


LETTER TO THE EDITORS

Tangential Extraperitoneal Retrorenal approach: a specified uniform technique for renal transplant biopsy

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Dear Editors,

While rarely discussed in literature, we want to draw attention to the fact that the risk for complications induced by percutaneous renal transplant biopsy (PRTB) might depend on the topography of the chosen biopsy path. Only a few possible techniques and approaches have been adequately described by now.

In 2010, Patel *et al.* [1] indicated substantial advantages of various tangential biopsy approaches. Still, their study reported cases of transfusion-requiring bleedings, intraperitoneal hemorrhage and rectus sheath hematoma. When the same technique was subsequently used in a larger single-center study capturing 2514 biopsies, it was associated with 1.9% major complications requiring hospitalization or therapeutic intervention [2]. Therefore, it was not much safer than the traditional biopsy approach.

Although we agree that tangential approaches must be expected to be safer than the perpendicular option, we believe that the technical aspect of a gold standard procedure—as is PRTB—should be defined more closely, at least for the typically positioned renal allografts (renal hilum oriented medially or anterior).

In this letter, we want to present the uniform Tangential Extraperitoneal Retrorenal (TER) approach, a precisely defined technique that we have used over a period of 6 years. TER was performed by the use of real-time ultrasound guidance and an automated biopsy device with 16-gauge needle size. It was defined by tangentially targeting the utmost dorsal part of the kidney's lateral circumference or upper pole using a horizontal "lateral-to-medial" approach starting around 2–3 centimeters median of the anterior superior iliac spine (Fig. 1). By this approach, multiple structures can be spared: the peritoneal edge, the epigastric arteries, the

renal pelvis as well as overlaying bowels. If intestine is detected in front of the kidney, the biopsy level is moved caudal. The caudal limitation is the arterial and venous anastomosis which sometimes lies in front of the kidney close to the abdominal wall. Usually, it is easily feasible to ensure safety distances of at least 2 cm to the intestine and the anastomosis region.

During the study period, the TER approach was applicable in 127 of 133 biopsy events (95.5%). The goal of our study was to test the safety and diagnostic efficacy of the TER approach and to compare results with other subject-related studies.

We conducted a single-center retrospective observational study including all patients who underwent TER biopsy of their renal transplant between January 10, 2011, and February 22, 2016. During the included 127 biopsy events, a total of 259 TER biopsy passes were performed on 104 individual patients. Biopsies were performed by one nephrology specialist (who had developed TER) and by four specialist trainees in nephrology who in total performed 17.3% of biopsy events.

Considering the preparation of patients, it was attempted to discontinue anticoagulant medication from 14 days before to 14 days after biopsy. This interval could be bridged with enoxaparin sodium. At the time of biopsy, blood pressure 160/90 was defined as maximally acceptable. If blood pressure was higher, nitroglycerine and/or urapidil, an α 1-adrenergic antagonist, were administered. Anxious patients were sedated with midazolam.

During the procedure, the patient was positioned supine or in a lateral decubitus position. To facilitate penetration, a short skin incision with a scalpel blade no. 11 was made. Local anesthesia with a xylocaine 2 percent solution was administered as one subcutaneous depot and one sonographically guided deep depot along the biopsy axis and up to the renal capsule. The angle of the needle guidance system was fixed at sixty degrees to the center of the probe. Tissue specimens were

