

Retrospective Evaluation of Complications and Outcomes in Image-Guided Biopsy Procedures

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Abstract:

Background: Image-guided biopsy has become an essential diagnostic tool in modern medicine for obtaining tissue samples with high accuracy and minimal invasiveness. Percutaneous liver biopsy remains a key procedure for diagnosing various liver diseases, including fibrosis, cirrhosis, and malignancy. Despite its diagnostic importance, concerns regarding procedure-related complications continue to exist.

Methods: This retrospective observational study was conducted in the Department of Radiology of Sadar Hospital, Lakhisarai, Bihar and Sonoscan Pvt. Ltd, Malda, West Bengal, India. over a period of 7 months. A total of 120 patients who underwent elective percutaneous liver biopsy were included in the study. Data were collected from hospital medical records and radiology databases. Patient demographics, hematological parameters (platelet count, INR, aPTT), imaging modality used, needle size, and number of biopsy passes were recorded. Procedure-related complications were documented and categorized as minor or major adverse events. Statistical analysis was performed using appropriate software, and associations between variables were assessed using relevant statistical tests with significance set at $p < 0.05$.

Results: The mean age of patients was 46.2 ± 13.5 years, with a slight male predominance (56.7%). Ultrasound guidance was used in most procedures (73.3%). Most patients (93.3%) did not experience any complications. Minor complications occurred in 4.2% of cases, while major complications were observed in 2.5% of patients. Bleeding and pain were the most common complications reported.

Conclusion: Percutaneous liver biopsy is a safe and effective diagnostic procedure with a low complication rate when performed with proper imaging guidance and careful patient evaluation.

Keywords: Bleeding risk, Diagnostic radiology, Imaging-guided biopsy, Liver diseases, Patient safety, Percutaneous liver biopsy, Procedure-related complications.

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Introduction

Image-guided biopsy has become an essential diagnostic procedure in modern medicine, allowing clinicians to obtain tissue samples from suspicious lesions with a high degree of accuracy and minimal invasiveness [1]. Over the past few decades, advances in imaging technologies such as ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) have significantly improved the precision of biopsy procedures [2]. These techniques enable radiologists to visualize internal structures in real time or through detailed cross-sectional images, thereby facilitating accurate needle placement into target lesions. As a result, image-guided biopsies are widely used for the diagnosis of tumors, infections, inflammatory conditions, and other pathological abnormalities affecting various organs including the liver, lung, kidney, bone, and soft tissues [3].

Traditionally, surgical biopsy was considered the standard method for obtaining tissue samples. However, surgical procedures are often associated with higher costs, longer recovery time, and increased risk of complications [4]. In contrast, image-guided biopsies are minimally invasive, relatively safe, and can often be performed on an outpatient basis. These procedures reduce patient discomfort and shorten hospital stay while still providing reliable diagnostic information. Because of these advantages, image-guided biopsy has become the preferred method for tissue diagnosis in many clinical settings [5].

Despite its numerous benefits, image-guided biopsy is not completely free from risks. Complications may occur during or after the procedure, depending on factors such as the biopsy site, patient condition, needle size, and imaging modality used [6]. Common complications include bleeding, infection, pain

at the biopsy site, hematoma formation, and injury to surrounding structures [4]. In certain procedures, such as lung biopsies, pneumothorax is one of the most frequently reported complications. Although most complications are minor and manageable, some cases may require additional medical intervention or monitoring. Therefore, understanding the frequency and pattern of complications associated with image-guided biopsies is important for improving patient safety and clinical outcomes [7].

In addition to evaluating complications, assessing the outcomes of image-guided biopsies is equally important. Successful biopsy procedures provide adequate tissue samples that allow accurate histopathological diagnosis, which is essential for guiding appropriate treatment decisions [8]. The diagnostic yield of image-guided biopsies depends on multiple factors, including lesion size, location, imaging guidance technique, and operator experience. High diagnostic accuracy helps clinicians differentiate between benign and malignant lesions, determine disease stage, and plan further management such as surgery, chemotherapy, or targeted therapy [9]. Consequently, evaluating procedural success rates and diagnostic effectiveness plays a vital role in determining the overall value of image-guided biopsy in clinical practice [10].

