Needle Size and the Risk of Kidney Biopsy Bleeding Complications

To the Editor: The percutaneous renal biopsy is an essential tool in the diagnosis and evaluation of kidney disease. Most renal biopsies are performed under direct ultrasound guidance with automated biopsy needles, techniques that have substantially reduced the risks of the procedure. However, the kidney biopsy still carries a considerable risk of bleeding complications. Although certain risk factors for bleeding, including hypertension, acute kidney injury, female sex, and older age, have been well documented, the association between the biopsy needle size and the rate of bleeding complications is unclear. Major complications, including hemorrhage requiring transfusion, angiographic intervention, nephrectomy, or death, have been reported in only around 2%–8% of renal biopsies, whereas minor complications, such as hematoma, are seen in anywhere from 17% to 33%.

Hematoma formation found on renal ultrasound is a direct assessment of post-biopsy bleeding and may be a more sensitive measure of bleeding than overt anemia or hemodynamic instability. At our institution, post-biopsy ultrasounds are routinely monitored for at least 6 hours after biopsy. A renal ultrasound is a direct assessment of post-biopsy bleeding. All patients were obtained as standard of care after kidney biopsy. We used electronic health record databases to capture demographic and clinical data. The outcome of interest was the occurrence of a post-biopsy hematoma. The secondary outcome was the change in hemoglobin concentration before and 6 hours after biopsy.

We used a \( \chi^2 \) or \( t \)-test to compare baseline characteristics between patients with 16G and 14G needles. We used multivariate logistic regression to test the association between the needle size and the occurrence of a post-biopsy hematoma adjusted for clinical and demographic characteristics. We selected covariates that were previously shown to be associated with an increased risk of bleeding after biopsy including age, sex, needle size, platelet count, systolic blood pressure, and estimated glomerular filtration rate. We additionally adjusted for fellow performance of biopsies and the number of passes. Finally, we adjusted for the presence of >40% fibrosis on the biopsy as this was associated with a risk of hematoma in the univariate analysis. We used R, version 3.2.2, for all statistical analyses and considered \( P < 0.05 \) to be statistically significant.

Our cohort consisted of 86 patients with a mean age of 56.5 ± 16.9 years. Baseline characteristics, stratified by needle size and by the occurrence of a hematoma, are shown in Table 1. A 14G biopsy needle was used in 44 (51%) of patients and a 16G biopsy needle was used in the remaining patients. There were a similar proportion of patients who had inpatient biopsies in the 14G group compared with the 16G group (34% vs. 43%, respectively, \( P = 0.54 \)). More passes were performed to obtain adequate samples in the 14G group compared with the 16G group (2.7 vs. 2.2, respectively, \( P = 0.003 \)). There was no effect of the number of passes on the risk of hematoma (\( P = 0.49 \)).

Hematoma formation was more frequent among individuals who underwent kidney biopsy using 14G needles compared with 16G needles (41% vs. 17%, respectively, \( P = 0.03 \)). There was no difference in the diagnostic yield of glomeruli between the 2 groups (43 ± 21.6 vs. 37 ± 12.3 glomeruli, respectively, \( P = 0.13 \)). There were no patients in whom the tissue obtained was inadequate to make a diagnosis. In a logistic regression analysis, the use of a 14G needle was associated with a significantly higher risk of hematoma (odds ratio 5.72, 95% confidence interval 1.54–25.7, \( P = 0.01 \)) after multivariable adjustment for
commonly reported factors associated with post-biopsy complications, including age, gender, needle size, whether a fellow performed the biopsy, the kidney that was biopsied, number of passes, systolic blood pressure, and eGFR (Table 2). Other factors that were significantly associated with hematoma in the multivariable model included the platelet count and the presence of significant (>40%) fibrosis on the renal biopsy. The post-biopsy fall in hemoglobin levels was 0.4 g/dl greater in patients who had a post-biopsy hematoma at 1 hour after biopsy was not predictive of a complicated post-biopsy course (positive predictive value of 43% and negative predictive value of 95% for predicting clinical complications). Another study found that the presence of a perirenal hematoma >2 cm immediately after biopsy was the strongest predictor of more severe anemia the morning after biopsy. The occurrence of a hematoma can also lead to longer hospital stays and higher treatment costs. We have previously shown that in our institution, outpatient biopsies are associated with an 82% decrease in costs.

