

# The utility of ultrasound guidance in transjugular liver biopsy: our experience

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## Abstract

**Purpose:** To demonstrate the utility of ultrasound (US) guidance in improving the safety and efficacy of transjugular liver biopsy (TJLB) by analyzing all the TJLBs performed by us in the last 4 years.

**Materials and methods:** Forty-seven patients who underwent TJLB in the last 4 years in our two centers were retrospectively analyzed. US guidance was used for all but for one patient during the two crucial steps of the procedure—for internal jugular vein (IJV) access and during the parenchymal biopsy. Biopsies were obtained under real-time sonographic guidance from the right lobe after confirming an adequate room for needle throw without breaching the liver capsule or any major hilar structures. Post-procedure complications, tissue yield, and histopathological adequacy of samples were analyzed.

**Results:** Overall technical success rate was 100%. No major complications were found where ultrasound-assisted TJLB (uTJLB) was performed. One patient who underwent non-US guided TJLB had an event of a capsular breach and intra-peritoneal hemorrhage requiring coil embolization. Samples were of adequate dimension. Histopathological positivity was 100%. The overall complication rate for uTJLB was 4.7% which was due to minor complications in two patients.

**Conclusions:** Addition of US unit to the angiographic suite is effortless and Interventional Radiologists being already skilled in US can easily implement this simple yet valuable modification to conventional TJLB procedures. Our experience on uTJLB further emphasizes the role of US guidance in improving the procedural success rate, safety profile, and efficacy in the histopathological outcome of TJLB in all patients irrespective of age and disease burden.

**Key words:** Ultrasound—Transjugular liver biopsy—uTJLB

Transjugular Liver Biopsy (TJLB) is a commonly performed procedure by the Interventional Radiologists when a percutaneous liver biopsy is not safe. It was first suggested as an experimental procedure by Dotter in 1964 [1]. TJLB is relatively safer in view of the fact that the Glisson's capsule is not breached and theoretically there is no possibility of intra-peritoneal hemorrhage subsequent to biopsy.

During TJLB, the needle enters the liver parenchyma by traversing the hepatic vein wall and if at all there is bleeding it will be into the venous system [2]. Hence, there is no chance of hypovolemia and subsequent complications. Jugular vein access and parenchymal puncture via hepatic vein wall are two crucial steps while performing TJLB. In fact, there are many studies demonstrating the safety and efficacy of TJLB provided it has been performed by physicians with adequate skill and experience in endovascular techniques [3–5]. However, potentially life-threatening complications are expected during both these venous punctures though TJLB is widely regarded as a relatively safer procedure even after multiple parenchymal passes [6]. Use of ultrasound guidance during jugular and trans-hepatic-venous parenchymal puncture allows direct visualization of needle passage and can significantly reduce complication rates.

In this study, we analyzed all the ultrasound-assisted TJLB (uTJLB) procedures done in two centers in the last 4 years where the ultrasound was used for jugular access and parenchymal puncture. We highlight the absence of any major complications in all of the procedures due to this simple and inexpensive modification of TJLB.

## Materials and methods

A retrospective review of 47 consecutive TJLB procedures performed between March 2014 and February 2018 at both institutions was conducted. Institutional Review Board approval was obtained. The patients were identified using the hospital Radiology Information System. Thereafter, the procedural and histological reports were reviewed as well as the clinical indications and post-procedural events. Case files were also reviewed to identify any recorded complications.

### *Technique*

Pre-procedural planning is done in most of the cases where a cross-sectional imaging of liver was done. Informed consent and adequate pre-procedural work up like basic blood parameters and serology were obtained for all patients.

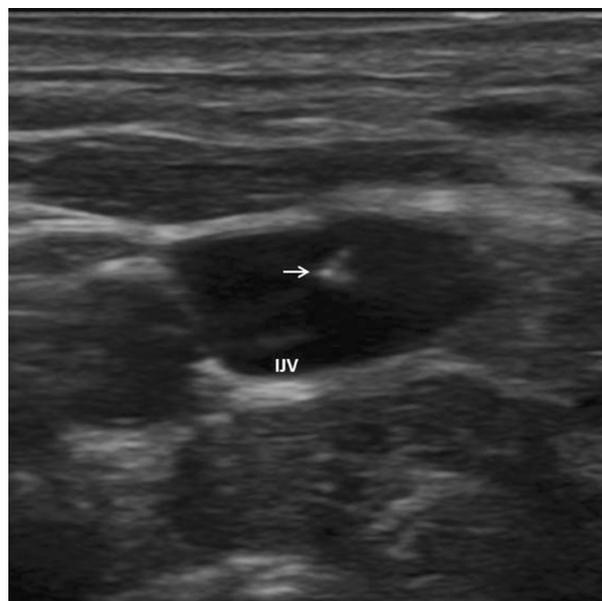
All the TJLB procedures were done in an angiographic suite (Innova 2100 IQ, General Electric, Boston, Massachusetts, USA) equipped with an ultrasound machine (Mindray m7, Shenzhen Mindray bio-medical electronics Co. Ltd, Shenzhen, China). All procedures were done under conscious sedation and with anaesthesiology back up. One case was performed without ultrasound guidance due to unavailability of ultrasound. Internal Jugular Vein (IJV) was the access point for all the patients.

