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Factors Affecting Length of Hospital Stay in Patients Underwent Percutaneous Nephrolithotomy

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Abstract
Background: Percutaneous nephrolithotomy (PNL) is the initial therapy of choice for stones in the kidneys that are over 2 cm in size, although the majority of patients undergoing PNL recover rapidly and discharge early, some patients still required prolonged length of hospital stay (LoS). **Aim:** To identify factors affecting LoS in patients undergoing PNL. **Research design:** Prospective (cohort) research design was utilized**. Setting:** At Assiut Urology University Hospital. **Sample:** A convenience sample of 138 adult patients who had undergone PNL surgery**. Tools:** Patients assessment sheet. **Results:** Out of 138 patients, 41 (29,7%) had prolonged LoS, The mean duration of hospital stay was (3.2±1.13) days, (rang 1-7), multivariate logistic regression analysis reflect that the presence of diabetes mellitus (P= 0.013, OR= 2.33, 95% CI, [1.62-65.08]), high serum creatinine level (P=0.004, OR= 1.12, 95% CI [1.43-6.51]) postoperative pain (P=0.049, OR= 2.81, 95% CI [1.02-271.89]), postoperative urinary tract infection (P=0.010, OR= 1.56, 95% CI [1.46-15.37]) were identified as independent factors affecting LoS in patients undergoing PNL. **Conclusion:** Diabetes mellitus, high serum creatinine level, postoperative pain and postoperative urinary tract infections were identified as independent factors that prolong LoS. **Recommendation:** Factors that affect LoS should early be identified to reduce health care expenditures and work burden on medical staff.

Keywords: Factors, Length of hospital stay & Percutaneous nephrolithotomy

Introduction
Percutaneous nephrolithotomy (PNL) is a minimally invasive operation used to treat large, many, and complex renal stones. It offers the greatest stone-free rate. It also effective on tiny stones that is resistant to other treatments. Nowadays, PNL is often a well-tolerated operation due to newer instruments and techniques that have reduced procedure complications and length of hospital stay. Traditionally, LoS after PNL has typically remained 2–5 days **(Fulla et al., 2022).**

Patient hospital length of stay (LoS) can be defined as the number of days that an in-patient will remain in hospital during a single admission event. As well as being one of the major indicators for the consumption of hospital resources, LoS can also provide an enhanced understanding of the flow of patients through hospital care units and environments, which is a significant factor in the evaluation of operational functions of various care systems. LoS is often considered a metric which can be used to identify resource utilization, cost and severity of illness **(Stone et al., 2022)**

Although the majority of patients undergoing PNL recover quickly and can be discharged early, some patients still require prolonged LoS because of sluggish recuperation. Recently observed that the rate of prolonged LoS after PNL can range from 0 to 34%, and the primary risk factors that contribute to this are psychological causes (also referred to as patients meeting discharge criteria but refusing to depart the hospital due to were worried of the development of undesirable outcomes).pain, bleeding, and urinary tract infections. **(Wu et al., 2022)**

Also an important potential trade-offs between LoS reduction and post-discharge adverse outcomes such as (readmissions, mortality) exist. Furthermore, prolonged LoS may be associated with negative patient and staff experience, as well as increased inpatient complications such as (hospital acquired infections, falls),where many of which may be preventable. Therefore, many hospitals aim to provide optimal medical and nursing care and a safe discharge instructions while avoiding prolonged LoS **(Siddique et al., 2021)**

By carrying out an accurate assessment, preventing postoperative complications, closely monitoring patients, providing standard care to increase surgery success rates, and having a thorough understanding of patients' needs to deliver the best nursing care and patient education, nurses can significantly reduce LoS of patients undergoing PNL. The patient should also

be reminded by the nurse of the significance of immediately reporting abnormal symptoms to a doctor, also careful monitoring of vital signs, careful observation of urine output and color changes, wound care, and careful observation for dressing and tube discharge and prevention of infection. In order to early diagnose and prevent urinary tract infection, nurses should evaluate indwelling catheters and undertake catheter care **(Abdelmowla et al., 2017).**