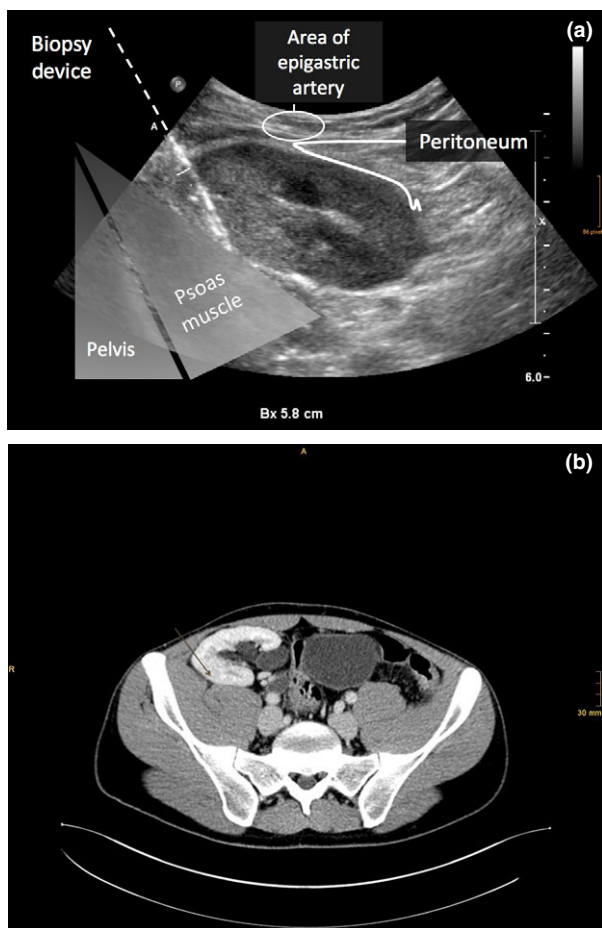


Figure 1 (a) Transverse sonogram [obtained during percutaneous renal transplant biopsy (PRTB)] including a schematic illustration of how to perform Tangential Extraperitoneal Retrorenal (TER) biopsy. The biopsy device is tangentially fired into the outer third of parenchyma on the kidney's posterior side, just where it is in contact with the iliopsoas muscle. (b) Typical contrast enhanced axial computed tomographic (CT) image with an arrow in direction of a TER biopsy. The peritoneal edge, the epigastric arteries, the renal pelvis, the ureter and the anastomosis region are spared. The 16-gauge spring-loaded biopsy needle runs through cortical tissue where high density of glomeruli can be expected. The penetration depth is up to 22 mm, and fragments have 1.3 mm diameter.

reviewed by use of a magnifier to help decide whether further biopsy passes would be necessary.

After the procedure, the patient had to stay supine with mild compression through an abdominal belt. All patients were hospitalized at least over night. We did not perform any outpatient biopsies during this study. On the day following biopsy, every patient was routinely scanned for hematomas and arteriovenous fistulas (AVF) with conventional and Doppler ultrasonography.

Transfusion-requiring complications were defined as a receipt of blood products within a 3-day interval as from the day of biopsy. Transfusions of plasma in the

context of plasmapheresis or immunoadsorption as well as preemptive platelet transfusions given before the biopsy procedure were not counted. Other transfusions were analyzed in detail and only nullified when *all* of the following conditions were met: if biopsy was explicitly uneventful (no bleeding complications or detected hematomas), if the timing or character of the hemoglobin curve spoke against an association of transfusion with the biopsy, and if there were obvious reasons for transfusion other than biopsy.

During 259 biopsy passes, no clinically relevant or therapy requiring complications occurred (0%). There was one case of gross hematuria (0.4%). Two patients had an uncomplicated vasovagal reaction. We detected four perinephric hematomas larger than 3×1 cm (1.5%). By use of Doppler ultrasound, 12 AVF were detected (4.6%) neither of which required embolization. Our complication rates can be compared to historical data in Table 1 [1–15]. Sample adequacy could be retrospectively assessed for 156 tissue core samples. At the mean number of 1.2 ± 0.4 evaluated samples per biopsy event, 82.7% of events were adequate with respect to Banff 97 criteria [16]. In biopsy events with two samples evaluated, 93.1% of events were adequate (Banff 97). Apart from that, 99.2% of events provided sufficient tissue from the viewpoint of the diagnosing pathologist.

This is the first study to precisely describe a uniform “lateral-to-medial” approach for PRTB that dictates to target the dorsal part of the allograft. Limited by its statistical power, our analysis revealed the *lowest* complication rate among all pertinent studies (Table 1). Notably, the supervised educational biopsy events performed by specialist trainees were equally safe (no hematomas $>3 \times 1$ cm, same incidence of AVF) and equally effective as regular biopsies.