### *Ultrasound screening*

A linear transducer is prepared with all sterile precautions. We use pre-packed sterile arthroscopic port cover which also covers the long wire (200 × 12 cm) for sterile preparation of the probe for IJV access. On table screening of right IJV was done prior to puncture to look for patency up to the subclavian vein. Screening of liver was also done using a clean curvilinear probe especially in an oblique coronal plane over the right intercostal spaces. This is to visualize along the hepatic vein to ascertain the approximate sampling area of parenchyma away from major vessels and capsule. This is done preferably by the same person who would assist later while performing the biopsy. Usually, a person with experience in ultrasound will be performing the liver puncture guidance.

### *Jugular access*

Using 18G puncture needle (Pyramax Healthcare, Hararyana, India) attached to a saline loaded syringe the right IJV is punctured under real-time visualization using ultrasound after infiltration of local anesthetic (Fig. 1). Position can be confirmed by aspirating dark red venous blood. A 0.035" J tip guide wire is inserted under fluo-



**Fig. 1.** US guided IJV access showing needle with in the vein. IJV, internal jugular vein.

roscopic guidance and a short 9F vascular sheath (Cook, Bloomington, IN, USA) is introduced into the jugular vein.

### *Hepatic vein cannulation*

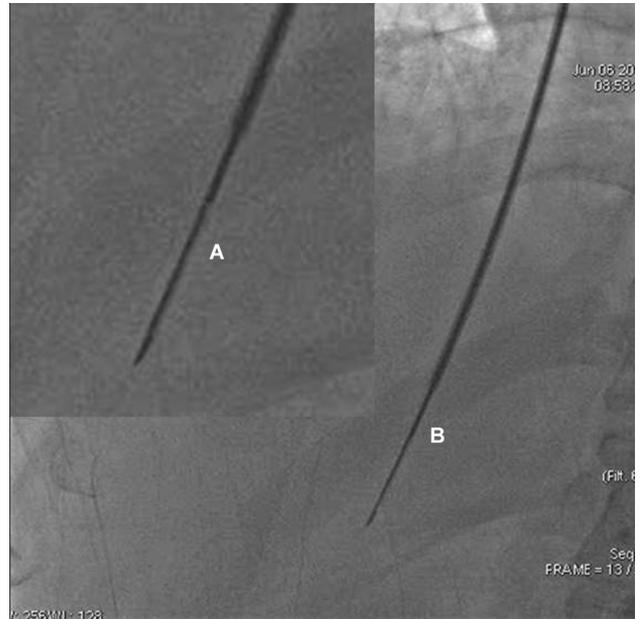
A 4 or 5F cobra catheter (Cordis, New Jersey, USA) over a hydrophilic guide wire (Terumo Corporation, Tokyo, Japan) is used to cannulate the hepatic vein (right hepatic vein in most of the cases). The sonographic guidance process starts here with the assistant demonstrating guide wire position within the hepatic vein. A hepatic venography was performed to confirm the site and to assess the anatomy (Fig. 2). After a satisfactory venogram, the hydrophilic guide wire is exchanged with a 0.035" super stiff guide wire (Amplatz, Cook, Bloomington, IN, USA). A 7F long sheath with the metal cannula of the TJLB set (LABS 100—Liver access and biopsy set, Cook, Bloomington, IN, USA) is inserted into the hepatic vein over the guide wire.