Nurses benefits from reducing LoS include care for fewer patients at time, able to spend more time at each patient's bedside, and as a result, patients are less likely to experience an adverse outcome such as a hospital-acquired infection, poor glycemic control, less LoS, readmission and even death. Also nurse will report less work burnout, less job dissatisfaction and being less likely to intend to leave their employer **(Lasater et al., 2021).**

Significance of study:

Based on investigator's clinical experience during the residence period in Assiut Urology University Hospital, it has been observed that a proportion number of patients who had undergone percutaneous nephrolithotomy are likely to have prolonged hospital stay which increases the risk of nosocomial infection, complications, also increase burden on medical staff and hospital budget, so that it was necessary to know factors that affect length of hospital stay of patients who underwent percutaneous nephrolithotomy.

Aim of study: Identifying factors influencing length of hospital stay among patients underwent percutaneous nephrolithotomy.

Research question: What factors influence length of hospital stay among patients underwent percutaneous nephrolithotomy?

Subject and Methods

Research design: The prospective (cohort) research design was used to carry out this study.

Setting: This study was carried out at Assiut Urology University Hospital, which is Upper Egypt's largest specialized hospital for the treatment of urological and genitourinary diseases. Where thousands of patients from all over the country come for treatment, examination, and surgeries each month.

Sample: Based on the sample equation, 138 adult patients were included in our study and divided into two groups based on length of hospital stay (group 1= length of hospital stay≤ 2 day, group 2= length of hospital stay > 2 day).

Inclusion criteria:

- Patients age range from (18-65)
- Both genders
- Patients diagnosed with renal stone and scheduled for percutaneous nephrolithotomy
- Patients able to communicate verbally and willing to participate in the study.

Exclusion criteria:

- Second look percutaneous nephrolithotomy,
- Psychiatric patients
- Debilitating condition.

Sample size

Using **Steven K. Thompson** equation was utilized to calculate sample size which includes:-

$$n = \frac{N \times p(1-p)}{\left[\left[N-1\times\left(d^2 \div z^2\right)\right]+ p(1-p)\right]}$$

N = total number of population

Z = confidence level is 0.95.

D =the error ratio is =0.05.

P = the property availability ratio and neutral =0.05

Tools for data collection

One tool was used to gather related data for current study.

Percutaneous nephrolithotomy patient's assessment form

It was structured by investigator depend on national and international literature review. It included the following:-

Part 1: Patients' socio-demographic data:

It consisted of patients' age, gender, marital status, body mass index, educational level, occupation, residence, habits and length of hospital stay.

Part 2: Preoperative data:

It involved data such as comorbid disease, previous urological procedures, nutrition and fluid assessment, laboratory investigations and imaging studies.

Part 3: Operative data:

It involved surgical data such as approach (supracostal, infracostal), number of punctures (single vs. multiples), site of punctures (upper calyx, middle calyx, lower calyx), type of disintegrators (ultrasonic, pneumatic), qualifications of main operators (professor, assist. Professor, lecturer, assist. Lecturer, resident), patient position (prone, supine), total operation time and insertion of JJ stent, nephrostomy tube.

Part 4: Postoperative data:

It included postoperative data such as 1st 24h post-surgery urine output assessment, pain assessment using Numerical Rating Scale which is an assessment scale with Patients are instructed to indicate a point on the linear line indicating the severity of pain, and ranges from 0 (no pain) to 10 (sever pain). **(Duncan et al, 1989)**. The following pain levels are represented by values on pain scale. (0) – no Pain, (1 - 3) - Mild Pain, (4 - 6) - Moderate pain, (7 to 10) –sever pain, pneumothorax, intraperitoneal injury, postoperative infection(referred as any symptomatic urinary tract infection of the kidneys, ureters, bladder, or urethra

developing after operative procedure) duration of urethral cauterization..

Procedures:

To accomplish the aim of the study, it passed through the following phases:

Preparatory phase

Tool development

It was structured by investigator based on national **(Abdelmowla et al., 2017)** and international **(Akman et al., 2011; Zhu et al., 2022)** literature review.

