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Reduction of hemorrhagic complications after non-focal renal biopsy with pre-procedure desmopressin administration

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PURPOSE

Ultrasound-guided non-focal renal biopsy (NFRB), which is performed to assess systemic renal processes, is associated with a 1.5%–14% bleeding risk. The goal of this study is to evaluate the safety and efficacy of 1-deamino-8-D-arginine vasopressin (DDAVP, or desmopressin) in mitigating bleeding risk when administered prior to NFRB.

METHODS

This retrospective observational study includes 158 patients who underwent NFRB between March 2022 and June 2025 at the study hospital before and after the implementation of a DDAVP administration protocol. Beginning in July 2023, every patient at the study site received intravenous DDAVP immediately before biopsy, regardless of renal function. Ultimately, 79 patients received DDAVP (the DDAVP group), and 79 did not receive the intervention (the non-DDAVP group). This study's primary endpoint was clinically significant bleeding (resulting in unplanned admission; intervention for bleeding, such as angiography or surgery; and/or death) within 1 week of biopsy. Secondary endpoints were hyponatremia or a thromboembolic event within 1 week of biopsy. The data from patients in the two groups were compared using Mann–Whitney U tests for non-parametric data, Student's t-tests for parametric data, and chi-squared tests for categorical data (with an alpha level of $P < 0.05$).

RESULTS

Six of the 79 patients (8%) in the non-DDAVP group experienced a clinically significant hemorrhage, compared with 0 in the DDAVP group ($P = 0.03$). Sodium levels were not significantly different between the two groups post-procedure ($P = 0.43$). There was no significant difference in the rate of thromboembolic events between the two groups [2/79 (2.5%) in the non-DDAVP group vs. 3/79 (3.8%) in the DDAVP group; $P = 1.00$]. The 5 patients (out of 158; 3.2%) who experienced a thromboembolic event within 1 week of NFRB had been on anticoagulants or antiplatelet agents that were held for biopsy.

CONCLUSION

DDAVP is associated with a reduction in unplanned hospitalizations and bleeding interventions (angiography and embolization) after NFRB, without an observed increase in thromboembolic events.

CLINICAL SIGNIFICANCE

Routine DDAVP administration before NRFB significantly reduces clinically significant bleeding, supporting its potential role as a simple prophylactic strategy.

KEYWORDS

Non-focal renal biopsy, desmopressin, hemorrhage

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Ultrasound-guided percutaneous non-focal renal biopsy (NFRB) is performed to assess systemic processes affecting the kidneys, such as nephropathies.[1] The Society of Interventional Radiology (SIR) considers NFRB to carry a high bleeding risk, with a threshold adverse event rate of 5%.[2] Bleeding after NFRB has been reported in up to 14% of cases,[3] with risk factors including a low estimated glomerular filtration rate (eGFR), hypertension, prolonged bleeding time, acute tubular necrosis, vasculitis, systemic lupus erythematosus, female sex, younger age, abnormal coagulation factors, anticoagulant or antiplatelet agent use, and anemia.[4-7] Hemorrhage after NFRB is particularly concerning, since anemia and a low eGFR yield a high risk of contrast-induced nephropathy, should contrast angiography be required.[8]

The administration of 1-deamino-8-D-arginine vasopressin (DDAVP, or desmopressin), a synthetic analogue of vasopressin that increases blood plasma levels of the von Willebrand factor and clotting factor VIII, has been proposed to minimize bleeding risk. Theoretically, DDAVP could reverse uremia-mediated prolonged bleeding times, impaired platelet aggregation, and von Willebrand factor dysfunction.[9] Systematic reviews suggest that there is insufficient high-quality evidence to support the routine use of DDAVP before NFRB.[10] Additionally, DDAVP may cause adverse events resulting from hypercoagulable states, including thromboembolic events and metabolic derangements (e.g., hyponatremia).[11] There is controversy in the literature regarding the use of DDAVP, with some studies showing a benefit and others showing none.[10] A recent randomized study demonstrated that DDAVP administration in patients undergoing biopsy resulted in fewer and smaller perirenal hematomas, regardless of baseline renal function,[12] though there were no differences in the need for interventions such as arterial embolization or hospital admission in this study. Based on this paper, a DDAVP administration protocol was initiated at our academic institution for all patients undergoing NFRB, and data were collected on all biopsies performed before and after the instatement of this protocol to assess the safety and efficacy of DDAVP in lowering bleeding risk.

