid aspiration from splenic lesions after a single needle pass. Aspirated fluid was sent for culture sensitivity analysis. For drainage procedures, according to the discretion of the radiologist, a 8F to 14F Malecot or Pigtail catheter was placed into a splenic abscess or collection using the Seldinger technique. Samples obtained were analysed for culture sensitivity.

After the procedure, patients had been admitted either to the ward as inpatients or to the day care ward for 24-hour observation as per routine care. Immediate postprocedural ultrasound screening of the abdomen was performed in all patients to detect complications such as haemorrhage. Repeat imaging was conducted when there were clinical concern during the postprocedural observation period or subsequent hospital visits.

Based on comprehensive patient evaluations, including the microbiological cultures and histopathological evaluations available, the final diagnoses were recorded and complications were categorised according to the SIR Clinical Practice Guidelines [14,15].

The primary outcome measure was the complication rate. The occurrence and severity of complications were evaluated following these procedures and management of these complications were also assessed.

STATISTICAL ANALYSIS

Descriptive statistics, including mean and standard deviation for continuous data and number of patients and percentages for categorical data, were reported. The complication rate was presented as numbers with percentages and 95% confidence intervals. The Pearson Chi-square test was used to assess associations between categorical variables. All tests were two-sided, and the level of significance was set at $\alpha=0.05$. Statistical analyses were performed using SPSS software Version 21.0 (Armonk, NY: IBM Corp).

RESULTS

A total of 312 patients were included in the study, of whom 212 (68%) were males and 100 (32%) were females. The mean age was 42.2 ± 15.8 years. Preprocedural imaging was available in 311 cases, revealed that 248 (79.7%) of the patients had multifocal involvement of the spleen, 59 (19%) had focal involvement, and 4 (1.3%) had diffuse involvement. The mean size of the spleen was 13.4 ± 2.9 cm.

Of the 312 procedures performed, 259 (83%) were diagnostic, and 53 (17%) were therapeutic. They included 125 (40.1%) FNACs, 18 (5.8%) biopsies, 116 (37.2%) aspirations, 52 (16.7%) drainages, and one (0.3%) percutaneous injection of sclerosant [Table/Fig-1].

Parameters	n (%)
Age in years, mean (range)	42.2 (3-79)
Sex	
Male	212 (68)
Female	100 (32)
Indication for intervention	
Splenic lesion for evaluation	149 (47.8)
Splenic abscess	153 (49)
Splenic cyst	8 (2.6)
Splenomegaly	2 (0.6)
Types of procedures performed	
FNAC	125 (40.1)
Biopsy	18 (5.8)
Aspiration	116 (37.2)
Drainage	52 (16.7)
Percutaneous injection of sclerosant	1 (0.3)
Blood transfusion prior to procedure	
	37 (12)
Number of needle passes made	
Less than or equal to 2	36 (12)
3-5	76 (24)
Data not available	200 (64)
Size of needle used	
18G	18 (5.8)
22G	118 (37.8)
23G	1 (0.3)
24G	3 (1)
25G	1 (0.3)
Data not available	171 (54.8)

[Table/Fig-1]: Demographic characteristics, indications and types of procedures performed.
*FNAC: Fine needle aspiration cytology

The final diagnosis, based on comprehensive patient evaluations, including the microbiological cultures and histopathological evaluations available, was infection in 199 (63.8%) patients, malignancy in 27 (8.7%) patients, and other pathologies such as cysts, haemangioma, haematoma, infarct, and sarcoidosis in 21 (6.7%) patients. Sixty-five patients (20.8%) remained undiagnosed [Table/Fig-2].

Of the 199 patients with a final diagnosis of infection, 95 (47.7%) underwent aspiration, 52 (26.1%) had FNACs, 46 (23.1%) had

drainage procedures, and 6 (3%) had biopsies. The diagnostic yield, defined as positive culture-sensitivity reports, was 49 (51.6%) for aspiration, 17 (32.7%) for FNAC, 34 (73.9%) for drainage procedures, and 3 (50%) for biopsies.