Content validity and reliability

Tool validity and reliability were tested by panel of five professional health care providers including four faculty members of Medical -Surgical Nursing Faculty of Nursing, Assiut University, and an Assistant professor of Urological surgery Faculty of Medicine, Assiut University who reviewed the tool, for clarity, relevance comprehensive, understanding, applicability and easiness.

Reliability of the tools was measured by Cornbach's alpha which was (0.822).

Pilot study

A pilot study was conducted on 10% of patient (13 patients) to evaluate the clarity, feasibility and applicability of tools. The data obtained from pilot study was analyzed and no changes were done. Patients participated in the pilot study were excluded from main study.

Ethical consideration

Research proposal was approved from Ethical Committee in the Faculty of Nursing, Assiut University. There was no risk for study subject during application of the study; confidentiality and privacy of the studied patients were asserted by the investigator. Explanation of the aim and nature of the study was done to studied patients. The right to refuse participation in the study was emphasized to the patients; consent for participation in the study was obtained.

Implementation phase

This study was carried out through a period of six months from May (2022) to the October (2022).

The investigator attended the mentioned setting three days per week from 9 am to 11pm to collect relevant data from studied patients.

- The investigator greeted patients, introduced self, the purpose of study was explained to studied patients prior to any data collection.
- Tool was filled in through patients' interviewing preoperatively.
- Collecting data related to socio-demographic characteristics of studied patients was done by using part(1)
- Preoperative data was completed by using part (2).
- Gathering of operative data where patient either in operating room or in post anesthesia care unit was done by using part(3)
- Postoperative data was completed where the patient transferred to the ward by using part(4)
- After finishing data collection, the investigator clarified to all patients any wrong or missing information about PNL, emphasizing the importance of follow up as scheduled and reporting any warning sign to medical staff.

Statistical analysis:

Data entry and data analysis were done by using SPSS program (Statistical Package for Social Science) version 26. Data presented as number, percentage, mean and standard deviation. Chi- square test and logistic regression analysis was performed to determine factors affecting length of hospital stay among patients undergoing PNL. P- Value considered statistically significant when $p < 0.05$.

Results:

Tables (1): Distribution of studied sample according to their socio-demographic data (n=138)

Socio-demographic data	N	%
Age group		
20<40 yrs.	55	39.8
40<60 yrs.	68	49.3
60 - 65 yrs.	15	10.9
Mean age ±SD(range)	44.2±12 (20-65)	
Gender		
Male	81	58.7
Female	57	41.3
Marital status		
Single	12	8.7
Married	123	89.1
Widow/widower	3	2.2
Mean BMI ±SD(range)	24.5± 3(16.8-33.8)	
Educational level		
Educated	104	75.4
Non-educated	34	24.6
Occupation		
Working	31	22.5
Not working	107	77.5
Residence		
Urban	35	25.4
Rural	103	74.6
Habits		
No habits	42	30.4
Current smoker	40	29
Excessive cafe /tea consumption	56	40.6
Mean LoS± SD(range)	3.2±1.2 (1-7) day	

**BMI – body mass index* **SD – standard deviations* **LoS –length of hospital stay*

Table (2): Comparison between two groups according to their socio -demographic data (n=138)

Socio-demographic	Group (1) (n=97) (LoS≤ 2 day)		Group (2) (n=41) (LoS> 2 day)		P- value
	N	%	N	%	
Age group					
20<40 yrs.	38	39.2	17	41.5	0.07^{ns}
40<60 yrs	52	53.6	16	39.00	
60 - 65 yrs.	7	7.2	8	19.5	
Age (mean ± SD)	43.6±11.8		45.6±13.4		0.582^{ns}
Gender					
Male	54	55.7	27	65.9	0.179^{ns}
Female	43	44.3	14	34.1	
Marital status					
Single	7	7.2	5	12.2	0.350^{ns}
Married	87	89.7	36	87.8	
Widow/widower	3	3.1	0	0.00	
BMI (mean ± SD)	24.4±2.7		24.7±3.3		0.382^{ns}
Occupation					
Office work	23	23.7	8	19.5	0.382^{ns}
Not working	74	76.3	33	80.5	

