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Does renal parenchymal thickness affect bleeding in percutaneous nephrolithotomy?

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Aim: Blood loss is a major concern during percutaneous nephrolithotomy. The aim of this study was to evaluate the effect of access point parenchymal thickness on bleeding in percutaneous nephrolithotomy procedures.

Materials and methods: In this study 85 patients who had undergone a percutaneous nephrolithotomy operation between February 2009 and July 2011 were reviewed retrospectively. All characteristics of the patients were investigated. The details of the operative procedure and the renal parenchymal thickness at the puncture site were also recorded. Blood loss was calculated during the peroperative and postoperative periods. Correlation and multivariate regression analysis were done to detect predictive factors on bleeding.

Results: Of the 85 percutaneous nephrolithotomy procedures done, 12 (14.1%) patients had no diminution of hemoglobin value postoperatively and were excluded. This left 73 percutaneous nephrolithotomy procedures that were evaluated. The mean peroperative hemoglobin drop was 1.79 ± 1.17 mg/dL. Stone size, operation time, and grade of hydronephrosis were correlated with hemoglobin drop significantly ($P = 0.047$, $P = 0.016$, and $P = 0.034$, respectively). There was no correlation between parenchymal thickness and bleeding ($P = 0.545$). In multivariate regression analysis, only the operation time was found to be a statistically significant independent predictive factor for peroperative bleeding in percutaneous nephrolithotomy ($P = 0.005$).

Conclusion: Renal parenchymal thickness and the grade of hydronephrosis do not predict peroperative hemorrhage in percutaneous nephrolithotomy procedures.

Key words: Percutaneous nephrolithotomy, parenchymal thickness, hemoglobin drop, bleeding

1. Introduction

Percutaneous nephrolithotomy (PNL) is an established procedure for surgical treatment in patients with large and complex renal calculi (1). Development of the technology and increasing experience in the last 2 decades have led to increased safety and efficacy. Nevertheless, complications may still occur. Renal hemorrhage is one of the most dangerous complications of PNL (2–4). Surgical bleeding is the main cause of blood loss, and as such, the urological surgeon is responsible for optimizing renal access, tract dilation, and renal manipulation and minimizing technical errors. As numerous functional, morphologic, biochemical, pathologic, nuclear, and radiologic studies have shown, PNL causes minimal or no renal injury. However, there is a belief that thick renal parenchyma is related to much peroperative and postoperative bleeding after a PNL procedure; thin renal parenchyma is also related to less bleeding. In addition, there have been a few published studies reporting no correlation between renal parenchymal thicknesses and bleeding during PNL (5,6).

The aim of this study was to identify the risk factors predicting peroperative and postoperative bleeding and to present the correlation between renal parenchymal thickness and bleeding due to the PNL procedure.

2. Material and methods

After informed consent was obtained verbally, 85 patients who underwent PNL procedures between February 2009 and July 2011 at Osmaniye State Hospital (Osmaniye, Turkey) were retrospectively reviewed. Preoperative patient evaluation included history, clinical examination, serum creatinine level, complete blood count, coagulation

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profile, and liver function tests. Radiological investigations included excretory urography and noncontrast computerized tomography (CT) to figure out the parenchymal thickness, kidney anatomy, stone position, and size. All procedures were made by same surgeon (MMR).

Before surgery, urinary tract infections had been treated with culture-specific antibiotics. Under the effect of general anesthesia and after placement of a ureteral catheter, with the patient prone, the skin was punctured at the posterior axillary line. The supracostal approach was performed in 2 (3%) patients. Percutaneous renal access was founded under the biplane or multidirectional C-arm fluoroscopic guidance through the posterolateral plane of the kidney. The pelvicaliceal system was entered at the lower posterior calix in patients with renal pelvis or lower caliceal stones. Middle or upper calix punctures were used when stones were present in these calices. The tract was dilated using coaxial telescopic dilatators; a 30-F Amplatz sheath was then advanced over the dilators and placed in the collecting system. All steps in tract dilation and Amplatz sheath placement were performed under fluoroscopic control in all patients. Small stones were removed with forceps and large ones were disintegrated with pneumatic, ultrasonic, or combined lithotripters. Except for 9 (11.8%) patients, a 16-F nephrostomy tube was placed at the end of the procedure. The tube was removed after 48 h and the patient was discharged home, provided that there were no complications. All patients were evaluated with intravenous pyelogram (IVP) and/or spiral CT after 1 month postoperatively. The PNL was considered successful when the patient was stone-free or did not need any further intervention (clinically insignificant residual stone fragments) (7). Residual stones that were accessible through the present nephrostomy tracts were managed by second-look PNL, while extracorporeal shock wave lithotripsy (ESWL) was used for inaccessible residuals larger than 4 mm and follow-up was adopted for residuals smaller than 4 mm. The patients' stone-free status was reevaluated after 3 months with noncontrast CT for those who required ESWL.