Diagnosis	n (%)
Infections	199 (63.7)
Tuberculosis	53 (17)
Splenic abscess- pyogenic	51 (16.3)
Splenic abscess- unknown	45 (14.4)
Melioidosis	42 (13.5)
Splenic abscess- fungal	6 (1.9)
Malaria	1 (0.3)
Leishmaniasis	1 (0.3)
Malignancy	27 (8.6)
Non Hodgkin's lymphoma	15 (4.8)
Hodgkin's lymphoma	9 (2.9)
Leukaemia	1 (0.3)
Splenic metastasis	2 (0.6)
Others	21 (6.7)
Cyst	6 (1.9)
Infarct	6 (1.9)
Haemangioma	4 (1.3)
Haematoma	1 (0.3)
Hereditary spherocytosis	1 (0.3)
Systemic lupus erythematosus	1 (0.3)
Haemophagocytic lymphohistiocytosis	1 (0.3)
Sarcoidosis	1 (0.3)
Not diagnosed	65 (20.8)

[Table/Fig-2]: Final diagnosis.

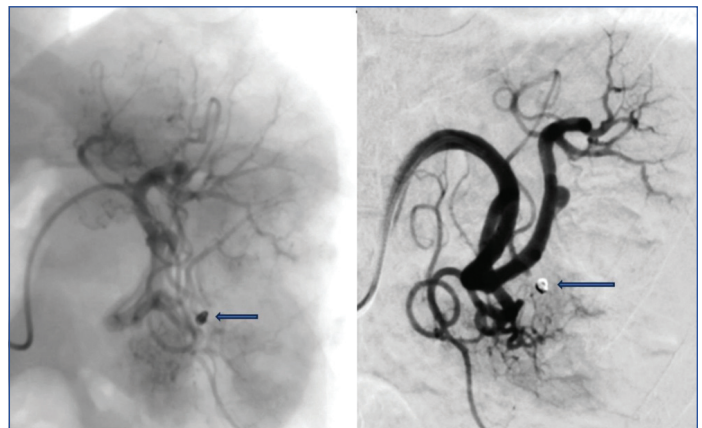
Of the 27 patients with malignancy, two (7.4%) underwent aspiration, 16 (59.2%) had FNACs, 8 (29.6%) had biopsies, and 1 (3.7%) had a drainage procedure. Eight (50%) of the 16 FNACs were diagnostic. For the remaining eight patients, diagnoses were made based on splenectomy (three patients), lymph node biopsy (two patients), bone marrow biopsy (two patients), and splenic biopsy (one patient). Seven of the eight biopsies performed (87.5%) were diagnostic. The eighth patient needed a splenectomy for diagnosis. The combined diagnostic yield of FNACs and biopsies in patients with malignancy was 62.5% (15 out of 24 cases). Both aspiration procedures were non diagnostic, with negative culture reports, likely performed on necrotic lesions. The patient who underwent a drainage procedure for suspected splenic abscess was found to have high-grade lymphoma.

Of the 52 splenic drainage procedures, 41 (78.8%) were therapeutic, while 11 were not successful and required alternative procedures such as splenectomy (n=5) or repeat guided drainages (n=4). In one patient, the catheter had to be removed due to pneumothorax in the immediate postprocedure period, and repeat drainage was not done. Splenectomy and peritoneal wash were advised for one patient with persistent intra-abdominal collection. This patient was later lost to follow-up. Percutaneous aspiration followed by injection of sclerosant was performed in a patient with a splenic cyst. Hence, the overall success rate of therapeutic procedures was 79.2% (42 of 53 cases).

Twenty-two out of 312 patients developed complications. The overall complication rate was 7.1% (95% confidence interval, 4.7% to 10.4%). As per the SIR Clinical Practice Guidelines classification, the complication rate following diagnostic procedures was 6.9% (18 out of 259), and that following therapeutic procedures was 7.5% (4 out of 53).

Six out of 22 patients with complications (27.3%) had Category-A complications, which included small peri-splenic haematomas that did not require therapy. Three patients (13.6%) had Category-B complications, meaning they had no significant consequences but required nominal therapy. One patient with a Category-B complication experienced immediate postprocedural hypotension and recovered with intravenous fluids. The second patient had unexplained breathlessness, which improved with oxygen therapy for a short duration. The third patient developed minimal left pneumothorax, which resolved immediately after catheter removal and required no further intervention.

