Open Access Maced J Med Sci **electronic publication ahead of print,**
published on March 29, 2019 as https://doi.org/10.3889/oamjms.2019.226

ID Design Press, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences.
https://doi.org/10.3889/oamjms.2019.226
eISSN: 1857-9655
Clinical Science

Complications and Risks of Percutaneous Renal Biopsy

Lada Trajceska, Galina Severova-Andreevska, Pavlina Dzekova-Vidimliski, Igor Nikolov, Gjulsen Selim, Goce Spasovski, Irena Rambabova-Busletik, Vesna Ristovska, Ladislava Grcevska, Aleksandar Sikole*

University Clinic of Nephrology, Faculty of Medicine, Ss Cyril and Methodius University of Skopje, Skopje, Republic of Macedonia

Citation: Trajceska L, Severova-Andreevska G, Dzekova-Vidimliski P, Nikolov I, Selim G, Spasovski G, Rambabova-Busletik I, Ristovska V, Grcevska L, Sikole A. Complications and Risks of Percutaneous Renal Biopsy. Open Access Maced J Med Sci. https://doi.org/10.3889/oamjms.2019.226

Keywords: Renal biopsy; Complications; Hematoma; Hematuria; Predictors

***Correspondence:** Aleksandar Sikole. University Clinic of Nephrology, Faculty of Medicine, University Ss Cyril and Methodius of Skopje, Skopje, Republic of Macedonia. E-mail: asikole@hotmail.com

Received: 12-Feb-2019; **Revised:** 18-Mar-2019; **Accepted:** 19-Mar-2019; **Online first:** 29-Mar-2019

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: Renal biopsy performed in native and transplant kidneys is generally considered a safe procedure.

AIM: In this study, we evaluated renal biopsy complications and risk factors in one nephrology facility.

MATERIAL AND METHODS: We conducted a three-year retrospective study on patients who underwent renal biopsy between January 2014 and December 2016. Strict written biopsy protocol was followed. Clinical and laboratory data were obtained from medical charts. Complications were categorised as minor and major, according to the need for intervention. Minor complications included macrohematuria and/or hematoma that did not require intervention. Major complications included hematuria or hematoma with fall of hematocrit that required a blood transfusion, surgery or caused death. A binary logistic regression model was used to analyse the possible factors associated with complications after the biopsy.

RESULTS: We analysed 345 biopsies; samples were taken from patients aged from 15-81 years, of whom 61% were men. A total of 21 (6%) patients developed a complication, 4.4% minor and 1.7% major complications. There were no nephrectomy or death due to biopsy intervention. Overweight patients, as well as those with higher creatinine, lower hemoglobin, higher blood pressure and biopsy due to AKI had higher chances to develop complications ($p = 0.037$, $p = 0.023$, $p = 0.032$, $p = 0.002$, $p = 0.002$, respectively). The patients' age, gender, kidney dimension, number of passes and uninterrupted aspirin therapy were not found as significant predictors of complications. In the multivariate logistic model, body weight (OR = 1.031, 95%CI = 1.002-1.062), lower hemoglobin (OR = 0.973, 95%CI = 0.951–0.996) and hypertension (OR = 1.025, 95%CI = 1.007-1.044) increased the risk of complications in biopsied patients.

CONCLUSION: Renal biopsy is a safe procedure with a low risk of complications when strict biopsy protocol is observed. Correction of anaemia and blood pressure is to be considered before the biopsy.