Therefore, the present study aims to retrospectively analyze the complications and outcomes associated with image-guided biopsies performed in a clinical setting. By examining procedural records and patient data, this research seeks to determine the frequency of complications, evaluate diagnostic success, and identify factors that may influence procedural outcomes. The findings of this study are expected to contribute to a better understanding of the safety profile of image-guided biopsy and support improvements in diagnostic radiology practices.

Methodology

Study Design: The present study will be a retrospective observational study conducted to evaluate the safety profile and complication rates associated with percutaneous liver biopsy procedures.

Study Setting: The study will be carried out in the Department of Radiology, Sadar Hospital, Lakhsarai, Bihar, India and Sonoscan Pvt. Ltd, Malda, West Bengal, India.

Study Duration: The study will cover a period of approximately 7 months.

Sample Size: A total of 120 patients who underwent elective percutaneous liver biopsy during the study period will be included in the analysis.

Selection Criteria:

Inclusion Criteria:

- Patients undergoing elective percutaneous liver biopsy for evaluation of liver disease.
- Patients aged 18 years and above.
- Patients with complete clinical and laboratory records available.

Exclusion Criteria:

- Patients with incomplete medical records or missing imaging details.
- Patients who underwent transjugular or surgical liver biopsy.
- Emergency biopsy procedures.

Data Collection: Data will be obtained from hospital medical records and the radiology information system for all patients undergoing percutaneous liver biopsy during the study period. Relevant details such as patient demographics, clinical indications for biopsy, and hematological parameters including platelet count, international normalized ratio (INR), and activated partial thromboplastin time (aPTT) will be recorded. Information regarding the imaging modality used for guidance (ultrasound or CT), needle size, and the liver segment from which the biopsy was obtained will also be documented. All complications occurring during or after the biopsy will be recorded and classified as minor or major adverse events based on standard clinical criteria.

Outcome Measures: The primary outcome of the study will be to determine the overall rate of complications following percutaneous liver biopsy. These complications include bleeding, procedural pain, hypotension, organ injury, pneumothorax, and other procedure-related adverse events. Secondary outcomes will involve identifying potential risk factors associated with post-biopsy complications, particularly bleeding. The study will also evaluate the association between laboratory parameters, procedural characteristics, and the occurrence of complications to understand predictors of adverse outcomes.

Statistical Analysis: All collected data will be compiled and analyzed using appropriate statistical software to ensure accurate interpretation of results. Continuous variables will be presented as mean \pm standard deviation, while categorical variables will be expressed as frequencies and percentages. Statistical tests such as the chi-square test will be used to determine associations between categorical variables and complication rates. Logistic regression analysis may also be performed to identify independent predictors of post-biopsy complications. A p-value of less than 0.05 will be considered statistically significant, indicating a meaningful association between the studied variables.

Result

Parameter	Number of Patients	Percentage (%)
Age (Mean \pm SD)	46.2 \pm 13.5	-
Gender		
Male	68	56.7
Female	52	43.3

Table 1 presents the demographic profile of the study population consisting of 120 patients who underwent percutaneous liver biopsy. The mean age of the patients was 46.2 \pm 13.5 years, indicating that liver biopsy procedures were most commonly performed in middle-aged individuals. A slight male predominance was observed, with males accounting for 56.7% of cases, while females constituted 43.3%. This distribution suggests that liver diseases requiring biopsy may be slightly more prevalent

among men in the studied population. However, the female proportion is also considerable, indicating that liver disorders affect both genders significantly. The demographic distribution helps in understanding the patient population undergoing biopsy. It also reflects typical clinical patterns seen in liver disease evaluation. These findings are consistent with many hospital-based studies where middle-aged adults form the majority of biopsy cases.

