

## Complications of automated spring fired biopsy gun technique. A retrospective analysis of 230 cases

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### Abstract

**Background:** Renal biopsy (RB) is a procedure which allows obtaining kidney tissue for a morphological diagnosis. As an invasive procedure, RB could lead to some complications. The aim of the study was to assess the incidence and the severity of various complications of renal biopsy (RB) performed by automated spring fired biopsy gun with needles 16 and 18G.

**Material and Methods:** A total number of 230 RB obtained from patients over 18 years of age, within the period from January 2009 to July 2013, were analyzed retrospectively. All RB were performed by a standardized technique using an automated spring fired biopsy gun, with 16, and 18 G disposable needle. The average age of the patients was  $45.5 \pm 22.3$  years, 119 male and 111 female. As many as 170 biopsies were performed with 16 G needle and 60 with 18G. The assessment of the early post-biopsy complications was done by renal ultrasound (US).

**Results:** Of all RB, 92.7% were successfully performed. In 60% of the failed RB 18 G needle was used. No post-biopsy complications were noted in 93.4%. Hematomas were observed in 15 out of 230 cases (6.6%). Of those, 80% were assessed as minor hematomas (12/15) with an average size of  $20.4\text{mm} \pm 11\text{mm}$  and they appeared to be asymptomatic. While 8 cases (66%) of all 12 minor hematomas were obtained by two passes (66%), only 4 cases (34%) of hematoma were observed after one pass  $<0.01$ . The cases of hematomas obtained with 16 G needle were significantly higher than those in the group with 18G (8 to 4,  $p < 0.05$ ). However, when the number of hematomas in both groups referred to the number of all biopsies in the corresponding group, no significant difference of this complication was observed,  $p > 0.05$ . The incidence of major complications was 1.3%.

**Conclusion:** The optimal period for US examination of the kidneys for early diagnosis of complications is up to 24 hours after RB. The experience of the physician performing the procedure is of great importance for reducing the risk of complications as well as the RB technique used. An automated spring fired biopsy gun with needle 16G is recommended. Hippokratia 2014; 18 (1): 40-43.

**Keywords:** Renal biopsy, biopsy complications, spring-loaded biopsy gun

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### Introduction

Diagnosis, treatment and prognosis of most chronic kidney disease is impossible without a precise histomorphological diagnosis. The renal biopsy (RB) is a procedure which allows obtaining kidney tissue for a morphological diagnosis. First RB was carried out in 1950. As an invasive procedure, RB could lead to some complications<sup>1,2</sup>. The risks associated with performing a percutaneous renal biopsy have substantially decreased in the past two decades because of technical advances in the method<sup>3</sup>. In the daily routine, RB is performed by an automated spring fired biopsy gun, which allows obtaining kidney tissue with minimal post-biopsy complications<sup>4-8</sup>. Performing the RB under continuous ultrasound guidance reduces the risk of complications substantially<sup>3,2</sup>. Overall, the RB has become a relatively safe procedure with life-threatening complications occurring in  $<0.1\%$  of biopsies in recent reports<sup>9</sup>. The optimal period for monitoring major and minimal post-biopsy complications comprises the

first 24 hours after the procedure<sup>7,9</sup>. Major complications require surgery or other invasive interventions. Massive hematomas accompanied with anemia due to severe bleeding, needing blood transfusion also belong to the major complications<sup>10-16</sup>. The most common among the minor complications are small intra and perirenal hematomas which resorb spontaneously as well as A-V fistula presenting with mild hematuria or asymptotically<sup>5,11</sup>. The success of the procedure is defined not only by the safety profile but also by the ability to obtain adequate tissue for histomorphological diagnosis<sup>10</sup>.

The aim of the study is to determine the incidence and severity of the various complications after performing a RB with an automated spring fired biopsy gun using 16 and 18G needles.

### Materials and Methods

The total number of RB at the Department of Nephrology at the University Hospital "Alexandrovska" with-

in the period from January 2009 to July 2013 was 420. Tru-cut needle manual biopsy technique was applied to 190 of the cases which were excluded from the analysis of the post-biopsy complications. Retrospectively 230 RB of patients over 18 years old within the period from January 2009 to July 2013 were analyzed, all of them performed with an automated re-usable spring fired biopsy gun (Magnum, Bard, UK) with 16, and 18 G disposable needle. The average age of the patients was  $45.5 \pm 22.3$  years, 119 men and 111 women. Elevated serum creatinine levels were observed in 46 cases corresponding to 20% of the patients studied: 8 patients with creatinine  $>800 \mu\text{mol/l}$ , five with creatinine ranging between 400 and  $800 \mu\text{mol/l}$ , six between 300 and  $400 \mu\text{mol/l}$ , and twenty five between 150 and  $300 \mu\text{mol/l}$ .