Socio-demographic	Group (1) (n=97) (LoS≤ 2 day)		Group (2) (n=41) (LoS> 2 day)		P- value
	N	%	N	%	
Educational level					
Educated	75	77.3	29	70.7	0.270^{ns}
Not – educated	22	22.7	12	29.3	
Residence					
Urban	25	25.8	10	24.4	0.523^{ns}
Rural	72	74.2	31	75.6	
Habits					
Current smoker	25	25.8	15	36.5	0.279^{ns}
Excessive use of cafe /tea	39	40.2	17	41.5	
No habits	33	34	9	22	

Chi square test for qualitative data between the two groups or More LoS –length of stay
Independent T-test quantitative data between the two groups Ns, no statistically significance difference.
BMI- body mass index SD- standard deviation

Table (3): Comparison between two groups according to their preoperative data (n=138).

Preoperative data	Group (1) (n=97) (LoS≤ 2 day)		Group (2) (n=41) (LoS> 2 day)		P- value
	N	%	N	%	
Comorbid conditions					
No comorbid condition	77	79.3	29	70.8	0.678^{ns}
Hypertension	15	15.5	5	12.2	0.418^{ns}
Diabetes mellitus	3	3.1	6	14.6	**0.02***
Chronic kidney disease	2	2.1	1	2.4	0.656^{ns}
Nutrition assessment					
Normal diet	74	76.3	34	82.9	0.265^{ns}
Special diet	23	23.7	7	17.1	
Fluid intake assessment					
2-3 L/ d	75	77.3	37	90.2	0.058^{ns}
More than 3 L/ d	22	22.7	4	9.8	
Previous urological procedures					
No previous urological procedures	47	48.5	21	51.2	0.356^{ns}
Endourology surgery	14	14.4	9	22.00	0.201^{ns}
Open surgery	30	30.9	10	24.4	0.288^{ns}
ESWL	6	6.2	1	2.4	0.329^{ns}
Preoperative lab. investigations					
Negative urine pus cells	44	45.4	19	46.3	0.531^{ns}
Positive urine pus cells	53	54.6	22	53.7	
Serum creatinine (mean ± SD)	1.04±.6		1.4±.8		**0.002****
HGB (mean ± SD)	13±2.4		13±1.8		0.909^{ns}
Prothrombine time (mean ± SD)	12.2±.7		12.3±.8		0.414^{ns}
Preoperative imaging study (CT)					
Stone size (mean ± SD) cm	2.3±.69		2.6±.7		**0.008****
Kidney condition					
Presence of both kidneys	91	93.9	40	97.6	0.329^{ns}
Solitary kidney	6	6.1	1	2.4	
Stone location					
Right kidney	42	43.3	22	53.7	0.117^{ns}
Lift kidney	55	56.7	19	46.3	
Presence of preoperative hydronephrosis	34	35.1	27	65.9	**0.001****
Presence of preoperative JJ stent	19	19.6	10	24.4	0.338^{ns}

Chi square test for qualitative data between the two groups or More LoS- length of stay
*Independent T-test quantitative data between the two groups *Significant level at P value < 0.05*
***Significant level at P value < 0.01 Ns: no statistically significant difference*
ESWL- extracorporeal shock waves lithotripsy HGB- hemoglobin

Table (4): Comparison between two groups according to their operative data (n =138).