All characteristics of patients were investigated, such as age, sex, previous operation history, preoperative creatinine and urine levels, renal components (side, thickest and thinnest parenchymal thickness, and degree of hydronephrosis), and stones (site, load). Stone burden was classified as single calix, pelvis, both pelvis and calyx, or staghorn stones.

The details of the operative procedure (number, site of percutaneous tracts, lithotripsy method, operation time, etc.) and the renal parenchymal thickness at the puncher side were also recorded.

Hemoglobin (Hb) and hematocrit values were analyzed preoperatively and postoperatively (1 h and 24 h after operation). Peroperative Hb drop was evaluated by the preoperative Hb value subtracted from the postoperative Hb value at 1 h, and also the added units of transfused blood (1 g/dL per unit, peroperative if necessary). Postoperative Hb drop was calculated by the 24-h Hb value subtracted from the postoperative 1-h Hb level and also the added units of postoperatively transfused blood. Blood transfusion was required for the fall in hematocrit values accompanying hemodynamic instability and patients with severe hematuria, which were those with a fall in hematocrit, fall in blood pressure, recurrent clot retention, and/or a requirement for inotropes to maintain hemodynamic stability.

Exclusion criteria were subjects without diminution of Hb value peroperatively and/or postoperatively, and that had no preoperative BT (blood transfusion).

2.1. Radiological evaluation

Hydronephrosis was classified as grade I (mild), II (moderate), III (severe), or IV (massive) based on IVP and ultrasound findings, as described by Fernbach et al (8). All examinations were performed on a Shimadzu DIN 3064 CT scanner with 8-mm slice thickness. We measured 3 sections through each kidney: 1 through the thinnest parenchymal point, 1 through the thickest parenchymal point, and 1 at the level of the access point of the renal parenchyma (reported as the average in case of multiple tracts). The thickness of renal parenchyma was measured by means of 2 perpendicular axes through fixed points in each kidney. The parenchymal thickness and hydronephrosis degree were established and confirmed by a radiologist. Intraobserver validation of renal CT parenchymal thickness and ultrasonography hydronephrosis measurements in PNL patients was made after 3 months by the same radiologist.

2.2. Statistical analysis

The data were analyzed using SPSS 18 (SPSS Inc., Chicago, IL, USA). The parameters affecting Hb drop were investigated using Spearman/Pearson correlation and Student's t-test, where appropriate. A multiple linear regression model was used to identify independent predictors of Hb difference.

A progression of univariate followed by multivariate analyses was applied to 17 variables selected from the characteristics of patients, renal components, stones, and the details of the operative procedure in PNL patients with decreased Hb value to determine those variables most predictive of bleeding. The models were compared with respect to their R^2 values, sum of squares for the model, residual, standard error, F statistics, and related P-value. Receiver operating characteristic (ROC) curves were also used. The significance level for P-values was assumed to be less than 0.05.

3. Results

Of the 85 PNL procedures, 12 (14.1%) patients who had no diminution of Hb value postoperatively and/or no preoperative BT were excluded. Blood transfusion was needed in 22 of 85 patients (18.7%); 1 patient was peroperatively, 19 were postoperatively, and 2 were both peroperatively and postoperatively transfused. In total, 73 PNL procedures were evaluated. Horseshoe kidney in 1 patient, rotation renal abnormality in 1 patient, and duplicated caliceal system in 1 patient were observed as renal anomalies. Sample size was adequate for power size (80%) and alpha (0.05) according to the power analysis (n = 73). The mean age of the patients was 48.16 ± 11.3 years, with 50 (68.5%) males and 23 (31.5%) females in the study. A total of 5 patients experienced perioperative severe bleeding due to progressive track dilatation, while 1 patient experienced severe hematuria after hospital discharge due to an arteriovenous fistula. All bleedings were conservatively controlled with hemostatic medications; no embolization was needed. The mean operation time, operation data, stone size, parenchymal thicknesses, and patients' characteristics are presented in Table 1. The mean peroperative Hb drop was 1.79 ± 1.17 mg/dL (range: 0–6.8). The mean postoperative Hb drop was 0.98 ± 0.72 mg/dL (range: 0–3.8).