Ten patients (45.4%) had complications that needed therapy or hospitalisation for under 48 hours (Category-C): nine patients required postprocedural blood transfusions, and one patient had pneumothorax requiring oxygen therapy. Two patients (9.1%) needed therapy and were hospitalised for over 48 hours (Category-D). One of these patients developed pseudo-aneurysm of a branch of the splenic artery post-procedure and required coil embolisation [Table/Fig-3]. The other patient developed peritonitis after a splenic abscess was drained and required emergency laparotomy and washout. One patient (4.5%) developed haemoperitoneum after splenic FNAC, required emergency splenectomy, and died during the postoperative period (Category-F complication). There were no patients with SIR Category-E complication noted. Overall, the most common complication encountered was postprocedural bleeding.



[Table/Fig-3]: Pre and post embolisation Digital Subtraction Angiography (DSA) images of a patient who developed splenic artery pseudoaneurysm post ultrasound guided procedure.

The mortality rate due to complications among patients who underwent image-guided percutaneous splenic interventions was 0.3% (1 in 312 cases). The complication rate and category according to the procedure performed are shown in [Table/Fig-4].

Procedure	Major complications (SIR Category-C to F) Number (percentage)	Minor complications (SIR Category-A and B) Number (percentage)	Total number (percentage)
FNAC (125 cases)	6 (4.8%)	2 (1.6%)	8 (6.4%)
Biopsy (18 cases)	0	0	0
Aspiration (116 cases)	5 (4.3%)	5 (4.3%)	10 (8.6%)
Drainage (52 cases)	2 (3.8%)	2 (3.8%)	4 (7.7%)
Percutaneous injection of sclerosant (1 case)	0	0	0

[Table/Fig-4]: Major and minor complications following splenic procedures.

*FNAC: Fine needle aspiration cytology

There was no significant association between the occurrence of complications and sex of the patient, type of procedure performed, multifocal or unifocal involvement of the splenic parenchyma, final diagnosis, size of needle used, number of needle passes made during the procedure, type or size of catheter used in drainage procedure, or preprocedural blood transfusion [Table/Fig-5].

Variables	Complication- No	Complication- Yes	p-value
Gender	Male- 195 (92%)	17 (8%)	0.331
	Female- 95 (95%)	5 (5%)	
Procedure performed	Aspiration- 107 (92.2%)	9 (7.8%)	0.852
	FNAC- 116 (92.8%)	9 (7.8%)	
	Drainage- 48 (92.3%)	4 (7.7%)	
	Biopsy- 18 (100%)	0	
	Sclerosant injection- 1 (100%)	0	
Involvement of the spleen	Multifocal- 230 (92.7%)	18 (7.3%)	0.271
	Focal- 56 (94.9%)	3 (5.1%)	
	Diffuse- 3 (75%)	1 (25%)	
Blood transfusion prior to procedure	No- 256 (93.1%)	19 (6.9%)	0.734
	Yes- 34 (91.9%)	3 (8.1%)	
Number of needle passes	Two or less- 33	3	0.384
	Three to five- 73	3	
Final diagnosis	Infection- 187	12	0.484
	Malignancy- 25	2	
	Others- 19	2	
Culture report (n=276)	Negative- 159	13	0.569
	Positive- 98	6	
Type of catheter used in drainage procedure (n=52)	Malecot- 11	1	1.000
	Pigtail- 37	3	
Size of catheter used in drainage procedure (Fr) (n=52)	8F- 14	0	0.417
	10F- 12	2	
	12F- 21	2	
	14F- 1	0	
Size of needle used (Gauge)	18G- 18	0	0.700
	22 G- 110	8	
	23G- 1	0	
	24G- 3	0	
	25G- 1	0	

[Table/Fig-5]: Association of occurrence of complications: Cross-tabulation. Chi-square test was used

DISCUSSION

In this study, 199 patients who underwent image-guided percutaneous procedures of the spleen had infectious lesions, while 27 patients had malignant lesions. Among the patients with malignancies, the combined diagnostic yield of splenic FNACs and biopsies was 62.5%. The diagnostic yield of biopsies was significantly higher than that of FNACs in present study. Civardi G et al., reported similar diagnostic yields for splenic FNACs and biopsies, except in the diagnosis of splenic lymphoma, where core needle biopsies were found to be more effective. Most of the cases included in this study had a final diagnosis of malignancy (215 out of 398 patients) [7]. Cavanna L et al., reported 45 out of 46 splenic biopsies (98%) yielding sufficient sample for diagnosis in patients with lymphoma [16]. Suzuki T et al., reported sufficient yield of sample in eight cases (100%) of splenic biopsies in patients with non Hodgkin's lymphoma [17]. In a study involving 52 cases, Gómez-Rubio M et al., reported similar diagnostic accuracy of FNAC and core needle biopsy, except for lymphomas, where the accuracy of FNACs was lower than that of biopsies [18]. The diagnostic yield of splenic FNACs was 50%, which was significantly lower than that reported (62.8% to 88.9%) when using 20-22G needles [6,7,19]. This could also be due to the varying expertise of the radiologist performing the procedure, as the skill of the operator performing the FNACs significantly affects the diagnostic efficiency [7].

