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Transjugular Random Renal Biopsy: A Review

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ABSTRACT

Random renal biopsy is considered the gold standard for the diagnosis of systemic renal disorders. Percutaneous biopsy remains a safe option for most patients; however, the percutaneous approach may be considered too risky in approximately 5-10% of patients. In these high-risk patients, transjugular renal biopsy (TJRB) may represent an underutilized alternative. TJRB is a technically difficult procedure with a learning curve of approximately 10 cases. When performed properly, TJRB is a safe alternative to percutaneous biopsy in patients with renal failure or who are at high risk of bleeding. This article aims to provide a comprehensive review of the indications, techniques, precautions, and complications of TJRB, a possibly underutilized technique. (REV INVEST CLIN. 2024;76(5):207-12)

Keywords: Transjugular. Renal biopsy. Indications. Technique. Percutaneous.

INTRODUCTION

Random renal biopsy is the gold standard in the diagnosis of systemic renal disorders[1]. Most renal biopsies can be performed using a percutaneous approach; however, in approximately 5-10% of cases, the percutaneous biopsy is considered to be too high-risk or technically difficult[2,3]. Transjugular renal biopsy (TJRB) is an option for high-risk patients who need a diagnostic renal biopsy[2,4]. TJRB is used in only a few centers[2,5,6] and has not been widely accepted in the United States. Possible factors leading to decreased utilization of TJRB include its association with a learning curve, the use of radiation, or increased cost[2,4,7].

TJRB was initially described in 1990 by Mal et al.[8] The authors mistakenly catheterized the right renal vein and obtained specimens from the right kidney while attempting a transjugular liver biopsy. Once aware of the mistake, the investigators decided to test the clinical feasibility of the newly discovered procedure in cadavers[8]. The cadaver test was successful and a modified needle was designed and tested in 50 patients[8]. The original technique was by aspiration of tissue using a glass syringe connected to the biopsy needle. Using this technique, the authors obtained diagnostic tissue in 84% of patients[8]. The mean number of glomeruli per sample was nine, and there were no major complications[8]. The conclusion of the report was that TJRB could be offered to patients with contraindications to percutaneous biopsy[8].

The purpose of this article is to review the indications, contraindications, results, procedural precautions, and complications of TJRB, possibly an underutilized technique.

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INDICATIONS AND CONTRAINDICATIONS

TJRB is indicated in patients with contraindications to percutaneous renal biopsy[7,9,10] or comorbidities that increase the risk of complications of a percutaneous biopsy[9,11]. The most common indications for TJRB include coagulopathies, thrombocytopenia, patients on anticoagulants, poorly controlled hypertension, morbid obesity, single kidney, unsuccessful or failed percutaneous biopsy, an indication for simultaneous liver and kidney biopsy[6,9,12], and intubated patients in whom prone position would be difficult or risky[4].

Reported contraindications are renal vein thrombosis because of a higher risk of bleeding or iatrogenic pulmonary embolism4 and hydronephrosis with thin renal cortex[4].

CLINICAL CONSIDERATIONS

Patient evaluation

Patients should be evaluated by the operators and written consent for the procedure should be obtained. Percutaneous random renal biopsy (PRRB) is considered to be a high-risk procedure for bleeding[13-15] and although not specifically reported, it is logical to think that precautions pertinent to a PRRB also apply to TJRB[16].

Two factors are key in the evaluation of patients undergoing renal biopsy to assess renal failure: (1) systemic blood pressure and (2) coagulation status[15]. Control of blood pressure is essential; systolic blood pressure < 150 mmHg and diastolic < 90 mmHg are required[1,17]. The Society of Interventional Radiology practice guidelines recommend assessment of bleeding risk in patients undergoing random renal biopsy[13]. Coagulopathies should be corrected before the procedure[7]. An international normalized ratio < 1.5 and a platelet count > 50,000 are recommended[17]. Patients with chronic kidney disease are known to have platelet dysfunction and are prone to bleeding complications[15]. Patients with platelet dysfunction can be treated with desmopressin to try to correct the problem[17]. It is important to know if the patient is being treated with antiplatelet agents or anticoagulants, as these drugs should be discontinued before the procedure[15].