Introduction

In spite of the continuous research on new biomarkers and other renal function non-invasive diagnostic tools, percutaneous renal biopsy remains a gold standard procedure for the diagnosis of renal disease [1]. It is performed in native and transplanted kidneys and is generally considered a safe procedure [2], [3]. The use of ultrasound guidance and automated biopsy gun provide a low risk of complications such as pain, bleeding, or a small hematoma. Major complications, including the need for nephrectomy or death, are extremely rare [4]. However, controversies persist regarding the optimal assessment and management of the bleeding risk [5], different pre and after procedure protocols, especially for the solitary native kidney, the optimal duration of observation and the possibility of performing it on an outpatient basis. Potential risk factors for bleeding complications are the female sex, elevated blood pressure, disturbed hemostasis and low haemoglobin level before intervention [6]. The risk of bleeding appears to be lower for transplant than for native kidney biopsy [7]. An outpatient programmed biopsy is considered to be with lower risk because of the better clinical status of the patient. It is also lower for the protocol transplant biopsies. On the other hand, for biopsies in patients with higher creatinine and acute kidney insufficiency, the risk of bleeding is expected to be higher [5].

In this study, we evaluated the kidney biopsy complications and the risk for bleeding in our nephrology facility.

Material and Methods

Study design

A retrospective observational study was performed with biopsied patients, hospitalised in the nephrology academic tertiary clinic.

Study population

We analysed the medical charts of all the patients who underwent renal biopsy (native or transplant), between January 2014 and December 2016. All subjects were 15-81 years of age, free of infection. All of the study procedures were conducted by the written protocols, and informed consent was provided.

Data collection

We collected data for the clinical parameters including gender, age (years), body weight (kg), history of hypertension, acute or chronic renal disease and proteinuria. Hypertension was defined as an average home systolic blood pressure higher than 140 mmHg before medication. Serum data were collected: creatinine (μmol/L), haemoglobin (g/L), platelet count ($x10^9$/L), prothrombin time (seconds) and activated thromboplastin time (seconds). Post-biopsy urinary tract infection was defined as symptoms of frequency, urgency, or pyuria. Hematoma or hydronephrosis was detected by ultrasound. The number of biopsy attempts and the number of obtained tissue cores was noted for each biopsy.

Biopsy protocol

Before biopsy, patients were controlled for systolic blood pressure (not to exceed 180 mmHg). Antiplatelet or antithrombotic agents (e.g. aspirin, GPII/IIIa inhibitors, dipyridamole and nonsteroidal inflammatory drugs) were discontinued at least 5 days before biopsy and the prothrombin time had to be normalised. Pentoxifylline was not to be taken within 1 day before the biopsy. One day before the biopsy, platelet count, prothrombin time and activated partial thromboplastin time had to be normal. A biopsy was not performed in patients with platelets under 100 and abnormal coagulation. The biopsy procedure, its risks and benefits were explained to the patient. The biopsies from the native kidneys were performed under real-time ultrasound guidance in a prone position with a pillow under the abdomen in order to reduce lumbar lordosis. Transplanted patients were placed in supine position. The patients cooperated by holding their breath for a few seconds. A spinal needle was used to locate the capsule of the lower pole and to provide local anesthesia for the biopsy. Two cores of renal tissue measuring one cm in length were obtained. An automated spring-loaded biopsy device and size of the needle 16 G were used. Immediately after biopsy, check for any bleeding hematoma by ultrasound was performed. Patients were instructed to maintain a supine posture in bed for several hours and bed rest overnight was recommended for programmed biopsy admissions. Vital signs were closely monitored after the biopsy. If any gross hematuria, back or abdominal pain, dizziness or nausea were noted, urinalysis, haemoglobin and serum examinations were conducted. Additional imagining investigations including additional sonography were performed when clinically indicated at the discretion of the attending physician. Complications (hematoma, hematuria, hydronephrosis, blood transfusions, haemoglobin decline, angiographic intervention, nephrectomy and other treatments or death) were all recorded. Complications were categorised as minor and major. Minor complications included macrohematuria and/or hematoma that did not require intervention such as blood transfusion or angiography. Major complications included hematuria or hematoma with fall of hematocrit that required a blood transfusion, angiography, surgery or caused hypotension that required intervention.

