ORIGINAL ARTICLE

Implementation and Results of a Percutaneous Renal Allograft Biopsy Protocol to Reduce Complication Rate

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Abstract

Percutaneous renal transplant biopsy (PRTB) is the gold standard for evaluating allograft rejection after renal transplant. Hemorrhage is the predominant complication. We describe the implementation of a standardized protocol for PRTB at a single institution, with the aim of reducing bleeding complications. Utilizing the plan-do-study-act model for quality improvement, we created and deployed a protocol centered on controlling patient's hypertension, platelet function, and anticoagulation status. The 4-year study encompassed a total of 880 PRTBs, before and after implementation of the protocol. Total complication rate, which was 5.8% in the 2 years leading up to implementation of the protocol, was reduced to 2.9% after the protocol was introduced ($P = .04$). A standardized approach to PRTB can potentially lower complication rates; we present a framework for implementating a quality improvement protocol at other institutions.

Key Words: Percutaneous renal biopsy, quality improvement, renal transplant, protocol, standardized

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DESCRIPTION OF THE PROBLEM

An average of 12,000 patients undergo renal transplant annually. Percutaneous renal transplant biopsy (PRTB) is the gold standard for the evaluation of renal allograft rejection [1]. Acute major hemorrhage is the most concerning complication of PRTB and may result in increased hospital length of stay, escalation of care, and reoperation. Minor complications are more common and include small subcapsular and perinephric hematomas, arteriovenous fistula formation, and hematuria, but they are often clinically inconsequential [2].

An unusually high number of major complications associated with PRTB was noted by our Radiology Quality of Care (QOC) Committee in 2012, and this prompted a quality improvement (QI) initiative at our institution. Previous studies have shown strong correlations between the risk of major hemorrhage in the setting of PRTB and several factors, including uncontrolled hypertension, coagulation status, and renal function [2]. Based on these observations, a departmental protocol for a standardized approach to PRTB was created and implemented at our institution.

WHAT WAS DONE

Plan: Defining the Scope of the Problem

The QOC Committee performed a preliminary review of the PRTB complications, which had been presented to the committee over the preceding 8 years. The percentage of cases reported to the QOC Committee, which had hovered historically in the 1%-2% range, had spiked in 2012 to exceed 3% (Table 1). Review of specific cases demonstrated that several complications occurred in patients who were high risk for the procedure, owing

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Table 1. Estimated historical renal biopsy complication rate (2005-2012)

Year	No. of Renal Biopsy Complications Reported to the QOC Committee	No. of Renal Biopsy Procedures Performed	Estimated Complication Rate (%)
2005	1	141	0.7
2006	5	238	2.1
2007	7	258	2.7
2008	3	271	1.1
2009	7	307	2.3
2010	5	352	1.4
2011	5	360	1.4
2012	13	380	3.4

Note: The estimate of complication rate differs slightly from the actual complication rate based on our rigorous chart review, because not all complications were submitted to the QOC committee. QOC = Quality of Care.

to hypertension, organ failure, or anticoagulation. The QOC Committee identified this area as an opportunity for QI, and a faculty member champion was selected to establish a protocol to reduce the complication rate.

Creation of a Protocol for Renal Transplant Biopsy

Creation of a protocol to reduce complication rates from renal transplant biopsy began with a literature search, using PubMed, to identify predictors of risk in the setting of PRTB. This evidence base, along with our own institutional experience, led to a set of proposed guidelines for renal transplant biopsy. The data on our institutional complications and the proposed guidelines were reviewed, and after debate and discussion within the department, a preliminary protocol was created. An interdisciplinary conference with the transplant nephrologists followed, with several modifications made based on their recommendations, and agreement was reached on a final protocol. These guidelines, along with their rationale, are described in the following portions of this section.

Blood pressure. Hypertension (>140/90 mm Hg) is an independent risk factor for complications after renal biopsy [3]. For inpatients with blood pressure >140/90 mm Hg, the inpatient care team was asked to reduce the patient's blood pressure to below the threshold limit before sending the patient to the radiology suite. The same criteria were applied to outpatients referred for same-day biopsy directly from the renal transplantation clinic. If the patient was still hypertensive in the radiology suite, blood pressure was controlled using antihypertensive medications and/or sedation, by the radiologist performing the procedure. At the radiologist's discretion, the procedure was deferred if the patient's blood pressure could not be controlled after reasonable efforts had been made toward this end in the radiology suite.

Platelets and coagulation status. Our institutional protocol required normalization of platelets and coagulation status. Platelets were transfused for platelet counts $< 75 \times 10^3$/mL. Fresh frozen plasma was transfused if the international normalized ratio was >1.5. Before biopsy, aspirin was withheld for five days, clopidogrel for seven days, and warfarin for five days. The international normalized ratio was checked on the day of biopsy. Heparin was stopped 6 hours before biopsy, and low–molecular weight heparin 12 hours before biopsy. Anticoagulants and antiplatelet agents could be restarted 12 hours after biopsy, but 24 hours was the preferred length of time.

Uremia. Uremia reduces platelet function. Administration of desmopressin acetate has been shown to improve platelet function in this setting [4]. In patients with blood urea nitrogen >50 mg/dL, we administered 0.3 μg/kg of desmopressin acetate at least 1 hour before biopsy. Because the effect lasts for up to eight hours, administration was conducted on the floor or in the renal transplantation clinic before the patient was sent to the radiology suite.

Critically ill patients. Critically ill patients with organ failure or respiratory failure are at high risk for complication after PRTB [4]. Risk versus benefit of biopsy was discussed with the requesting clinician. Biopsy was performed on critically ill patients only if absolutely necessary.

Procedure performance. Renal allograft biopsies were performed under real-time ultrasound guidance by an attending radiologist or supervised fellow, using a coaxial biopsy system composed of a 17-gauge introducer and an 18-gauge biopsy device (Argon BioPince; Angiotech, Plano, Texas or Bard Max-Core; Bard Biopsy Systems, Tempe, Arizona). Biopsy passes were targeted to the cortex at either pole of the kidney, avoiding passes into the medulla. Gelfoam embolization of the parenchymal biopsy tract was recommended but left to the discretion of the performing radiologist.

Do: Implementation of the Protocol

After achieving consensus among the performing radiologists and referring nephrologists, the protocol was implemented in July 2013. The guidelines were provided