In patients with infections, splenic aspirations had a diagnostic yield of 51.6% (49 cases), which was significantly lower than that reported in a previous study where the causative agent could be isolated from all the samples obtained from image-guided aspirations performed

in five patients with splenic abscesses. The total sample size of that study was seven patients [12]. The lower yield could also be a result of administering antibiotic therapy prior to the procedure or because, for most patients, molecular tests to diagnose rarer aetiologies were not performed. Culture sensitivity performed on samples collected from drainage procedures had a higher diagnostic yield than samples from aspiration, FNAC, or biopsy. This might be because drainage procedures, which are performed on larger abscesses or collections, are easier to sample.

The overall complication rate following ultrasound-guided splenic procedures was 7.1% (95% CI: 4.7% to 10.4%), which was higher than the pooled overall complication rate of 4.2% (95% CI: 1% to 15.5%) reported in a meta-analysis [8]. The overall complication rates reported following ultrasound-guided splenic procedures vary widely, from 0.5 to 62.5%, in this meta-analysis. This is likely due to the heterogeneity in the reporting of postprocedural complications in the previous studies. In present study, major complications (SIR Category-C, D, E, and F) accounted for 4.1% of cases, while minor complications (SIR Category-A and B) were observed in 2.9% of cases. A previous study records minor complications of bleeding in 8.2% of patients following splenic biopsies and major complications in 1.6% [20].

Since present study was performed in a teaching institution, complications seen could be attributed to the widely varying expertise of the attending radiologists, ranging from trainees to experienced interventional radiologists. The effect of the experience of the radiologist performing the procedure on the complication rate could not be evaluated in this study because of its retrospective design. The lack of standardised postprocedural follow-up protocols contributes to the varying complication rates reported in literature. The complication rates in present study could also have been influenced by the differences in postprocedural monitoring techniques. More number of minor complications may have been picked up in present study due to vigilant postprocedural monitoring and a low threshold for ultrasound screening in the hospital.

The complication rates in present study were slightly higher for therapeutic procedures (7.5%) than for diagnostic procedures (6.9%). This could be related to differences in the preprocedural clinical status of the patients, with those requiring therapeutic interventions usually being sicker. The mortality rate in this study (0.3%) was comparable with that following ultrasound-guided biopsies of other solid organs like the liver [21].

A prospective study with standardised postprocedural monitoring, including postprocedural pain scores and ultrasound screening at regular intervals, would help ascertain minor, asymptomatic, or mildly symptomatic postprocedural complication rates more accurately. Defining the indications for ultrasound screening after discharge will enable consistency across centres and could allow for more accurate comparisons of complication rates across studies in the future. A targeted study evaluating the association between the experience of the radiologist performing the procedure and the rate of postprocedural complication would be of value, especially in teaching institutes. Assessment of the association between the time interval from the initiation of antibiotic therapy to when the splenic samples were obtained and the diagnostic yield of culture sensitivity and additional molecular tests for rarer aetiologies would be of value to assess the impact of antibiotics on the diagnostic yield in patients with infections.

Limitation(s)

Being a retrospective study, data that were not mentioned in the patient records or radiology reports could not be accessed. As this was an observational study spread over a period of 15 years, with procedures done by interventional radiology consultants and

trainees, uniform protocol for patient selection, procedural technique, or follow-up could not be followed. The complication rates could have been underestimated in this study, as only those thought to be clinically significant during the postprocedural monitoring would have been recorded. The effect of the experience of the radiologist performing the procedure on the complication rates could not be evaluated.

CONCLUSION(S)

Percutaneous ultrasound-guided procedures were found to be safe and efficacious in this patient cohort with predominantly infectious diseases, with a low mortality rate. The most common complication encountered was postprocedural bleeding.

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