Statistical methods

Data were expressed as the mean ± standard deviation for continuous variables and as frequency/percentage for categorical variables. Demographic and clinical characteristics of the entire cohort were recorded. A binary logistic regression model was used to analyse the possible factors associated with complications after the biopsy. A P value of less than 0.05 was considered significant. All statistical methods were performed using the SPSS statistical software package, version 17.0

Results

We analysed 345 biopsies performed in 342 patients with the native or transplanted kidney in three consecutive years, with a mean of 115 biopsies per year. Baseline demographics are shown in Table 1. Female patients and those with transplanted kidney were less frequently biopsied (39% and 14%, respectively). In a large percentage of patient's elective biopsy was performed (69%) and in 43

patients the indication was due to acute kidney injury (AKI). The mean systolic blood pressure was under 140 mmHg (136.02 ± 21.72 mmHg), but the history of hypertension was present in a vast majority of the patients (74%). The size of the biopsied kidney varied between 87-155 mm and mean pre-biopsy creatinine level was 263.79 μmol/L. Patients body weight varied between 30-125 kg, 29% were ≥ 80 kg. In 1.4% of the patients, therapy with aspirin was not interrupted due to biopsy. Technical success (a produced specimen) was achieved in 339 (99.12%) patients. Specimen inadequacy occurred in 3 (0.88%), and those biopsies were subsequently repeated. Mean pre-biopsy haemoglobin level was 116 g/L and it dropped after biopsy by less than 10 g/L in 12.6% of patients and by more than 10 g/L in nearly 7% of patients.

Table 1: Demographic and clinical data of the patients

Baseline data	N (%) mean ± SD
Male (%)	211 (61)
Mean age (years)	47.75 ± 15.5
Body weight (Kg) >80 kg	99 (29%)
Pre-biopsy-Hb (g/L)	116.96 ± 22.49
Hb change (g/L)	1.38 ± 6.78[a]
Hb change >10 g/L (%)	24 (6.9) [a]
Platelets (x10^9/L)	242.03 ± 75.29
Systolic BP (mmHg)	136.02 ± 21.72
Creatinine (μmol/L)	263.79 ± 272.11
History of Hypertension (%)	256 (74)
Solitary native kidney (%)	3 (0.86)
Transplanted kidney (%)	49 (14.2)
Indication due to AKI (%)	43 (12.5)
Elective biopsy (%)	241 (69.9)
Indication due to proteinuria (%)	222 (64.3)
Small sized kidney (<100 mm length) (%)	48 (13.9)
Aspirin (%)	5 (1.4)
Passes	2.09 ± 0.34
Cores	2.02 ± 0.3
Second biopsy (%)	3 (0.88)

Hb – haemoglobin, BP - blood pressure, [a]vailable in 296.

A total of 21 (6%) patients developed a complication (Table 2). There were 15 (4.4%) minor and 6 (1.7%) major complications. The patients who developed major complications received blood transfusion therapy. The most common complication was hematuria (4.9%). Large and small hematoma occurred in 4 patients, but only in two blood transfusion was required. One patient was transferred to ICU because of severe hypotension and one to surgery, but there were no nephrectomy or death due to the biopsy intervention. No urinary infection or hydronephrosis occurred.

Table 2: Complications following a kidney biopsy

Complication	n (%)
Hematuria	17 (4.9)
Hematoma (> 5 cm)	2 (0.6)
Hypotension/shock	2 (0.6)
Minor complications	15 (4.4)
Major complications	6 (1.7)

Identification of significant independent predictors of complications was performed by entering factors in the univariate model of logistic regression. Overweight patients, those with higher creatinine, lower hemoglobin, higher blood pressure and biopsy due to AKI had higher chances to develop complications (p = 0.037, p = 0.023, p = 0.032, p = 0.002, p = 0.002, respectively). The patients' age, gender, kidney dimension, number of passes and uninterrupted aspirin therapy were not found as significant predictors of complications. In transplanted, solitary native kidney and programmed biopsies, the risk was also insignificant. In the multivariate logistic model, the higher body weight (p = 0.037), lower hemoglobin (p = 0.02) and hypertension (p = 0.007) aggravated the risk of complications in biopsied patients (Table 3).