When performing two biopsy passes, good diagnostic efficacy could be achieved with the TER approach (93.1%). In other PRTB studies, the rates of adequate samples as per Banff criteria ranged from 54.9% to 96.0% [6,13]. To date, two studies have reported higher specimen adequacy than ours [1,13]. However, one of these studies reported a very high incidence of gross hematuria and the other reported major bleeding complications [1,13]. In the context of safety and efficacy, obtaining two cores using a uniform TER needle path might be a safe way to ensure or improve the efficacy of renal transplant biopsies.

The learning curve associated with the new procedure showed an improvement of diagnostic adequacy over the course of time. When only the second half of biopsy events (event number 64–127) is analyzed, diagnostic

Table 1. Comparison of complication rates (in %): results of the TER technique and historical data.

PRTB study	No.	Minor bleeding	Gross hematuria	AV fistula	Transfusion	Coiling/surgery	Graft loss	Death
Redfield et al. ^[3]	3738	0.5 *	x	0.1 *	0.7	0.4	0	0
Morgan et al. ^[2]	2514	x	x	x	1.3	0.7	0	0
Furness et al. ^[4]	2127†	2.6 *	2.8	2.4 *	0.1	0.1	0.04	0
Schwarz et al. ^[5]	1670	2.4	3.5	7.3	0.3	0	0	0
Schmid et al. ^[6]	1614	1.2	3.2	5.9	0.1	0.2	0	0
Li et al. ^[7] ‡	502	overall minor complications: 4.2		overall major complications: 1.6		x	x	x
Tapia-C. et al. ^[8]	390	3.1 *	0.8	2.3 *	3.1	1.8	0.6	0.3
Torres-R. et al. ^[9]	385	2.3¶	1.0	x	0	0.5	0	0
Li et al. ^[7] §	378	overall minor complications: 2.4		overall major complications: 0.5		x	x	x
Preda et al. ^[10]	345	5.2 *	0.6	x	1.4	0.3	0.3	0.5
Patel et al. ^[11]	336	x	0.6	x	0.6	0	0	0
Laute et al. ^[11]	282	2.1 *	3.5	x	0	0	0	0
Vidhun et al. ^[12]	277	13.4	2.7	x	0.7	0	0	0
Birk et al. ^[13]	262	x	4.2	x	0	0	0	0
Benfield et al. ^[14]	212	0.5 *	2.8	x	0.9	0.9	0	0
Nicholson et al. ^[15]	100	x	8.0	x	0	0	0	0
TER approach	259	1.5**	0.4	4.6	0	0	0	0

x = not taken into consideration.

No. = number of consecutive biopsies or biopsy passes.

*No routine sonographic follow-up performed.

†No. = 1486 for minor complications.

‡Before implementation of a biopsy protocol.

§After implementation of a biopsy protocol.

¶Only subcapsular hematomas were considered.

**Clinically not relevant hematomas >3 × 1 cm.

Schmid et al.: only percutaneous group included.

Preda et al.: only allograft group included.

[12], [13], [14]: pediatric patient population

adequacy is 90.6% (Banff 97) at 1.4 ± 0.5 samples per biopsy event. The complication rate did not significantly vary and was not higher in the initial phase.

We believe that an international promotion for *tangential* renal transplant biopsy could help to reduce the number of serious complications (graft losses, surgical interventions, coiling, etc.). If anatomical circumstances allow, the TER approach might be the safest tangential variant. When performing TER biopsy, the needle runs exclusively outside of the peritoneum and all important structures around the kidney are spared.

Further trials and improvements of the TER approach are desired.

Funding

The authors have declared no funding.

Conflict of interests

The authors of this manuscript have no conflict of interests to disclose.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article:

Table S1. Diagnostic efficacy of PRTB: a comparison of the TER approach with historical data.

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