Patients on antiplatelet medications or anticoagulation

Anticoagulation medication should be discontinued before a TJRB2. The recommendations are to stop warfarin 5 days before the procedure and discontinue direct oral anticoagulants (DOAC) 48 h before the procedure[18]. Heparin or argatroban drips should be stopped 4 h before the procedure[13]. Special precautions are recommended in patients on low molecular weight heparin, fondaparinux, and DOAC[15] because the bioavailability of these drugs may be higher in patients with chronic kidney disease[15]. Aspirin should be held 5 days before the procedure[14] and antiplatelet drugs (i.e., Clopidogrel [Plavix]) should be stopped 5 days before the biopsy[15].

Transjugular renal biopsy technique

Careful angiographic technique is essential to avoid complications. A learning curve of approximately 10 cases has been reported for TJRB[4]. TJRB should be performed in a state-of-the-art angiography suite. The procedure can be performed under local anesthesia, moderate sedation, monitored anesthesia care, or general anesthesia[4]. The patient is placed in the supine position and the neck is prepped and draped for transjugular venous access. Ultrasound (US) guidance is recommended for transjugular vein access to avoid complications. The right or left internal jugular veins can be used for access. A 65 cm multipurpose angiographic catheter is then used to perform selective catheterization of the right renal vein. The ideal renal vein for endovascular biopsy is the vein from the lower pole of the kidney[2,7,9]. A high-quality venogram is essential to select the most appropriate vein for catheterization[3]. If the right renal vein is unsuitable for access, the left renal vein can be selected[9].

Once access to a suitable renal vein has been obtained, a small amount of contrast is injected to demarcate the renal cortex. A 180 cm Rosen wire (Cook, Bloomington, IN) is advanced into the lower pole renal vein. The Rosen wire has a blunt “tight J” design that prevents perforation of the renal capsule during renal vein catheterization. Afterwards, a 9 Fr × 45 cm sheath is advanced into the lower pole renal vein under fluoroscopic guidance. The transvenous biopsy system is then advanced through the sheath to the targeted area in the lower pole of the kidney. The biopsy tract is directed

with a posterolateral course to avoid colonic injury[10]. Most operators now use a side-cut needle[19] as opposed to the originally described aspiration needle[4].

A specific system for transvascular renal biopsy was manufactured by Cook (QuickCore, Cook, Bloomington, IN)[20]; however, it is no longer available[21]. Two Food and Drug Administration-approved systems for transvascular biopsy are available in the United States: (1) 18 and 19-gauge Cook Transjugular Liver Biopsy System (LABS 200, Cook, Bloomington, IN)2 and (2) 18 and 19-gauge Argon T-Lab system. (Argon, Athens, TX) system. Ideally, the biopsy should be performed with a cytopathologist with experience in renal biopsies present in the procedure room[9,14]. The cores are given to the cytopathologist who can evaluate the specimen on-site and determine if the specimen is of diagnostic quality[9]. The presence of an expert dedicated renal cytopathologist in the procedure room may reduce the number of needle passes and theoretically, decrease the risk of bleeding[3,7,9]. In the absence of a cytopathologist with experience on site, the recommendation is to obtain four tissue cores for a diagnostic specimen[2]. If injury to the renal capsule or collecting system is identified during biopsy, this can be embolized during the procedure[10]. Injection of a small amount of contrast is recommended after each needle pass to determine if the renal capsule has been perforated[22].

Once the operator is satisfied with the number and quality of samples, the procedure is terminated. Manual compression is held at the transjugular puncture site and the patient is transported to a recovery area.

Patient care after biopsy

A standardized, evidence-based follow-up protocol for patients undergoing random renal biopsy has not been described[23,24]. Follow-up protocols vary widely and are influenced by local practice. Follow-up protocols range from an early discharge of 2 h with instructions to return to an emergency department if any complications arise to 24 h admission with serial monitoring of hemoglobin levels[23].

In general, it is agreed that patients should be observed in a recovery area for at least 2 h after biopsy[24]. A renal US is recommended after biopsy to check for the presence of a perirenal or retroperitoneal hematoma[4,23,25]. The negative predictive value of a renal US is 95%[23,25]. The patient's urine should also be assessed for the presence of hematuria[26]. If not on anticoagulants, it is reasonable to discharge the patient 2 h after biopsy if the renal US is negative and there is no gross hematuria[24].