Main points

- Non-focal renal biopsy (NFRB), performed to evaluate systemic renal disease, carries a bleeding risk that may be reduced by the administration of desmopressin (DDAVP or 1-deamino-8-D-arginine vasopressin) immediately before the procedure.
- A clinically significant hemorrhage occurred in 8% of the patients who did not receive DDAVP, compared with 0% of those who received DDAVP.
- No differences in the rates of hyponatremia or thromboembolic events were observed between the two groups.
- Routine DDAVP administration before NFRB may improve patient safety by preventing major bleeding.

Methods

This single-center retrospective observational study, conducted at Charleston Area Medical Center in Charleston, West Virginia, complies with the Health Insurance Portability and Accountability Act and was approved by the Charleston Area Medical Center Institutional Review Board (protocol number: #23-935, date: 03.06.2023). One-hundred fifty-eight patients who underwent ultrasound-guided NFRB, performed by two interventional radiologists with 11 and 31 years of experience, between March 2022 and June 2025 were included (Figure 1). Due to its retrospective nature, informed consent was not required for this study. Initially, DDAVP was not administered to any patient peri-procedurally. Beginning in July 2023, every patient was administered DDAVP intravenously (0.3 mcg/kg) within 1–2 hours before biopsy, regardless of renal function. Ultimately, 79 patients received DDAVP (the DDAVP group), and 79 did not receive the intervention (the non-DDAVP group). One operator who joined the practice in May 2023 performed NFRPs under both computed tomography and ultrasound guidance. For consistency across cases and to allow for meaningful comparisons, this analysis was limited to procedures performed with ultrasound guidance.

Biopsies were performed using a 17-gauge coaxial guide to obtain 18-gauge cores, with the on-site assessment of specimen adequacy performed by trained cytotechnologists. The obtained tracts were embolized with an absorbable gelatin sponge. Anticoagulants and antiplatelet agents were always held, according to SIR practice guidelines.[13] Blood pressure was controlled such that systolic blood pressure (SBP) was maintained below 140 mmHg. Inpatients were not accepted for biopsy unless their SBP was < 140 mmHg. If a patient's pressure was elevated upon arrival to the interventional radiology unit, 10 mg of intravenous hydralazine was administered. If their SBP was < 150 mmHg, the patient was placed in a prone position, and intravenous midazolam and fentanyl were administered. If their SBP was still > 140 mmHg, a second dose of hydralazine was administered. If the patient's SBP was still not < 140 mmHg, the procedure was aborted and rescheduled with anesthesiologic support. Patients were recovered for ≥ 2 hours on strict bedrest in a supine position, either in their inpatient beds or in a recovery space, prior to discharge.

Patients who underwent biopsies were identified by a search of the institution's picture archiving and communication system. Demographic characteristics, laboratory information, vital signs, hospitalization status, and other interventions were gleaned from medical charts. The primary endpoint of this