Table 1. Patients' characteristics and operation data.

	Patients' characteristics (N = 73)			
	Minimum	Maximum	Mean	Standard deviation
Age (years)	20	73	48.16	11.307
Hb loss (mg/dL), peroperative	0	6.8	1.79	1.17
Hb loss (mg/dL), postoperative	0	3.8	0.98	0.72
Stone size (mm)	22	65	39.38	10.636
Operation time (min)	56	250	108.15	40.951
Maximum parenchymal thickness (mm)	9	38	14.06	5.288
Minimum parenchymal thickness (mm)	1	12	6.18	2.724
Parenchymal thickness of access point (mm)	1	23	8.63	4.290
Preoperative creatinine (mg/dL)	0.52	1.87	0.85	0.23
	N (%)			
Sex	Male	Female		
	50 (68.5)	23 (31.5)		
Previous operation (same kidney open, PNL, ESWL)	Yes	No		
	22 (30.1)	51 (69.9)		
Side	Right	Left		
	37 (50.7)	36 (49.3)		
Access location	Lower	Upper	Middle	Multiple
	52 (71)	1 (3)	12 (15)	8 (11)
Stone location	Calix	Pelvis	Calix + pelvis	Multicalix + pelvis
	17 (23)	17 (23)	23 (32)	16 (22)
Access	Single	Double		
	62 (84.9)	11 (15.1)		
Nephrostomy	Tube	Tubeless		
	64 (88.2)	9 (11.8)		
Residual stone	Yes	No		
	25 (34.2)	48 (65.8)		
Hydronephrosis (grade)	I	II	III	IV
	10 (13.7)	12 (16.4)	28 (38.4)	23 (31.5)
Lithotripsy	Pneumatic	Ultrasonic	Combination	
	52 (71.2)	16 (21.9)	5 (6.8)	

Hb = hemoglobin, PNL = percutaneous nephrolithotomy, ESWL = extracorporeal shock wave lithotripsy.

In the regression model, factors considered to predict bleeding were not statistically significant for postoperative Hb drop. In Table 2, 3 factors (stone size, operation time, and grade of hydronephrosis) were correlated with peroperative bleeding significantly (P = 0.047, P = 0.016, and P = 0.034, respectively). Parenchymal thickness was not found to be correlated with peroperative bleeding (P = 0.545).

According to multivariate analysis in Table 3, all parameters were included in the regression model for detecting predictive factors related to peroperative bleeding. Only the operation time was found to be a statistically significant independent predictive factor associated with peroperative bleeding (P = 0.005). All other factors were not found as predictive factors associated with peroperative bleeding. There was no statistically significant relationship between postoperative bleeding and parenchymal thickness of the access point (P = 0.647).

In ROC curve analysis, the cut-off point of operating time for blood transfusion need was found to be 90 min, which had a sensitivity of 90% and specificity of 47% (area under the curve [AUC] = 0.718; P = 0.001; Figure 1).

4. Discussion

Open surgery was the standard therapy for urinary calculi up to about 30 years ago. However, the development of minimally invasive treatment methods, such as ESWL, and simultaneous endourological procedures like ureterorenoscopy and PNL has replaced open stone surgery almost completely. It is well recognized that in the western world, a percutaneous approach is preferred to open surgery for most cases of complex renal calculi resistant to ESWL. PNL is a safe and reliable technique for renal stones. It has replaced open surgery as the treatment of choice for large, multiple, and staghorn renal calculi (1,9).