### *Parenchymal puncture and biopsy*

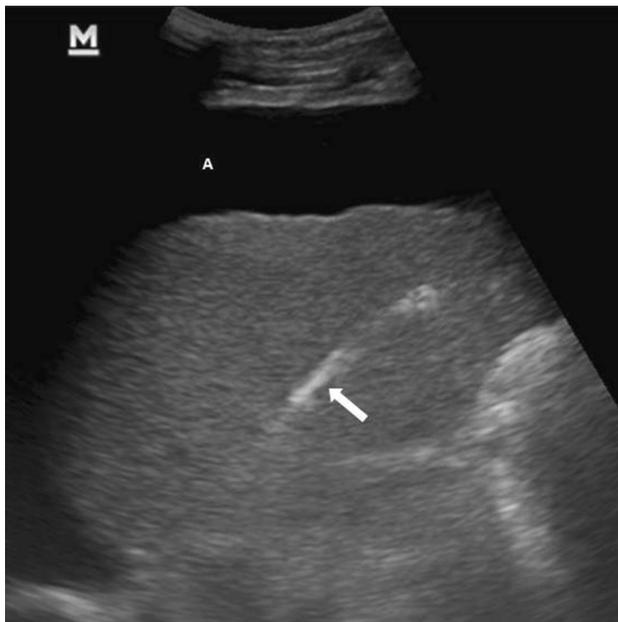
A 60 cm long 18G biopsy needle with 20 mm throw (LABS 100, Cook, Bloomington, IN, USA) is inserted through the long 7F sheath under fluoroscopic guidance up to the proximal, mid third of hepatic vein. Its position is again demonstrated using ultrasound in an oblique coronal plane. Under ultrasound guidance, the parenchyma is entered traversing the hepatic venous wall by rotating the cannula anteriorly. The needle within the parenchyma is visualized under ultrasound (Fig. 3). After confirming the needle position away from major



**Fig. 2.** Prebiopsy right hepatic venogram, anteroposterior view. HV, right hepatic vein; P, ultrasound probe in the right intercostal space can also be seen.



**Fig. 4.** Anteroposterior view of biopsy needle in the parenchyma before (B) and after (A, in the inset box) firing the needle.



**Fig. 3.** Right hepatic oblique coronal view depicting the biopsy needle within the hepatic parenchyma (arrow). A, ascites.



**Fig. 5.** Post biopsy hepatic venogram, anteroposterior view showing no evidence of contrast extravasation.

hilar vessels and ruling out the possibility of a capsular breach, the biopsy was performed (Fig. 4). Repeat biopsies were performed as and when it is required. Post-procedure venogram (Fig. 5) and on table abdominal ultrasound screening were performed to rule out any hemorrhagic complications.

*Post-procedure care*

Hemostasis achieved after removal of the vascular sheath with manual compression in reverse Trendelenburg position. Patients were shifted to the ward after weaning off from sedation. They were instructed to be on nil per os (NPO) for 2 h and thereafter started with graded oral feeds. Patients were kept for 6 h monitoring and discharged after 24 h. All the events during and after the

procedure were documented. Complications were recorded based on the Society of Interventional Radiology criteria [7].

## Results

Among the 47 patients from both centers who underwent transjugular liver biopsy, 33 were males and 14 were females with a mean age of 52.5 years (range 26–69 years). Seven (15%) patients were of post-transplant status. Most common indication for TJLB was coagulopathy (38%) followed by ascites (Table 1). Two patients (4%) underwent TJLB via left IJV access due to thrombosed right IJV. All except one (98%) underwent uTJLB. Inability to obtain a liver biopsy due to any reason was considered a technical failure. The technical success rate in our study is 100%.

All the biopsies were obtained from the right lobe. RHV was cannulated in 45 patients (96%) and MHV in 2 patients. The mean number of samples obtained was  $2.1 \pm 0.7$  and mean sample size was  $8.2 \pm 3.4$  mm. All the patients had an adequate histopathological diagnosis (Table 2). However, samples from two patients needed the second opinion for diagnosis. None of the patients underwent a repeat biopsy.

## Complications

We had one major complication of capsular breach with intra-peritoneal hemorrhage in a patient where uTJLB was not performed. This was successfully managed by coil embolization (Fig. 6). Minor complications were recorded like neck pain (1 patient) and biliary penetra-

tion (1 patient) which were symptomatically managed and were self-limiting (Table 3).

## Discussion

The transjugular liver biopsy is a relatively safer procedure in patients for whom percutaneous liver biopsy is contraindicated. However, there can be minor and major complications secondary to TJLB. The second most common difficulty while performing TJLB is IJV access which is only next to hepatic vein cannulation. Use of ultrasound-guided real-time puncture of IJV as in our study is well documented and is practiced in most of the centers. This avoids complications like neck hematoma, carotid puncture, and pneumothorax.