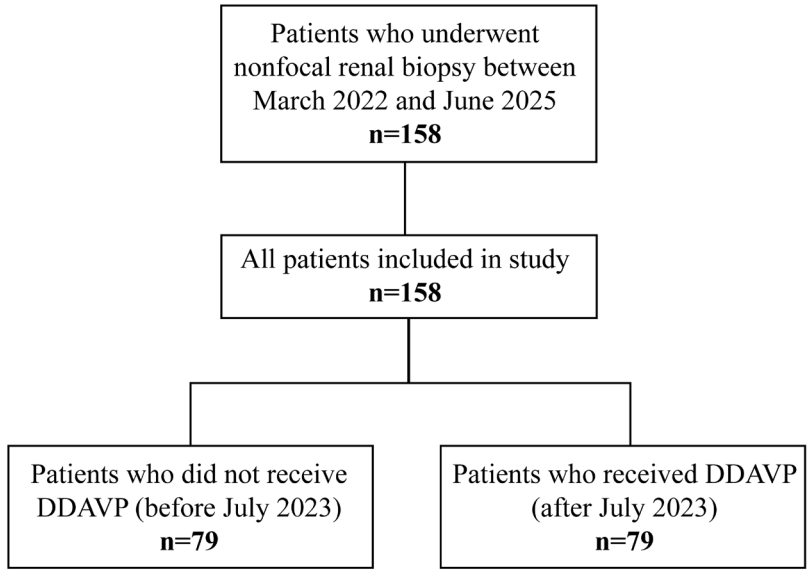


Figure 1. Study flowchart. DDAVP, 1-deamino-8-D-arginine vasopressin (desmopressin).

study was clinically significant hemorrhage. Given the high rate of transfusions for anemia in patients with renal failure, clinically significant hemorrhage was defined as hospital admission, angiography with or without embolization, and surgery to control bleeding within 1 week of biopsy. Secondary endpoints were a thromboembolic event within 1 week of biopsy and hyponatremia. Thromboembolic events were defined as stroke, myocardial infarction, and other embolic complications and were determined based on their documentation in consultation notes. Sodium and hemoglobin levels were observed within 24 hours before and after biopsy.

Statistical analysis

Data analysis was performed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Comparisons of continuous variables were conducted using Mann–Whitney U tests for abnormally distributed data and represented as median (interquartile range; range), and Student's t-tests were used for normally distributed data and represented as (mean ± standard deviation; range). Categorial data were compared using chi-squares tests and Wilson confidence intervals (CIs)—or Fisher's exact test and a Clopper–Pearson for CIs (for binomial variables)—and presented as number (n), proportion (%), and CI, as dictated by the data. Alpha was set to $P < 0.05$ for all tests. Multivariate analysis was completed using Firth's bias-reduced logistic regression.

Results

The patients in the non-DDAVP group were older on average than their counterparts in the DDAVP group but matched them in terms of baseline renal function (Table 1). Most often, three core biopsies were obtained. The median dose of DDAVP administered was 25 (13.6; 12–43.7) mcg in the DDAVP group. Sodium and hemoglobin levels did not differ between the two groups before or after the procedure (Table 2). Blood transfusion within 48 hours of biopsy was the same for both groups (Table 2).

Six of the 79 patients (8%) in the non-DDAVP group experienced a clinically significant hemorrhage within 1 week of biopsy, compared with 0 patients in the DDAVP group ($P = 0.03$) (Table 2). Among these 6 patients (Table 3), the median pre-procedure eGFR was 29.5 (14; 6–83), compared with 30 (34; 6–100) among the patients in the non-DDAVP group who did not experience clinically significant bleeds ($P = 0.82$). No patient required surgery to stop bleeding after biopsy, and there were no deaths. In both groups, there were patients who experienced a stroke or myocardial infarction, but the odds of thromboembolic events were not significantly different between the two groups (odds ratio: 1.52; 95% CI: 0.25–9.35).