However, it is an invasive procedure with reported complication rates of 3% to 18% according to different investigators (2–4). One of the most serious complications is renal hemorrhage. Blood loss is a normal feature of PNL because some bleeding may occur during renal puncture, tract dilation, use of nephroscopy between calices, and stone disintegration. It is considered a complication only when a blood transfusion is required. A transfusion rate of 3% to 23% has been reported. Fortunately, in most cases bleeding can be controlled with conservative measures, such as clamping the nephrostomy, hydration and diuretics, hemostatic medications, and Kaye balloon tamponade (10,11). Therefore, the necessity of renal embolization to control severe bleeding is low (range: 0.3% to 1.4%) (2–4,12–18). The transfusion rate in our series was comparable to these ranges (18.7%), and no embolization was needed in our patients with severe bleeding.

In a study by the Clinical Research Office of the Endourological Society (CROES), the overall complication rate in PNL was 15%, which commonly involved bleeding. The predictive factors of bleeding in PNL were operating time, stone load, caseload, and sheath size (19–21). In

Table 2. Correlation table between hemoglobin drop and operation time, stone size, and hydronephrosis.

		Hb drop	Stone size	Operation time	Hydronephrosis	Parenchymal thickness (for access point)
Hb drop	Correlation	1	–0.234*	–0.281*	–0.255*	0.073
	P		0.047	0.016	0.034	0.545
Stone size	Correlation	–0.234*	1	0.508**	0.334**	–0.195
	P	0.047		0.0001	0.005	0.103
Operation time	Correlation	–0.281*	0.508**	1	0.362**	0.001
	P	0.016	0.0001		0.002	0.996
Hydronephrosis	Correlation	–0.255*	0.334**	0.362**	1	–0.047
	P	0.034	0.005	0.002		0.701
Parenchymal thickness (for access point)	Correlation	0.073	–0.195	0.001	–0.047	1
	P	0.545	0.103	0.996	0.701	

Hb = hemoglobin.
*: Correlation is significant at the 0.05 level, **: correlation is significant at the 0.01 level.

Table 3. Multivariate analysis of predictive factors for bleeding during PNL. Significance of ANOVAs for regression model was 0.005 (P-value). R = 0.331, R^2 = 0.11.

Factor	Unstandardized coefficients B	Beta	P-value	95% Confidence interval for B	
Constant	–0.747		0.06	–1.527	0.033
Operation time	–0.009	–0.331	0.005	–0.016	–0.003
Stone size	–0.006	–0.055	0.779	-0.048	0.036
Hydronephrosis	–0.161	–0.138	0.357	–0.509	0.187
Stone type (staghorn-other)	–0.228	–0.086	0.63	–1.173	0.717
Age	0.024	0.234	0.128	–0.007	0.056
Sex	–0.121	–0.047	0.773	–0.958	0.716
Operation history	–0.077	–0.188	0.18	–0.192	0.037
Stone location	0.036	0.035	0.202	–0.325	0.397
Tract (single-multiple)	0.448	0.147	0.321	–0.450	1.345
Tubeless	–0.385	–0.098	0.477	–1.464	0.694
Lithotripsy method	0.015	0.008	0.062	–0.480	0.510
Parenchymal thickness (for access point)	–0.011	–0.038	0.869	–0.143	0.121
Maximal parenchymal thickness	–0.08	–0.035	0.848	–0.079	0.095
Minimum parenchymal thickness	–0.01	–0.021	0.903	–0.169	0.149
Access location	–0.324	–0.284	0.763	–0.683	0.035
Site	–0.89	-–0.037	0.792	–0.754	0.557
Preoperative creatinine level	–1.04	–0.186	0.151	–2.473	0.391

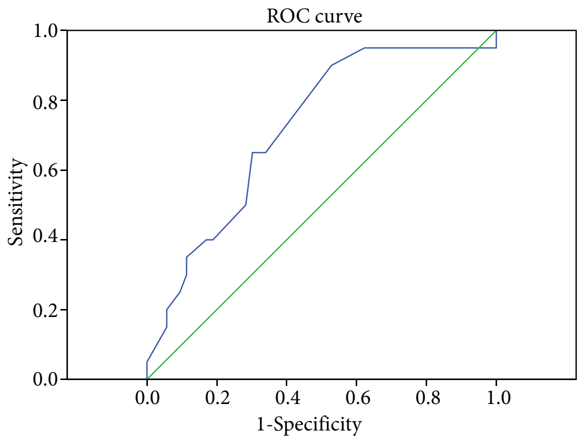

Figure 1. ROC curve for operation time and blood transfusion. Cut-off point was found as 90 min for sensitivity of 90% and specificity of 47% (AUC = 0.718; P = 0.001).