In a meta-analysis by Kalambokis et al. reporting 7649 TJLBs revealed a maximum of 8 series, reported the absence or use of US guidance in IJV access. In this study, failure to cannulate the IJV accounted for one-fourth of the technical failures. This was less frequent when ultrasound was used [8].

In a study by Soyer et al., sonographic guidance was significantly better than conventional IJV access, reducing the number of failed catheterizations from 22% to 0%. Sonography also reduced the mean number of passes required to catheterize the jugular vein and was successful in 100% of patients in whom conventional catheterization failed [9]. All the patients in our study had IJV access in the first attempt under US guidance and none of them developed complications related to IJV puncture further emphasizing the utility of real-time US guidance.

In our study series, all of the patients except one underwent uTJLB. The complication rate of uTJLB was nil. In fact, the one patient in whom uTJLB was not performed, unfortunately, there was a capsular perforation. The liver was not grossly shrunken in this patient. Even though few centers are using transabdominal ultrasound guidance while performing TJLB in selected cases like that of shrunken liver and gross ascites (Fig. 7A and B) we would like to highlight the effectiveness of this simple addition to the TJLB armamentarium in all cases irrespective of the liver morphology and disease status. Largest meta-analysis on TJLB with 64 series by Kalambokis et al. analyzed more than 7000 TJLB procedures [8]. None of the studies mention the use of real-time transabdominal ultrasound while performing the parenchymal biopsy. In the most recently done largest single center study of 601 cases of TJLB by Mammen et al. described the use of real-time ultrasound in cases with grossly shrunken liver, in left lobe biopsies and also in transcaval punctures to ensure adequate liver parenchyma for the biopsy needle to avoid a capsular breach [10].

In a study of TJLB in 1000 patients by Lebrec et al., they described intra-peritoneal hemorrhage as the most

**Table 1.** Indications for TJLB

TJLB indication	No of patients	%
Coagulopathy	18	38.3
Ascites	13	27.7
Ascites and coagulopathy	7	14.9
Post transplant	7	14.9
Post transplant with ascites	2	4.2

**Table 2.** Histopathological diagnosis

Histology	No of patients
Fibrosis	28
Cirrhosis	17
Acute or chronic hepatitis	19
Steatosis	4
Cholestasis	4
Autoimmune hepatitis	3
Hepatic vein thrombosis	2
Acute rejection	1
Primary biliary cirrhosis	1
Hemochromatosis	1
Sepsis	1
Drug induced hepatotoxicity (Ceftriaxone)	1



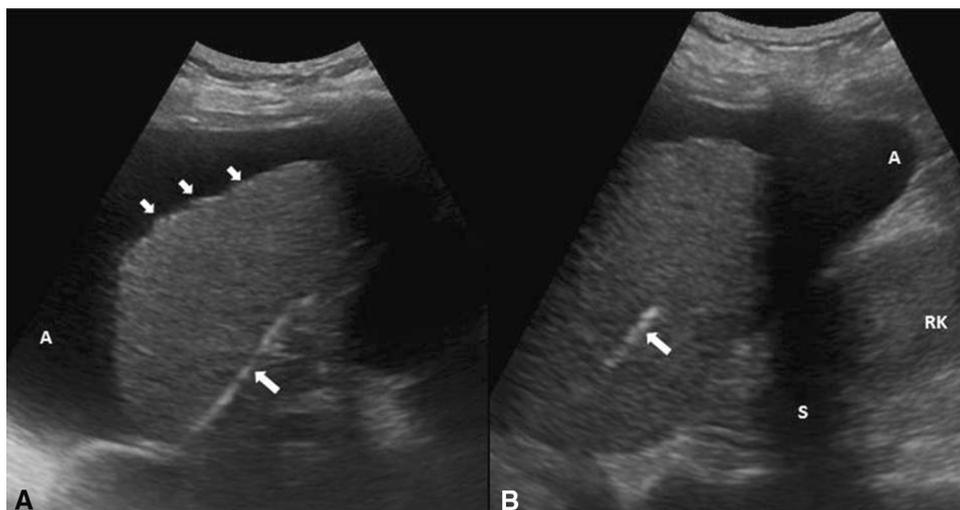
**Fig. 6.** Non-US guided TJLB resulting in capsular breach and intra-peritoneal contrast extravasation (white arrow) and are managed by coil embolisation (black arrow).