Table 1. Baseline characteristics

Characteristic	w/o DDAVP	w/ DDAVP	*P* value
Number of patients (n)*	79	79	
Mean age (years)	59 ± 14	54 ± 18	0.04
Male gender (n [%])	38 (48.1%)	43 (54.4%)	0.43
Performed on inpatient basis (n [%])	29 (36.7%)	44 (55.7%)	0.02
Number of cores (median [IQR; range])	3 (1; 2–11)	3 (1; 2–7)	0.10
Maximum SBP during biopsy (mmHg) (mean ± SD)	123.8 ± 13.0	120.6 ± 15.6	0.16
DBP during biopsy (mmHg) (mean ± SD)	69.1 ± 10.1	67.1 ± 12.9	0.30
Hemoglobin before biopsy (g/dL) (median [IQR; range])	n = 45, 9.5 (2.4; 6.7–17.7)	n = 57, 9.4 (2.9; 7.2–19.4)	0.50
eGFR before biopsy (mL/min) (median [IQR; range])*	n = 76, 30.0 (33; 6–100)	23.0 (38; 4–128)	0.39
Sodium before biopsy (mmol/L) (mean ± SD; range)	n = 44, 136.8 ± 4.3; 126–145)	n = 57, 137.19 ± 3.3; 130–144	0.61

*n = 79, except where otherwise noted.
DDAVP, 1-deamino-8-D-arginine vasopressin (desmopressin); IQR, interquartile range; SBP, systolic blood pressure; SD, standard deviation; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate; w/o, without; w/, with.

Table 2. Adverse events and laboratory changes after biopsy

Characteristic	w/o DDAVP	w/ DDAVP	*P* value
Number of patients (n)*	79	79	
Sodium after biopsy (mmol/L) (mean ± SD; range)	n = 36, 136 ± 3.81; 130–147	n = 46, 137 ± 3.96; 130–146	0.43
Hemoglobin after biopsy (g/dL) (median [IQR; range])*	n = 36, 9.2 (2.0; 6.7–16.6)	n = 46, 8.8 (2.9; 6.5–15.8)	0.28
Blood transfusion within 48 h	8 (10.1%)	8 (10.1%)	1.00
Clinically significant hemorrhage within 1 week (n [%; 95% CI])	6 (7.6%; 0.03–0.16)	0 (0%; 0.95–1.00)	0.03**
Unplanned admission only (n [%; 95% CI])	2 (2.5%; 0.003–0.089)	0 (0%; 0.95–1.00)	0.50**
Angiography only (already admitted) (n [%; 95% CI])	1 (1.3%; 0.0003–0.069)	0 (0%; 0.95–1.00)	1.00**
Unplanned admission and angiography (n [%; 95% CI])	3 (3.8%; 0.008–0.107)	0 (0%; 0.95–1.00)	0.25**
Surgery for bleeding control (n [%; 95% CI])	0 (%; 0.95–1.00)	0 (0%; 0.95–1.00)	
Thromboembolic event within 1 week (n [%; 95% CI])	2 (2.5%; 0.003–0.089)	3 (3.8%; 0.008–0.107)	1.00**
Myocardial infarction (n [%; 95% CI])	1 (1.3%; 0.0003–0.069)	2 (2.5%; 0.003–0.089)	1.00**
Stroke/transient ischemic attack (n [%; 95% CI])	1 (1.3%; 0.0003–0.069)	1 (1.3%; 0.0003–0.069)	1.00**

*n = 79, except where otherwise noted; **Fisher's exact test.
DDAVP, 1-deamino-8-D-arginine vasopressin (desmopressin); SD, standard deviation; IQR, interquartile range; CI, confidence interval; w/o, without; w/, with.

Table 3. Characteristics of patients with clinically significant hemorrhage after biopsy

Patient	1	2	3	4	5	6
Age (years)	66	29	61	75	75	39
Gender	M	F	M	F	F	F
Number of cores	3	5	4	6	3	5
Maximum SBP (mmHg)	146	120	132	108	114	120
eGFR	20	6	32	27	34	83
Hemoglobin (g/dL) before	13.4	6.7	11.8	12.3	9.7	13.5
Hemoglobin (g/dL) after	14	8.5	10	11.4	7.1	8.8
Blood transfusion	No	Yes	Yes	No	Yes	Yes
Unplanned admission	Yes	Yes	Yes	Yes	No*	Yes
Angiography	No	Yes	Yes	No	Yes	Yes
Embolization		Yes	No		No	Yes

*Already admitted.
SBP, systolic blood pressure; eGFR, estimated glomerular filtration rate.