our study, multivariate analysis showed that the only predictive factor of bleeding was operation time (P = 0.001; Figure 2; Table 3). However, caseload was not studied, all procedures were done by same surgeon, and also the same sheath size (16 F) was used. In the CROES study, patients whose operations lasted longer than 75 min (76–115 min) had statistically significantly more severe postoperative complications compared with those whose operative time was shorter than 50 min. The risk of more severe postoperative complications increased even further for those whose operative time was more than 115 min (20). In another study, Akman et al. found a cut-off point for blood transfusion as 58 min. The demonstrated predictive factors for bleeding were the number of access points, stone type (staghorn or other), diabetes mellitus, preoperative Hb level, and operation time of up to 58 min in their study (22). In the present study, if the operation

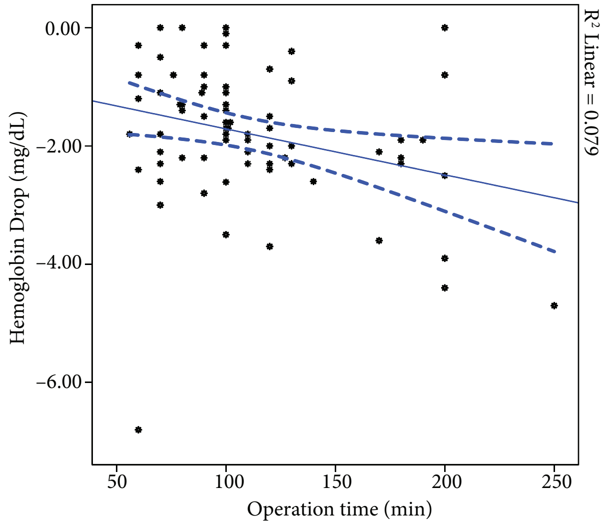

Figure 2. Scatter-dot figure between hemoglobin drop and operation time. Fit line with 95% confidence interval.

time was longer than 90 min according to the ROC analysis, transfusion requirement and also bleeding risk would be increased (odds ratio = 8.03, relative risk = 5.2; Figure 1).

Stone size and stone type were detected as predictive factors for blood transfusion and mean Hb drop in published studies (22,23). In staghorn calculi, the number of maneuvers was increased due to reaching renal calices for stone disintegration and removal. These maneuvers may cause injury to the renal collecting system and parenchyma, leading to possible bleeding. In our study, we demonstrated that there was correlation between stone size, operation time, and Hb drop. The correlation coefficient between operation time and Hb drop was higher than that between stone size and Hb drop (r = –0.281 vs. r = –0.234, respectively; Table 2). The P-value associated with correlation was more significant between operation time and Hb drop than between stone size and Hb drop (P = 0.016 vs. P = 0.047, respectively). It seems that stone size could affect Hb drop indirectly via affecting operation time. On the other hand, in multivariate analysis, which included stone size, only operation time was found to be an independent predictive factor for peroperative bleeding.

Akman et al. demonstrated that the grade of hydronephrosis was not a risk factor for total blood loss in 649 PNL procedures (22). They also found that postoperative blood transfusion need was not dependent on the grade of hydronephrosis. Ahmed et al. evaluated excessive bleeding after PNL operation (23) and found that there was no significant difference between the rate of severe vascular injuries in patients with or without hydronephrosis. Akman et al. further showed that presence of hydronephrosis and renal stone size and type significantly affected the operative time during PNL (22). In the present study, we demonstrated that the grade of hydronephrosis did not affect bleeding in regression analysis, despite the fact that there was a correlation between Hb drop and the grade of hydronephrosis (Tables 2 and 3; Figure 3). Thus, hydronephrosis did not seem to affect bleeding directly. Hydronephrosis may affect bleeding indirectly due to patients' severe stone load, which causes prolonged operation time.