RB was performed according to individual indications by an infiltrative 2% Lidocaine anesthesia in the absence of absolute contraindications. A standardized biopsy technique including a biopsy needle 16 or 18 G disposable type with an automatic gun was used (automated re-usable spring fired biopsy gun)<sup>6,7</sup>. The target of the biopsy was the lower pole of the left kidney, previously localized by ultrasound guidance. RB was performed under normal coagulation parameters, normal platelet count, fibrinogen, prothrombin time, international normalized ratio (INR), activated partial thromboplastin time (aPTT), in presence of two functioning kidneys, stable hemodynamics, and blood pressure  $\leq 150/90 \text{ mmHg}$ . As many as 170 biopsies were performed with 16 G needle and 60 with 18 G needle.

All patients after RB were hospitalized and they followed a standard protocol consisting of 2 hours bed rest after the biopsy. Arterial blood pressure was monitored every 4 hours in the first 24 hours. Renal ultrasound (US) was performed in all cases, up to 24 hours after the biopsy for an early diagnosis and analysis of the post-biopsy complications. Renal haematomas were visualized with conventional US and depending on the localization they were defined as intra or peri-renal. As clinically significant were considered hematomas larger than 10 mm.

## Results

Of all biopsies, 92.7 % (213/230) were successfully performed - sufficient material for a histological diagnosis was obtained. The mean number of glomeruli in the biopsy was  $15 \pm 6$ . In cases of RB performed with 16 G needle, the mean number of glomeruli was  $14 \pm 5$ , while in cases of the RB with 18 G needle, the mean number was significantly lower, however still enough for exact histological diagnosis:  $11 \pm 2$  ( $p < 0.05$ ). In 17 out of 230 biopsies (7.3%), there were no sufficient glomeruli in order to provide a histological diagnosis and were classified as unsuccessful. As many as 60 % of the unsuccessful biopsy were performed with 18G needle and 40% with 16G needle ( $p < 0.01$ ). In 78% from all biopsies (180/230) the material was obtained after one pass, in 22% (50/230) - after two passes.

In 93.4% of the cases with a successfully performed

procedure no post-biopsy complications were observed. The US control study did not show any post-biopsy hematoma in 215 biopsies. The detected US hematomas up to 24 hours after the RB were 15 (15/230 biopsies) which is 6.6 % of all biopsies. Around 80% of the hematomas (12/15) were negligible small with an average size  $20.4 \text{ mm} \pm 11 \text{ mm}$  and they were asymptomatic. From all those 12 minor hematomas, 8 were intrarenal and 4 were both intrarenal and perirenal. In 8 of the 12 minor hematomas, the biopsy was obtained after two passes (66%), and in 4 of 12 cases (34%) the biopsy material was obtained after one pass ( $p < 0.01$ ). In the group of the biopsy performed with 16 G needle, which includes 170 patients, 8 minor hematomas were registered thus the incidence of hematoma in this group was 4.7% In the group of the biopsies with 18 G needle, which consisted of 60 patients, 4 minor hematomas were registered. The incidence of hematomas in this group was 6%. When the number of hematomas in both groups referred to the total number of biopsies for each group, no significant difference was observed  $p > 0.05$ .

Five of the minor hematomas were in patients with impaired renal function, the mean level of serum creatinine was  $180 \pm 50 \mu\text{mol/l}$ , the rest 7 minor hematomas were observed in patients with normal renal function,  $p = 0.05$ .

Only 3 major hematomas with average size  $12 \text{ cm} \pm 2.8 \text{ cm}$  were observed. Thus the incidence of major complications was 3 of 230 cases (1.3% from biopsies). In one case of intrarenal hematoma with 12cm size an active bleeding was registered, which led to decrease in hemoglobin and 3 blood transfusions were performed. The bleeding was managed conservatively and no embolization or surgery was necessary. The other major hematomas were perirenal and their size was 12 cm and 10 cm, respectively. The ultrasound monitoring showed an increase in the hematoma size in the first 24 hours after the biopsy, however the active bleeding within 24 hours was managed conservatively. All major hematomas occurred in patients with normal renal function, normal coagulation status, and blood pressure. The major complications were observed in one patient with lupus vasculitis and in two patients with lupus nephritis. The material in one case of major complication was taken after two passes and in the rest 2 cases with a single pass. In all cases 16 G needles were used.