All 5 patients who experienced thromboembolic events within 1 week of biopsy had been on an anticoagulant or antiplatelet therapy that was held, as per SIR guidelines, for biopsy. A regression model that evaluated covariates—including 1) the use or nonuse of DDAVP; 2) eGFR levels, broken into three ranges (≥ 45, ≥ 15 to < 45, and < 15); 3) the number of cores obtained (≤ 4 or > 4); 4) age (≥ 65 or < 65 years); and 5) visit status (inpatient or outpatient)—and considered 155 patients showed that those who did not receive DDAVP were 13.8 times (95% CI: 1.0–185.0) more likely to experience a clinically significant hemorrhage ($P = 0.048$). No other covariates were significant.

Discussion

In this single-center retrospective study, DDAVP administration before NFRB was associated with a significant reduction in the risk of clinically significant hemorrhage. The patients who received DDAVP were administered the intervention regardless of baseline renal function. No differences in thromboembolic events or hyponatremia were observed between the two groups in this cohort. Our findings suggest that the routine administration of DDAVP before NFRB may prevent hemorrhagic complications, which are associated with worse outcomes and increased healthcare costs.

This study differs from prior literature in two ways. First, this study focused on clinically significant bleeds, whereas prior research investigated hematomas after biopsy, which are common but do not necessarily result in a need for intervention.[12] Second, DDAVP administration in this study proceeded regardless of baseline eGFR, unlike prior reports.[14] Low eGFR is a risk factor for bleeding after NFRB due to uremic platelet dysfunction, which may be reversed by DDAVP. For patients with no coagulopathies or uremia, DDAVP may lower bleeding risk by stimulating the release of the von Willebrand factor, improving platelet adhesion and aggregation, and enhancing clotting activity.[15]

The lack of an observed increase in thromboembolic events or hyponatremia provides reassurance for the broader use of DDAVP prior to biopsy. DDAVP is an antidiuretic agent that promotes water retention, potentially leading to hyponatremia, though this was not observed in the current study. DDAVP also has thrombogenic properties that could cause major thromboembolic events, including stroke and myocardial infarction. It may be that the holding of anticoagulants and antiplatelet agents itself leads to the observed risk of stroke and myocardial infarction, regardless of DDAVP administration. The finding that NFRB is associated with a 3%–5% risk of stroke or myocardial infarction is important to note when counseling patients who are on antiplatelet or anticoagulant medications and who are planning to undergo NFRB.

This study has several limitations. Its retrospective, non-randomized design inherently limits our ability to establish causality and is subject to incomplete data and unmeasured confounders. Patients who received DDAVP were not matched to those who did not, which may have resulted in selection bias. In particular, biopsies performed without DDAVP administration were more commonly performed on an outpatient basis and on older patients. Additionally, the study was conducted over a 3-year period, during which time an evolution in procedural techniques, operator experience, and institutional practice patterns may have occurred, potentially introducing temporal and procedural biases. As a single-center study, these findings may not be generalizable to other settings. Data on potential confounders, such as platelet and clotting function, which may influence bleeding outcomes, were not consistently available. Finally, this study was not adequately powered to detect a difference in very rare observations, such as thromboembolic events. Given the low absolute difference in the rate of stroke and myocardial infarction between the two groups (1.3%), approximately 4,000 patients per group would be required to achieve 90% power at an alpha level of 0.05. Future prospective randomized studies with larger and more diverse cohorts would help confirm these findings and clarify the role of DDAVP in reducing bleeding complications after NFRB in all patients, regardless of renal function.

In conclusion, DDAVP administration immediately before NFRB is associated with a decrease in unplanned hospitalizations and angiographic procedures, with no observed increase in thromboembolic events or hyponatremia. The routine administration of DDAVP prior to NFRB may mitigate hemorrhagic complications.

Footnotes

Conflict of interest disclosure

Dr. Deipolyi is a paid consultant for Boston Scientific, Inc., and Varian, Medical. The other authors have no conflicts of interest.

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