Increased number of access points was important in respect to bleeding. Muslumanoglu et al. reported that an increased number of access points caused more bleeding in their study, which included 275 patients. Bleeding was encountered in 7.6% of patients managed with 1 percutaneous access point, and in 18.5% of cases managed with 2 or more access points (P < 0.05). In addition to this, the location of the access point was found as another risk factor for bleeding in their study. Bleeding was found in 39.1% and 7.5% of patients managed with supracostal access and subcostal access, respectively (P < 0.01). Puncture to upper calices can cause injury of posterior segmental artery braches, leading to increased risk of bleeding (24). Akman et al. reported similar results; the number of access points was detected as an independent predictive factor for bleeding in multivariate analysis. Contrarily, they found that the access point was not a risk factor for bleeding in univariate analysis (22). In some series, the number of access points was not found to be a risk factor for vascular injury (13,17,25). In the present study, neither access point nor access location was detected to be

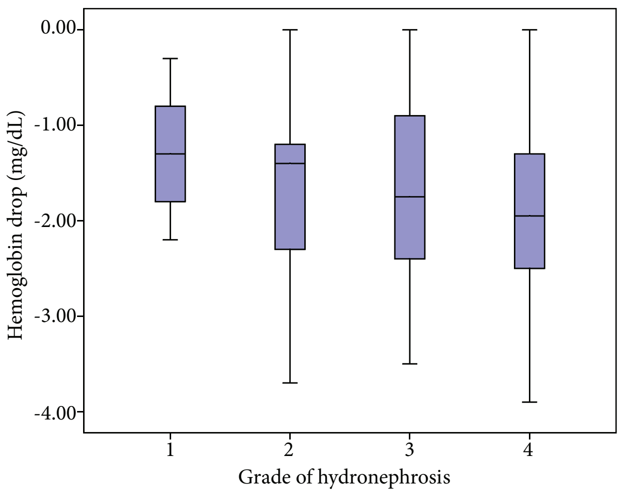

Figure 3. Box-plot graphic between grade of hydronephrosis and bleeding.

a risk factor for blood loss according to the multivariate analysis. Since we had only 2 patients managed by upper pole access, a limitation of the present study, we did not have an adequate number of patients with upper pole access. In addition, this study was designed to evaluate the relationship between parenchymal thickness and bleeding with an adequate number of patients according to the statistical power size. It was difficult to say that upper pole puncture had an effect on bleeding with only 2 patients.

In a retrospective clinical study including 74 patients who had undergone PNL, Cho et al. evaluated the lithotripsy method. They compared the safety and efficacy of the lithotripsy method in the 74 patients; 35 underwent PNL treated with pneumatic lithotripsy and 39 underwent PNL treated with combined (pneumatic and ultrasonic) lithotripsy. They demonstrated that blood loss in the combined group was significantly lower than in the pneumatic group (1.12 ± 0.61 vs. 1.39 ± 1.02, $P = 0.013$). However, Cho et al. used Student's t-test instead of the multivariate test (26). Pneumatic lithotripsy works with a ballistic effect on the stone, and these effects could reflect on renal pelvis via the stone. Ballistic trauma could cause bleeding in the renal pelvis. The same scenario could be possible in ultrasonic lithotripsy in terms of microtrauma. It is known that many factors could affect blood loss in a PNL operation other than the lithotripsy method. Additionally, Lehman et al. randomized 30 patients who underwent PNL with ultrasonic lithotripsy alone and a combination of pneumatic and ultrasonic lithotripsy. They reported no differences in mean blood loss between the groups (27). In a recent study, we found that the lithotripsy technique was not a predictive factor for bleeding in multivariate analysis.

Severe hydronephrosis usually causes parenchymal thickness over a long-term period and deteriorates renal function due to chronic obstruction. We detected no correlation between the grade of hydronephrosis and maximum, minimum, mean, and access point parenchymal thickness ($r = -0.144$, $P = 0.2$; $r = -0.129$, $P = 0.2$; $r = 0.193$, $P = 0.1$; and $r = -0.47$, $P = 0.7$, respectively). According to our results, parenchymal thickness of the access point was not found to be an independent predictive factor for blood loss during operation in multivariate analysis (Table 3). Thick renal parenchyma did not bleed much more than thin renal parenchyma. In the literature, it was speculated that puncture and dilatation through thick renal parenchyma might increase the possibility of bleeding due to damage of more renal tissue and its vascular supply. El-Nahas et al. reported that increased parenchymal thickness due to having a solitary kidney was detected as a risk factor for severe bleeding in PNL. In a solitary kidney, compensatory hypertrophy is a normal physiological response. As a result, thickening of the renal parenchyma increases kidney size (23). Another study reported that an ipsilateral renal unit did not have any effect on the blood loss, but parenchymal thickness was a significant predictor for bleeding (5). In contrast, they found P-values of the effect of parenchymal thickness in bleeding to be 0.05, and they reported that it was statistically significant but should be insignificant. Turna et al. evaluated the factors affecting blood loss in PNL. Their regression model included renal parenchymal thickness, for which the size categories were 10 mm in diameter or smaller and larger than 10 mm. They found that parenchymal thickness did not affect bleeding in PNL (6). According to our study, parenchymal thickness of the access point was measured and found statistically insignificant for blood loss in multivariate analyses, which include parenchymal thickness as a continuous variable (Tables 2 and 3; Figure 4).