Operative data	Group (1) (n=97) (LoS≤ 2 day)		Group (2) (n=41) (LoS> 2 day)		P- value
	N	%	N	%	
Approach					
- Infracostal	92	94.8	32	78.00	**0.005****
- Supracostal	5	5.2	9	22.00	
Number of punctures					
- Single	54	55.7	14	34.1	0.016*
- Multiples	43	44.3	27	65.9	
Site of punctures					
- Upper calyx	6	6.2	7	17.1	0.076^{ns}
- Middle calyx	28	28.9	14	34.1	
- Lower calyx	63	64.9	20	48.8	
Type of disintegrators					
- Ultrasonic	6	6.2	0	0.00	0.115^{ns}
- Pneumatic	91	93.8	41	100.00	
Qualification of operators (main operator)					
- Professor	40	41.2	16	39.00	0.255^{ns}
- Assist. professor	0	0.00	1	2.4	
- Lecturer	49	50.5	23	56.1	
- Assist. Lecturer	8	8.2	1	2.4	
Intraoperative patient position					
- Supine	15	15.5	4	9.8	0.274^{ns}
- Prone	82	84.5	37	90.2	
Total operation duration (min)	151.24±32.7		172.5±36		**0.001****
Insertion of intraoperative JJ stent	22	22.7	6	14.6	0.202^{ns}
Presence of residual stone	13	13.4	5	12.2	0.545^{ns}
Insertion of nephrostomy tube	66	68.8	36	87.8	0.014*
Intraoperative blood transfusion	69	71.9	33	80.5	0.20^{ns}

Chi square test for qualitative data between the two groups or More
Independent T-test quantitative data between the two groups **Significant level at P value < 0.05*
***Significant level at P value < 0.01* *Ns: no statistically significant difference*
LoS –length of stay *Min- minute*

Table (5): Comparison between two groups according to their postoperative data (n=138).

Postoperative data	Group (1) (n=97) (LoS≤ 2 day)		Group (2) (n=41) (LoS> 2 day)		P- value
	N	%	N	%	
Postoperative assessment					
Urine output ml/1st 24 postoperative	960±267		973±235		0.790^{ns}
Duration of catheterization /day Mean± SD	7± 4.4		7.44 ± 4.8		0.708^{ns}
Postoperative pain					
No pain	62	64	19	46.3	**0.030***
-Mild	14	14.4	3	7.3	
-Moderate	20	20.6	15	36.6	
-Sever	1	1	4	9.8	
Technical Complication					
-Pneumothorax	4	4.1	6	14.6	**0.041***
-Intraperitoneal injury	6	6.2	8	19.5	**0.013***
Postoperative UTIs	13	13.4	17	41.5	**<0.001****

Chi square test for qualitative data between the two groups or More
Independent T-test quantitative data between the two groups **Significant level at P value < 0.05*
***Significant level at P value < 0.01* *Ns: no statistically significant difference*
UTIs- urinary tract infections *LoS –length of stay*

Table (6): Univariate and Multivariate regression analysis of factors affecting hospital length of stay among patients undergoing PNL (n=138).

Variables	Univariate			Multivariate		
	OR	Sig.	95% CI	OR	Sig.	95% CI
Diabetes mellitus **(Yes)**	1.68	0.022*	5.37(1.27-22.65)	2.33	**0.013***	10.28(1.62-65.08)
High Serum creatinine	0.83	0.004**	2.29(1.29-4.06)	1.12	**0.004****	3.05(1.43-6.51)
Stone size	0.68	0.009**	1.98(1.19-3.29)	0.57	0.116	1.77(0.87-3.59)
Presence of preoperative hydronephrosis **(Yes)**	1.27	0.001**	3.57(1.66-7.71)	0.80	0.190	2.23(0.67-7.44)
Surgical steps **(Supracostal)**	1.64	0.006**	0.19(0.06-0.62)	1.64	0.075	0.19(0.03-1.18)
Number of punctures **(multiples)**	0.88	0.022*	2.42(1.13-5.18)	0.32	0.537	1.38(0.5-3.82)
Total operation duration	0.02	0.001**	1.02(1.01-1.03)	0.00	0.954	1(0.98-1.02)
Insertion of nephrostomy tube **(Yes)**	1.22	0.020*	3.38(1.21-9.46)	1.25	0.100	3.5(0.79-15.55)
Postoperative pain **(Sever)**	2.57	0.025*	13.05(1.37-123.94)	2.81	**0.049***	16.64(1.02-271.89)
Pneumothorax **(Yes)**	1.38	0.041*	3.99(1.06-14.97)	0.04	0.970	1.04(0.13-8.33)
Intraperitoneal injury **(Yes)**	1.50	0.013*	4.46(1.36-14.6)	1.46	0.075	4.3(0.86-21.43)
Postoperative UTIs **(Yes)**	1.52	<0.001**	4.58(1.95-10.74)	1.56	**0.010***	4.74(1.46-15.37)

Dependent variable is patient length of hospital stay **Statistically Significant Factor at P. value <0.05*
***Statistically Significant Factor at P. value <0.01* *UTIs –urinary tract infections*

Table (1): Shows distribution of studied patients according to their socio-demographic characteristics. It reflects that nearly one half (49.3%) of studied patients their age range (40<60 yrs.) and more than one half (58.1%) of studied patient were male.