**Table 3.** Complications in uTJLB and TJLB

Complications	uTJLB (n = 46)	TJLB (n = 1)
Major	0	1
Minor	2	0
Total	2	1

serious complication of this procedure and found that perforation of the liver capsule was due to excessive forward rotation applied to the needle, especially in a smaller liver [11]. uTJLB can avoid this pitfall since ultrasound guidance can clearly demonstrate the direction of needle trajectory into the parenchyma and the

interventional radiologist can judge the parenchymal thickness where the needle throw would reach without penetrating the capsule or a major hilar structure. Kalambokis et al. identified the incidence of major and minor liver puncture related complications as 0.2% and 3% respectively, in 60 adult series involving 7493 TJLBs. There was 0.05% of large hepatic hematomas, 0.2% of small hepatic hematomas, 0.2% of intra-peritoneal hemorrhage, 0.04% of hemobilia, 0.01% each of IVC perforation and renal vein perforation and 1.4% of subclinical capsular perforation. They also reported non-US guided IJV access related complications such as neck hematoma (0.8%), carotid artery puncture (0.15%), pneumothorax (0.05%), and Horner’s syndrome (0.04%)



**Fig. 7.** TJLB (A) in shrunken liver (short arrows) and (B) in gross ascites showing needle with in the liver (long arrow). A, ascites; RK, right kidney, S, rib shadow.



**Fig. 8.** Placement of DSA monitors and ultrasound screen while performing uTJLB. A third assistant for US guidance can also be seen.

[8]. Smith et al. in a study of 410 TJLBs using US guided IJV access reported no IJV access related complications. However, there was liver puncture related complications such as intra-peritoneal hemorrhage (0.2%) and capsular perforation (1.5%) [12]. Mammen et al. also used US guided IJV access in a study of 601 TJLBs, but reported IJV access related complications such as neck hematoma (0.7%), cause of which was grossly abnormal parameters and pneumothorax (0.2%). They reported liver puncture related complications like hemobilia (0.7%) and intra-peritoneal hemorrhage (0.3%) [10]. There is no mention of subclinical capsular perforation. In comparison, our study even though with a smaller number of uTJLBs using US guidance in both IJV access and liver puncture showed no complications. This underlines the utility of US guidance in improving the safety of TJLB.

All the patients in our study had satisfactory tissue sample for adequate histopathological diagnosis. However, two patients had diagnosis only on the second opinion. The tissue sample sizes were comparable to routine TJLB samples [13]. It is already known that the quality of specimens obtained using the transjugular approach is comparable, if not better, to those obtained via the percutaneous approach [14]. In addition, Smith et al. reported 5 cases of non-targeted biopsy (1.2%) in TJLB with non-US guided parenchymal puncture, which showed tissues from cartilage, kidney and a portion of pancreatic pseudocyst. Only a randomized control trial on uTJLB vs. TJLB with large sample size can prove whether ultrasound guidance gives a better sample yield compared to conventional TJLB.

Almost all of the Interventional Radiology departments are equipped with or have access to an Ultrasound machine nowadays. Hence presumably there is no additional cost burden added to the patient by performing uTJLB. We use our portable US machine for performing uTJLB (Fig. 8). An overall success rate of 100% may be

presumed as unusually high. This could be due to a smaller sample size. It is already proven that the length of the procedure, the total radiation dose and the fluoroscopic time in certain interventional procedures like transjugular intrahepatic portosystemic shunt creation can be reduced by using ultrasound guidance [15]. Likewise, the length of the procedure, fluoroscopic time, and the total radiation dose in uTJLB may be less than that of in conventional TJLB in view of the fact that fluoroscopic guidance may be avoided while using ultrasound for parenchymal puncture and biopsy. In our study, the mean duration of the procedure was 31 min with a fluoroscopic time of 3.6 min. This is lower compared to when TJLB was performed without US guidance, where the mean duration was 40 min with the fluoroscopic time of 4 min [10]. The radiation dose in uTJLB ranged from 75 to 188 mGy. This was found to be lower compared to the few conventional TJLBs performed by us where the radiation dose ranged between 88 and 344 mGy. It is obvious that since the fluoroscopic time when performing uTJLB is lower than that of conventional TJLB the radiation dose also would be lower. However, we could not directly compare the radiation dose with any larger study in the literature. The mean number of needle passes was also not analyzed. These limitations warrant the need for a randomized control study with a large number of patients.

## Conclusion

TJLB is a relatively safer procedure when a percutaneous liver biopsy is contraindicated. Ultrasound is a valuable tool while performing TJLB in both during IJV access and parenchymal puncture. Ultrasound-assisted TJLB may further reduce the complication rate of TJLB. Interventional radiologists being already well versed with ultrasound can incorporate this simple but valuable modification of TJLB in their daily practice effortlessly.

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