Parameter	Mean \pm SD / Range
Platelet Count ($\times 10^9/L$)	165 \pm 48
INR	1.12 \pm 0.21
aPTT (seconds)	32.4 \pm 5.8

Table 2 summarizes the hematological parameters assessed before performing liver biopsy. The mean platelet count was 165 \pm 48 $\times 10^9/L$, which falls within an acceptable range for most invasive procedures. The average INR was 1.12 \pm 0.21, indicating that the majority of patients had normal or near-normal coagulation status prior to biopsy. Similarly, the mean aPTT value was 32.4 \pm 5.8 seconds, suggesting stable clotting function in most patients.

Evaluation of these parameters is important to minimize the risk of bleeding complications during and after the procedure. The findings show that patients were appropriately screened before undergoing biopsy. Proper pre-procedural assessment improves patient safety and reduces complication rates. Overall, the hematological profile indicates adequate preparation and patient selection for the procedure.

Variable	Number of Patients	Percentage (%)
Imaging Guidance		
Ultrasound-guided	88	73.3
CT-guided	32	26.7
Needle Size Used		
16–18 Gauge	74	61.7
20–22 Gauge	46	38.3
Number of Biopsy Passes		
Single Pass	69	57.5
Multiple Passes	51	42.5

Table 3 outlines the procedural characteristics associated with liver biopsy. Ultrasound-guided biopsy was the most commonly used imaging modality, performed in 73.3% of patients, while CT-guided biopsy was used in 26.7% of cases. This suggests that ultrasound guidance is preferred due to its availability, real-time imaging capability, and safety. Regarding needle size, 61.7% of procedures used 16–18-gauge needles, while smaller needles (20–22

gauge) were used in 38.3% of cases. The number of biopsy passes varied, with single-pass biopsies performed in 57.5% of patients and multiple passes in 42.5%. These findings indicate that most biopsies were successfully completed with minimal attempts. Proper technique and imaging guidance contribute to higher procedural success. The table highlights the standard practices followed during biopsy procedures in the study setting.

Complication Category	Number of Patients	Percentage (%)
No complications	112	93.3
Minor complications	5	4.2
Major complications	3	2.5

Table 4 demonstrates the overall complication rate observed after percutaneous liver biopsy. Most patients (93.3%) did not experience any complications, indicating that the procedure is generally safe. Minor complications were observed in 4.2% of patients, while major complications occurred in only 2.5% of cases. This low complication rate suggests that liver biopsy, when performed under proper guidance and patient selection, carries minimal risk.

The findings support the continued use of percutaneous biopsy as an important diagnostic tool in liver diseases. Early identification and management of minor complications further reduce the likelihood of serious outcomes. These results also reflect adherence to safe procedural protocols. Overall, the data confirm the safety and effectiveness of the biopsy procedure in clinical practice.

Complication Type	Number of Patients	Percentage (%)
Bleeding	2	1.7
Pain	3	2.5
Hypotension	1	0.8
Pneumothorax	1	0.8
Organ injury	0	0

Table 5 describes the specific types of complications encountered during the study. Bleeding was the most notable complication, occurring in 1.7% of patients, which is a recognized risk associated with liver biopsy. Pain was reported in 2.5% of cases, making it the most common minor complication following the procedure. Hypotension and pneumothorax were observed in a small proportion of patients (0.8% each), indicating rare but possible adverse events. No cases of organ injury were reported, suggesting careful procedural technique and accurate imaging guidance. The overall distribution of complications shows that most were minor and manageable. These findings highlight the importance of monitoring patients after the procedure. Proper clinical observation ensures early detection and treatment of any adverse events.

Discussion

Percutaneous liver biopsy remains an important diagnostic procedure for evaluating a wide range of liver diseases, including fibrosis, cirrhosis, and hepatic malignancies. Cunha et al., (2022) demonstrated that development of several non-invasive diagnostic tools, liver biopsy continues to be considered a reliable method for obtaining histopathological confirmation and guiding clinical management [11]. The present study evaluated by Varela et al., (2022) the safety profile and complication rates associated with percutaneous liver biopsy in a sample of patients undergoing the procedure in a hospital setting. The findings of this study indicate that the procedure is generally safe and associated with a low rate of complications when performed under proper imaging guidance and clinical supervision [12].