Table (2): Reflects distribution of two groups according to their socio-demographic characteristics. It reveals that there was no statistically significant difference between two groups according to their socio-demographic characteristics

Table (3): Clarifies that there were statistically significant differences between two groups regarding preoperative data such as diabetes mellitus, high serum creatinine, mean stone and presence preoperative hydronephrosis

Table (4): Shows that there were statistically significant differences between two groups regarding surgical approach, number of punctures, operation time and insertion of nephrostomy tube.

Table (5): Illustrated that there were statistically significant differences between two groups regarding postoperative pain, pneumothorax, intraperitoneal injury, postoperative urinary tract infections

Table (6): Reflects that according to univariate analysis, there were statistically significant differences between two groups regarding presence of diabetes mellitus, high serum creatinine, large stone size, preoperative hydronephrosis, supracostal surgical approach, multiple number of punctures, total operation time, nephrostomy tube placement , postoperative pain, pneumothorax, intraperitoneal injury, postoperative UTIs, were identified as significant independent factors affecting LoS .

Regarding Multivariate analysis, it was found that diabetes mellitus, high serum creatinine, postoperative pain and postoperative UTIs were identified as independent factors affecting LoS.

Discussion:

LoS reduction is a crucial step to improve the effectiveness of cost of PNL because LoS might have an impact on its effectiveness. Traditionally, hospital stays following PNL have lasted between two and five days. However, urologists have begun discharging patients the day of or the night following PNL in an effort to increase patient satisfaction and lower healthcare cost **Zhu et al., (2022).**

The current study was designed to identify Factors Affecting Length of Hospital Stay in Patients Underwent Percutaneous Nephrolithotomy through the following items:

Socio-demographic data

One hundred thirty-eight subjects participated in our study. It was observed that the age (mean ±SD) of the studied patients was (44.2±12) years, current finding in congruent with **Jafari et al., (2021),** who reported that the age (mean ±SD) of their study participants was (42.1±13.2).

Regarding gender, the current study revealed that more than one half and more than one third of studied patients were male, female respectively, nearly to our finding **Doykov et al., (2022)** who mentioned that male patients constituted two third of their entire sample.

From researcher opinion, advanced age increase the risk of kidney stone due to physiological changes that occur in urology system also comorbid condition such

as diabetes, hypertension and chronic kidney disease which impaired kidney function, thus increase risk of kidney stone. Also regarding gender difference, it is noted that male patient more risk for kidney stone then female in Egypt due to lifestyle difference as male patients exposure more to sunlight during work lead to more sweating with little water intake and drink more tea and coffee especially in remote area with poor water quality.

Regarding body mass index (BMI), the present study reported that the mean BMI of studied patients was (24.5± 3), this finding similar with **Hasan et al., (2022)** who found that the mean BMI of their study participants were (24.29 ± 3.9).

Regarding LoS, the current study found that the LoS (mean ±SD) of studied patients was (3.2±1.2) days, this finding in agreement with **Akman et al., (2011)** who reported that LoS (mean ±SD) of their study participant was (2.9 ±1.7) days.

Preoperative data

The present study found that there were statistically significant differences between two groups regarding diabetes mellitus, this finding in agreement with **Akman et al., (2011)** who mentioned that among patient-related factors, diabetes and impaired renal function correlated with longer hospital durations according to the multivariate analysis. Also **Wang et al., (2022)** found that diabetes is a known risk factor for postoperative complications such as infections, poor wound healing, anastomotic leaks, and heart problems as a result, this complications lead to prolonged LoS.