The use of 14G needles was associated with a higher complication rate without providing any appreciable benefit for diagnostic yield. Although the presence of a hematoma is a minor complication, it is associated with an increased risk of major complications. One study has shown that the absence of a hematoma 1 hour after biopsy was strongly associated with an uncomplicated post-biopsy course, although the presence of a

| Predictor                | Univariate model | Multivariate model |
|--------------------------|------------------|--------------------|
|                         | Odds ratio | 95% CI | P-value | Odds ratio | 95% CI | P-value |
| 14-gauge versus 16-gauge  | 3.46       | 1.30–10.00 | 0.02 | 5.72       | 1.54–25.79 | 0.01 |
| Left versus right side   | 2.03       | 0.65–7.71 | 0.25 | 2.05       | 0.48–10.40 | 0.35 |
| Number of passes         | 1.24       | 0.67–2.25 | 0.48 | 0.99       | 0.42–2.28 | 0.98 |
| Platelets (per 100 K/u)  | 1.60       | 1.02–2.68 | 0.05 | 1.91       | 1.06–3.87 | 0.05 |
| Intestinal fibrosis >40% versus <40% | 4.70 | 1.76–13.1 | 0.002 | 5.86 | 1.53–25.6 | 0.01 |
| Age (per 10 yr)          | 0.85       | 0.65–1.22 | 0.25 | 0.83       | 0.55–1.22 | 0.35 |
| Female versus male       | 0.95       | 0.37–2.43 | 0.9 | 0.58       | 0.17–1.87 | 0.37 |

Factors adjusted for in the multivariable model: age, gender, needle size, whether fellow performed the biopsy, kidney that was biopsied, number of passes, platelet count, systolic blood pressure, eGFR, interstitial fibrosis (>40% vs. <40%). CI, confidence interval; eGFR, estimated glomerular filtration rate.

**Table 2. Predictors of hematoma after renal biopsy**
relative to inpatient biopsies. Although not statistically significant, there was a reduction in the number of admissions for observation in our cohort using 16G needles that, based on our prior research, likely reduced overall costs associated with the procedure.

Whether or not larger needles are associated with a higher complication rate after kidney biopsy is controversial. Smaller studies have found no association between needle size and major complications. This may be due in part to the low overall event rate of major complications in these studies. In contrast, a large meta-analysis of biopsies from 1980 to 2011 found that the use of 14G needles was associated with a higher rate of transfusion after biopsy compared with 16G and 18G needles. However, another large study using data from a Norwegian kidney biopsy registry spanning a similar time frame found that there was no difference in major complication rates between 14G and 16G needles, although the overall rate of complications in that study was remarkably low. In addition, there was a trend towards a higher rate of complications in individuals using 18G needles, suggesting that there may have been a selection bias where patients perceived to be at a higher risk of bleeding were more likely to have a biopsy with smaller needles.

More recently, a study comparing 14G and 16G needles found that there was no difference in adequacy but that the rate of post-biopsy hematomas was significantly higher with larger needles (39% vs. 22%). These findings were comparable to the results of this study.

The findings of this study are limited due to the small sample size and its retrospective nature, which could introduce potential bias. Our findings suggest that there is a need to carefully weigh the potential risks of using a larger biopsy needle against the desire for more diagnostic tissue.

In conclusion, 16G needles result in fewer post-biopsy hematomas and have equivalent diagnostic yield compared with 14G needles for kidney biopsy.

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DISCLOSURE

All the authors declared no competing interests.

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