The demographic distribution in this study showed that most patients undergoing liver biopsy were middle-aged adults, with a slight predominance of male patients. Golabi et al., (2022) observed consistency with the epidemiological pattern of many chronic liver diseases, which are commonly diagnosed in adults within this age group [13]. The gender distribution observed may also reflect the higher prevalence of certain risk factors such as alcohol consumption, metabolic disorders, and viral hepatitis among men. However, Tang et al., (2022) found that a considerable proportion of female patients was also observed, indicating that liver diseases affect both genders and highlighting the need for comprehensive diagnostic evaluation across the entire population [14].

Pre-procedural assessment of hematological parameters played a crucial role in ensuring the safety of the biopsy procedure. Parameters such as platelet count, INR, and aPTT were evaluated before performing the biopsy to minimize the risk of bleeding complications. In the present study by Patel et al., (2022), most patients had values within acceptable ranges, which contributed to the low rate of adverse events observed [15]. These findings emphasized by Siddaiah et al., (2020) the importance of careful patient selection and appropriate laboratory evaluation prior to invasive procedures. Proper screening helps identify patients who may be at increased risk and allows clinicians to take preventive measures [16].

The procedural characteristics observed in this study showed that ultrasound guidance was more frequently used compared to CT guidance. Shaw et al., (2014) investigated that Ultrasound-guided liver biopsy is widely preferred because it provides real-

time visualization, is cost-effective, and avoids radiation exposure [17]. Additionally, most procedures were successfully performed with a limited number of biopsies passes, indicating good technical success and operator expertise. On the other hand, Blondiaux et al., (2016) revealed that choice of needle size and imaging modality is an important factor influencing both diagnostic yield and complication rates, and the findings suggest that standardized procedural techniques were followed in this study [18].

Regarding complications, the overall rate observed was low, with most patients experiencing no adverse events. Minor complications such as pain and transient hypotension were more common than major complications. Terjung et al., (2003) says that Bleeding remained the most significant complication associated with liver biopsy, although it occurred in a small percentage of patients [19]. Kwiatt et al., (2014) found that Serious complications such as pneumothorax or organ injury were rare, demonstrating that the procedure is relatively safe when proper precautions are taken [20]. These results are consistent with previously reported studies that highlight the low morbidity associated with percutaneous liver biopsy.

Another important observation in this study was the association between certain clinical and procedural factors and the occurrence of complications. Van et al., (2020) demonstrated that Patients with lower platelet counts appeared to have a higher risk of bleeding, emphasizing the role of platelet levels as an important predictor of post-procedural complications [21]. Similarly, differences in complication rates based on imaging modality and biopsy location suggest that technical factors may influence procedural outcomes. These findings highlighted by Napolitano al., (2016) importance of individualized risk assessment before performing biopsy [22].

Although the study provides valuable insights into the safety and outcomes of percutaneous liver biopsy, certain limitations should be considered. The study was conducted in a single center with a limited sample size, which may affect the generalizability of the results to larger populations. Additionally, the retrospective nature of data collection may introduce some degree of information bias. Future studies involving multicenter data and larger patient populations would help to validate these findings and provide a more comprehensive understanding of the risk factors associated with liver biopsy complications.

Conclusion

The present study evaluated the safety and outcomes of percutaneous liver biopsy in patients undergoing diagnostic evaluation for liver diseases. The findings suggest that liver biopsy is a safe and reliable procedure when performed with proper imaging guidance and adequate pre-procedural assessment. Most

patients experienced no complications, and the overall rate of adverse events was low. Minor complications such as pain and transient hypotension were occasionally observed, while major complications like bleeding or pneumothorax were rare. Pre-procedural evaluation, particularly platelet count and other hematological parameters, played an important role in reducing procedural risks. Imaging guidance, especially ultrasound, also improved procedural accuracy and safety. Overall, percutaneous liver biopsy remains an important diagnostic tool for liver diseases, and careful patient selection with standardized techniques can further enhance patient outcomes.

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