As a conclusion, only the operation time affects mean blood loss in PNL. All other parameters, such as age, sex, previous treatment, maximum or minimum parenchymal thickness, parenchymal thickness of access point, side, access location, stone location, stone size, number of access points, nephrostomy, and type of lithotripsy, did not affect bleeding.

According to the present study, renal parenchymal thickness and the grade of hydronephrosis did not predict peroperative hemorrhage in PNL procedures. Thin renal parenchyma was not associated with less bleeding, and thick renal parenchyma was not associated with greater bleeding.

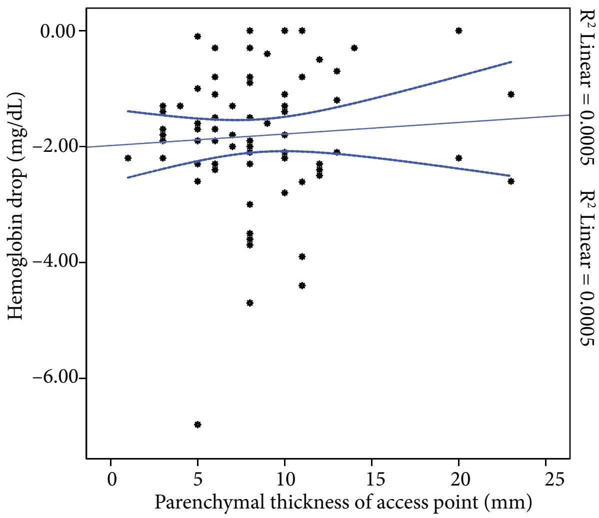

Figure 4. Scatter-dot graphic between parenchymal thickness of access point and bleeding. Fit line with 95% confidence interval.