Table 3: Binary logistic regression of factors associated with increased risk for major bleeding

Risk factor	Odds Ratio	95% confidential interval	P-value
Body weight	1.031	1.002 to 1.062	0.037
Hemoglobin	0.973	0.951 to 0.996	0.02
Hypertension	1.025	1.007 to 1.044	0.007

Discussion

Chronic kidney disease is a worldwide problem and determination of the diagnosis by biopsy is of great value in the early treatment of those patients. Renal biopsy is usually recognised as a safe procedure in native and transplanted kidneys [6], [8], [9], [10]. Brachemi's review on large clinical trials provided an estimate of the frequency of complications after renal biopsy with required blood transfusions from 0.3% to 10% and death due to biopsy in less than 0.1% (5). In our analysis, complications that required blood transfusions were classified as major complications, and their number was rather low – 6 (1.7%). Also, we had no deaths or nephrectomies. Hematuria was noted as the most frequent complication in many studies, ranging from 1.9% up to 10% [6], [11], [13]. In our study, not only gross hematuria but also the lightest transient ones were recorded. It occurred in 17 (4.9%) patients. Thirteen of those patients did not need any blood transfusion. Symptomatic hematoma occurred in only two cases (0.6%), which was less than that presented in other studies [14], [15].

In the assessment of the factors associated with biopsy complications, our results confirmed the previously recognised traditional bleeding factors. Higher serum creatinine and AKI were significant confounding factors in biopsy complications in a large multicentric study on 2563 patients [16] but were also found in smaller monocentric studies, as ours [8], [11]. In our results, these factors lost statistical significance in the multivariate model. Arterial hypertension was found to double the bleeding risk in an analysis of 462 biopsies [14]. Similar results were published by the Norwegian registry on 8573 biopsies [6]. Still, there were studies which did not confirm this association [8], [9] emphasising the history of hypertension as a factor and not the present blood pressure. In our study group, the vast majority of patients had a history of hypertension (74%), but only current hypertension

increased the bleeding risk as an independent predictor. As previously published, the lower pre-biopsy hemoglobin level [4], [11] was also associated with higher risk of complications in our patients. Hemoglobin dropped after biopsy for more than 10 g/L in 6.9% of the patients, but blood transfusion was needed in only 1.7%. This fact also partly explained the data that the lower the hemoglobin the higher the risk of need for transfusion. The indication for a kidney biopsy from a solitary kidney remains an important decision with regards to safety issues and a potential nephrectomy [5]. Only three solitary native kidneys were biopsied in the analyzed period of three years. None of those patients showed any complication. In the group of transplanted patients (14.2%), only one patient had severe bleeding, but recovered well. This low grade of complications in graft biopsies has been confirmed in many studies comparing native and transplanted kidneys [15], [17], [18].

Considering the coagulability as a major concern for bleeding complications, before biopsy in all our patients, platelet count was within reference values (Table 1). Antiplatelet or antithrombotic agents were to be withheld 5 days before biopsy. In 5 (1.4%) of our cases, aspirin was not interrupted at the discretion of the physician, and no bleeding complications occurred. Recent studies support the strategy of not stopping aspirin before renal biopsy in native [16] and transplanted kidneys [19], demonstrating a similar safety profile of the procedure. Obesity is a growing problem in modern medicine. Conventional biopsy is difficult to perform in obese patients and hence, an alternative approach has been developed [20]. In Lees study on 2563 native renal biopsies, there was no increased risk in obese (BMI > 30) patients [16]. But in our study, the body weight was found associated with a higher risk of bleeding complication.

In all 342 patients, 345 biopsies were performed with a standard 16 Ga needle, with two or three passes. The number of passes did not affect the risk of complications, which is in line with previous studies [14].

In conclusion, renal biopsy is a safe procedure with a low risk of complications. Careful assessment of the risk for complications should be performed before the biopsy. Strict biopsy protocol must be observed. Correction of anaemia and blood pressure is to be considered before the biopsy.

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