## Discussion

RB is an easy, fast and safe method which provides tissue from the kidney for further histological examination. Korbet SM et al, have presented a review on the post-biopsy complications, analysing the literature from the last 20 years and they have shown that within that period nearly 1% of cases have shown major complications requiring invasive procedures, blood transfusions or surgery. The incidence of hematoma does not exceed 25%. The incidence of minor hematomas varied from 5 to 25%<sup>4,9,10-14,16</sup>. The authors recommend an ultrasound monitoring within 24 hours after RB, when more than

95% of the complications occur<sup>1,2,4,6-9</sup>. The introduction of new biopsy techniques: biopsy under ultrasound guidance and the use of an automatic type Gun, can decrease the incidence of complications substantially without a change in the frequency of major complications. Literature data show that hematoma after biopsy Gun system is observed in about 10% of the cases<sup>11,13,14,17</sup>. In our work published in 2007 we reported a hematoma incidence within 24 hours, for the Gun technique RB, under 10% which is in line with retrospective studies in Europe<sup>1-3,14,16,18</sup>. Present data show hematomas in 6.6% of the biopsies while 93.4% are without any complications. In fact, 80% from the hematomas observed do not present with clinical symptoms. The number of hematomas after RB in which the material is obtained after two passes is significantly higher than the number of minor hematomas in cases of a single pass. When the number of hematomas in the two groups referred to all biopsies in the corresponding group, no significant difference in the incidence of this complication was observed. When we perform the biopsy with bigger size of needle (16 G) we would expect more cases of hematomas but we found higher (but not significant) percentage of hematomas in the group of 18 G (6%). These findings are explained by the fact that we performed the biopsies in this group with more than one pass which increases the risk of post biopsy hematoma. In order to assess the importance of the needle thickness as a risk factor for hematomas approximately the same number of biopsies performed with 14, 16 and 18 G needle should be analyze. A disadvantage of present study is the lack of such groups and no biopsies taken with needle 14 G. Literature data reveal that the thickness of the needle is an important factor determining the risk of hematoma and the thick needles 14G are most at risk<sup>12-14,16</sup>. On one hand, the thickness of the needle is a significant factor for the development of hematomas but from the other hand the size of the needle is an important factor for the quality of the material obtained. Data from the literature show that in most biopsies performed with gun, 16 G needles are used<sup>2,4,7,9,13,16</sup>. Only in 7.3% of the biopsies, in our analysis, there were not enough glomeruli for a histological diagnosis; of these biopsies 60% were performed with 18G needle, and only 40% with 16 G needle. Another disadvantage of the current study is that it does not provide meta-analysis of other clinical factors such as age, stages of renal insufficiency, histological diagnosis which are relevant to the risk of post-biopsy complications. Patients selection may affect outcome because studies with older patients, more women, and higher rates of acute kidney injury had higher complication rates. We focused our attention only on the risk which is connected to the RB technique. In the current analysis the incidence of major complication is 1.3%. Our data were similar to those previously reported in the literature<sup>2,10,14-16</sup>. Number of major complications in the current study was too small to be able to analyze the risk factors for bleeding. It is noteworthy that patients with major complications suffer from systemic lupus erythematosus and

vasculitis. Although a normal coagulation and absence of antiphospholipid antibodies were observed before the RB, it is possible that the disease itself -vascular inflammation and fragility, endothelial dysfunction contribute to the risk of bleeding.

In summary, our results as well as literature data indicate that the automated technique of spring fired biopsy gun with needles 16 and 18 G reduces the incidence of complications. The biopsies performed with 16 G needle have an advantage in terms of quality of the obtained material compared to 18 G needles, the material is significantly larger and it improves the diagnostic process. Furthermore, there is a biopsy technique and clinical factors which determine the risk of post-biopsy complications. We confirm that the optimum period for ultrasound examination of kidneys for an early diagnosis of complications is up to 24 hours after RB. To reduce the risk of hematoma, the physician's RB technique and experience is crucial. Except for the coagulation, there are no certain clinical or laboratory criteria which point the patients at high risk for post-biopsy complications<sup>12,14-16,19,20</sup>.

Our results concerning the incidence of major and minor hematomas support data from the literature about the complications of biopsy performed with an automated spring fired biopsy gun published in Europe in the last 10-15 years<sup>1,2,4,8,11,13</sup>. We strongly recommend a biopsy gun technique under ultrasound guidance with needle 16G, which ensures a sufficient material for histological diagnosis without significantly increased risk of hematoma. Despite possible post-biopsy complications, RB is a routine invasive procedure in nephrology, which poses minimal risks to patients and it is necessary for the diagnostic and therapeutic process.

#### Conflict of interest

None declared by authors.

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