References

1. Preminger GM, Assimos DG, Lingeman JE, Nakada SY, Pearle MS, Wolf JS Jr. Chapter 1: AUA guideline on management of staghorn calculi: diagnosis and treatment recommendations. J Urol; 173: 1991–2000.
2. Segura JW, Patterson DE, LeRoy AJ, Williams HJ Jr, Barrett DM, Benson RC Jr et al. Percutaneous removal of kidney stones: review of 1000 cases. J Urol; 134: 1077–81.
3. el-Kenawy MR, el-Kappany HA, el-Diasty TA, Ghoneim MA. Percutaneous nephrolithotripsy for renal stones in over 1000 patients. Br J Urol 1992; 69: 470–5.
4. Lee WJ, Smith AD, Cubelli V, Badlani GH, Lewin B, Vernace F et al. Complications of percutaneous nephrolithotomy. Am J Roentgenol 1987; 148: 177–80.
5. Kukreja R, Desai M, Patel S, Bapat S, Desai M. Factors affecting blood loss during percutaneous nephrolithotomy: prospective study. J Endourol 2004; 18: 715–22.
6. Turna B, Nazli O, Demiryoguran S, Mammadov R, Cal C. Percutaneous nephrolithotomy: variables that influence hemorrhage. Urology 2007; 69: 603–7.
7. Rassweiler JJ, Renner C, Eisenberger F. The management of complex renal stones. BJU Int 2000; 86: 919–28.
8. Fernbach SK, Maizels M, Conway JJ. Ultrasound grading of hydronephrosis: introduction to the system used by the Society for Fetal Urology. Pediatr Radiol 1993; 23: 478–80.
9. Atmaca AF, Canda AE, **Ö**zdemir AT, **Ş**erefo**ğ**lu EC, Do**ğ**an B, Balbay MD. Comparison of outcomes of percutaneous nephrolithotomy on patients with normal and malformed kidneys. Turk J Med Sci 2009; 39: 599–605.
10. Galek L, Darewicz B, Werel T, Darewicz J. Haemorrhagic complications of percutaneous lithotripsy: original methods of treatment. Int Urol Nephrol 2000; 32: 231–3.
11. Kaye KW, Clayman RV. Tamponade nephrostomy catheter for percutaneous nephrostolithotomy. Urology 1986; 27: 441–5.
12. Kessaris DN, Bellman GC, Pardalidis NP, Smith AG. Management of hemorrhage after percutaneous renal surgery. J Urol 1995; 153: 604–8.
13. Martin X, Murat FJ, Feitosa LC, Rouviere O, Lyonnet D, Gelet A et al. Severe bleeding after nephrolithotomy: results of hyperselective embolization. Eur Urol 2000; 37: 136–9.
14. Patterson DE, Segura JW, LeRoy AJ, Benson RC Jr, May G. The etiology and treatment of delayed bleeding following percutaneous lithotripsy. J Urol 1985; 133: 447–51.
15. Reddy PK, Hulbert JC, Lange PH, Clayman RV, Marcuzzi A, Lapointe S et al. Percutaneous removal of renal and ureteral calculi: experience with 400 cases. J Urol 1985; 134: 662–5.
16. Sacha K, Szewczyk W, Bar K. Massive haemorrhage presenting as a complication after percutaneous nephrolithotomy (PCNL). Int Urol Nephrol 1996; 28: 315–8.
17. Srivastava A, Singh KJ, Suri A, Dubey D, Kumar A, Kapoor R et al. Vascular complications after percutaneous nephrolithotomy: are there any predictive factors? Urology 2005; 66: 38–40.
18. Stoller ML, Wolf JS Jr, St Lezin MA. Estimated blood loss and transfusion rates associated with percutaneous nephrolithotomy. J Urol 1994; 152: 1977–81.
19. Labate G, Modi P, Timoney A, Cormio L, Zhang X, Louie M et al. The percutaneous nephrolithotomy global study: classification of complications. J Endourol 2011; 25: 1275–80.
20. Yamaguchi A, Skolarikos A, Buchholz NP, Chom**ó**n GB, Grasso M, Saba P et al. Operating times and bleeding complications in percutaneous nephrolithotomy: a comparison of tract dilation methods in 5,537 patients in the Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study. J Endourol 2011; 25: 933–9.
21. İnci M, Şarlı B, Çelik A, Demirtaş A, Baydilli N, Akpek M et al. Relationship between urolithiasis and diastolic function of heart. Turk J Med Sci 2013; 43: 574-579.
22. Akman T, Binbay M, Akcay M, Tekinarslan E, Kezer C, Ozgor F et al. Variables that influence operative time during percutaneous nephrolithotomy: an analysis of 1897 cases. J Endourol 2011; 25: 1269–73.
23. El-Nahas AR, Shokeir AA, El-Assmy AM, Mohsen T, Shoma AM, Eraky I et al. Post-percutaneous nephrolithotomy extensive hemorrhage: a study of risk factors. J Urol 2007; 177: 576–9.
24. Muslumanoglu AY, Tefekli A, Karadag MA, Tok A, Sari E, Berberoglu Y. Impact of percutaneous access point number and location on complication and success rates in percutaneous nephrolithotomy. Urol Int 2006; 77: 340–6.
25. Tomaszewski JJ, Smaldone MC, Schuster T, Jackman SV, Averch TD. Factors affecting blood loss during percutaneous nephrolithotomy using balloon dilation in a large contemporary series. J Endourol 2010; 24: 207–11.
26. Cho CO, Yu JH, Sung LH, Chung JY, Noh CH. Comparison of percutaneous nephrolithotomy using pneumatic lithotripsy (lithoclast®) alone or in combination with ultrasonic lithotripsy. Korean J Urol 2010; 51: 783–7.
27. Lehman DS, Hruby GW, Phillips C, Venkatesh R, Best S, Monga M et al. Prospective randomized comparison of a combined ultrasonic and pneumatic lithotrite with a standard ultrasonic lithotrite for percutaneous nephrolithotomy. J Endourol 2008; 22: 285–9.

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