In patients who are on anticoagulants, if the US after the biopsy shows no hematoma and the urine is clear, anticoagulation may be resumed 24 h after the biopsy[23]. If there is mild hematuria, the proposed recommendation is to start anticoagulation 48-72 h after biopsy[23]. If gross hematuria is identified, a clinical decision must be made to determine what is the best course of action. Some operators will decide to obtain a computed tomography angiogram to determine if there is active bleeding at the biopsy site and some operators will immediately take the patient to angiography for diagnostic arteriogram and embolization if active bleeding is identified[23].

CLINICAL UTILITY AND OUTCOMES

TJRB is safe if properly performed[26]. The procedure does have a learning curve of approximately 10 cases[4,9]. A systematic review written in 2020 summarized 17 articles describing results with TJRB[21]. Three retrospective studies comparing PRRB with TJRB have been published[9,21,22] with similar diagnostic yield, success rate, and complication rates[11,21]. Reports on TJRB indicate that diagnostic renal tissue can be obtained in 74-98% of cases[21]. The number of passes to obtain diagnostic tissue is not always reported but it ranges between 2 and 5 passes[27]. The number of glomeruli obtained ranges from 5 to 19[21]. Bleeding not requiring transfusion is reported to be approximately 22.3% and bleeding requiring transfusion is 4.5%[21]. Embolization to control bleeding is required in 1-2% of patients[21]. Table 1 summarizes the results reported in select retrospective studies that offer the highest-quality and most representative review of TJRB. Although previous reviews of TJRB have been highlighted in the literature, these studies are noted to include smaller studies without clear evidence and with a lack of criteria for inclusion in a complete review. For these reasons, multiple studies have been selectively excluded from our table; however, they serve to provide important clinical insight into the real-world application of TJRB.

Table 1. Representative series describing TJRB results

Author	Year	Pts	Needle	Dx (%)	#Passes	#Glom	MC (%)
Rychlik et al.[26]	2001	67	NA	79	NA	10.8	18
Sofocleous et al.[20]	2002	7	Cook blunt	100	4	NA	0
Thompson et al.[19]	2004	25	Cutting needle	91.3	NA	9.8	8
Misra et al.[7]	2008	38	Cook blunt	92	< 5	4.8	2.6
See et al.[3]	2008	59	Quick core	95	5.3	10	12.5
Sarabu et al.[29]	2011	23	NA	87	NA	NA	13
Nielly et al.[22]	2020	256	Mod. colapinto	97	NA	23.8	2

TJRB: transjugular renal biopsy; MC: major complications.

Findings from preliminary observations at our institution support the current understanding that TJRB is a safe option for patients with an absolute contraindication to PRRB. In total, 21 TJRB have been performed at our institution in 20 patients. One (4.5%) patient required a second biopsy due to the tissue being insufficient for diagnosis. The mean glomeruli obtained per specimen was 24 ± 13.5 (range 5-61). Overall, the diagnostic rate of TJRB at our institution was 90.5% (19/21). One (4.5%) patient experienced bleeding during the TJRB that required embolization. The technical success rate of TJRB was 95.2% (20/21). One (4.5%) TJLB was considered a technical failure due to bilateral renal vein thrombosis in a patient with systemic lupus erythematosus and lupus anticoagulant.

TRANSJUGULAR RENAL BIOPSY COMPLICATIONS

Reported complications after TJRB can be divided into minor and major complications according to SIR standards of practice[21]. A meta-analysis review of 15 articles on the topic reported bleeding complications in 202/896 procedures (22.6%)[21]. Minor bleeding complications were reported in 18.2% of procedures and major bleeding complications required either transfusion or intervention in 4.5%[21]. Larger needle size had no significant correlation with an increased risk of bleeding complications[21]. Notably, one study found a lower risk of major bleeding with TJRB compared to percutaneous renal biopsy when controlled for bleeding risk factors[11]. Renal capsular perforation was identified in 11%[21]. Other reported complications included pain, renal vein thrombosis, acute kidney injury, bladder obstruction, and jugular vein access complications[9]. Although rare, arteriovenous fistula after TJRB has been reported[10].

FUTURE APPLICATION

The transjugular approach to obtaining renal cortex was described in 1990[8]. The procedure was originally indicated in patients with either high bleeding risk or morbid obesity, in other words, patients with high complication risk after a percutaneous biopsy[4,8,9,23]. The technique is popular in France[11]. TJRB has not gained widespread acceptance in the United States[12]. Reports from the US are limited to series with few patients[2,7]. The reasons for the lack of widespread use in the USA may be related to cost, the use of radiation, increased procedural time, and lack of familiarity with a procedure that has a relatively steep learning curve[4]. The procedure is safe if properly performed, the diagnostic rate approaches 90%, the major complication rate is low (around 5%) and patients needing intervention to control bleeding are even lower (around 1-2%). Bleeding rates have been reported to be as high as 22%, but it is not entirely clear how the authors of these series classified the bleeding complications. Small-to-moderate-sized peri-renal hematomas are not uncommon after random renal biopsy and it may be excessive to classify these as bleeding complications.

In day-to-day practice, it seems difficult to justify extensive use of TJRB. A standard PRRB is a relatively simple procedure that can be performed under US or CT guidance[1]. A PRRB requires less time and ancillary staff. The patient is placed in the prone position, the kidneys are scanned with US or CT and then,

the biopsy is performed under real time imaging guidance[23]. Once the patient has been prepped and scanned, the procedure takes approximately 5-10 min and it has been described to be safe[23]. Previous reports emphasized needle size, specifying that a larger gauge needle (14 gauge) was essential for a diagnostic specimen; however, this is not accurate since a diagnostic specimen can be obtained with smaller caliber needles with less bleeding risk[23,28].

A TJRB requires a dedicated angiography suite, the use of ionizing radiation, a team with expertise in the procedure, and a catheterization suite ancillary staff[9]. A straightforward TJRB usually takes 30-40 min and includes patient preparation, sedation, and catheterization techniques[3]. Careful technique is essential for a successful TJRB[7]. Finding a suitable renal vein may be technically challenging and add procedural time and patient discomfort[21]. Even with these practical disadvantages, in certain cases, it may be better to offer the transvenous approach for selected patients because the use of TJRB may avoid a major complication[11]. The problem with this concept of practice is that if an operator is confronted with the challenge of a TJRB, he or she may not be properly trained to do the procedure because of a lack of familiarity with the technique[4,27]. This poses a technical and ethical concern. TJRB has a learning curve of approximately 10 cases, so an operator will not be proficient with the technique if TJRB is attempted only 2-3 times a year[4]. This may lead to procedural complications and a false notion that the procedure is not safe. If both the nephrology and IR groups in a given institution agree that TJRB should be an option offered to high-risk patients, then the teams who are willing to offer this technique will have to agree to offer TJRB in patients who may not necessarily require the transvenous approach so that expertise is gained in the institution, and this may pose ethical concerns.

In terms of which patient should definitely undergo a TJRB as opposed to a PRRB, Halimi et al. described a risk of bleeding score for patients who need a random renal biopsy for diagnosis of renal disease and compared the outcomes between patients undergoing PRRB and TJRB[11]. In their analysis, the transvenous approach was preferred in patients with a calculated risk score > 20, and bleeding episodes were lower in patients who underwent TJRB when compared to the percutaneous route[11]. It seems reasonable to state that patients with a calculated risk score of > 20 should undergo TJRB[11,28], but the results of this study will still need to be validated.

Retrospective comparisons of PRRB and TJRB have shown that both procedures are safe and offer diagnostic specimens[9,21,22]; however, there are no randomized trials comparing PRRB to TJRB[21]. A randomized prospective study to compare TJRB with PRRB may not be feasible since TJRB is usually performed in patients who are at high risk of bleeding[4,8,26] with a PRRB, and this represents, approximately 5% of patients who need a diagnostic renal biopsy, a relatively limited group of patients[9]. A prospective randomized study would require a large number of patients and the participation of multiple centers with expertise in the technique to yield statistically sound results and this may be a difficult task to achieve.

CONCLUSION

TJRB is a technically difficult procedure with a learning curve of approximately 10 cases. It has been described as a safe alternative in patients with renal failure who require biopsy for diagnosis and who are at high risk of bleeding with a PRRB. The technique has not gained wide popularity and this may be related to factors including cost, technical expertise, and radiation exposure. A prospective randomized trial would provide more information about this possibly underutilized technique but it may be difficult to design and conduct.

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