The current study found that high serum creatinine level was risk factor that prolong LoS, this finding in agreement with **Guo et al., (2021)** who found that high serum creatinine levels was the only laboratory finding identified as the most important risk factor that correlated with prolonged LoS, particularly in patients with kidney or liver diseases at admission.

This can be explained by, patients who admitted to hospital with high blood glucose and high serum creatinine had prolonged LoS and don't carry out surgery until their blood glucose and creatinine levels are controlled also after PNL stay under observation for preventing any complications which may occur in postoperative period.

The current study found that there were statistically significant difference between two groups regarding stone size, this finding in congruent with **Zhu et al., (2022)** who mentioned that larger stone size is an significant risk factor for increasing LoS after PNL, which may be lead to long operation time, more surgical tracts and additional nephrostomy tubes and increase the risk of postoperative complications thus, increase LoS.

The current study revealed that there were statistically significant difference between two group regarding presence of preoperative hydronephrosis, this finding is similar to **Zhu et al., (2022)** who found that presence of preoperative hydronephrosis increase risk of prolonged LoS .

This can be explained by large stone size and presence of preoperative hydronephrosis increase operation time and may be indicated for second look PNL. Also it may raise the risk of postoperative problems, include bleeding and urinary tract infection thus, increase LoS.

Operative data

The current study indicated that supracostal surgical approach was significant risk factor that increases LoS, this finding in congruent with **Akman et al., (2011)** who mentioned that the intercostal access was significantly associated with the occurrence of a hydro-pneumothorax because of its anatomical proximity to the kidney. Also reported that only 2 cases with subcostal accesses developed hydrothorax, the intrathoracic complication rate in patients managed with intercostal access was 6.8% in their series. The logistic regression predicts the odds of the LoS to be 1.79 times higher for intercostal compared with subcostal access.

The current study indicated that multiple number of puncture was significant risk factor that increase LoS, this finding in agreement with **Akman et al., (2011)** who found that there was significant difference among their participant regarding multiple access number.

The current study found that there were statistically significant difference between two groups regarding operation time, this finding in agreement with **Kreydin & Eisner (2013)** who mentioned that long operation time is undoubtedly linked to the difficulty of the surgery (large stone magnitude, large stone density, complicated kidney stones), which may raise the risk of postoperative complications like sepsis and hemorrhage as a result, LoS increased.

Regarding insertion of intraoperative nephrostomy tube, the present study reported that there were statistically significant difference between two groups, this finding in agreement with **Wang et al., (2012)** who reported that reported that nephrostomy tube was linked with a longer hospital stay compared to the tubeless PNL, also **Zhu et al., (2022)** reported that the number of nephrostomy tubes was considered to be an significant risk factor that prolong LoS after PNL operation.

Postoperative data

The current study indicated that there were statistically significant differences between two groups regarding postoperative pain, this finding in similar with **Chen et al., (2020)** who found that pain

and discomfort post PNL lead to prolonged hospitalization. According to **Wu et al., (2022)** who mentioned that Postoperative pain after minimally invasive surgery includes the creation of a percutaneous access tract through the parenchyma and parenchymal shearing, renal pelvic pressure, renal tissues, visceral pain primarily accompanied by autonomic nerve reaction, and low back pain caused by an indwelling nephrostomy tube. It may originate from the renal capsule, muscle, subcutaneous tissues, or the skin.

Regarding post PNL complications intraperitoneal injury, pneumothorax, urinary tract infections, the present study revealed that there were statistically significant difference between two groups, this finding in agreement with **Khan et al., (2006)** who correlated that hospital costs and days of hospitalization with surgical complications in 7457 patients who underwent PNL surgery, where 6.9% of these patients had at least one postoperative complication. These complications increased the expenses by 78% and the length of hospital stay by 114%, both with a statistical significance.

Moreover **Oliveira et al., (2021)** identified that patient with postoperative complications stayed in the hospital for more than 3 days in 60.71% of the cases. In cases with major complications (grades IIIa to IVb of the Clavien-Dindo classification), prolonged hospitalization was observed in 91.66% of the cases.

Conclusion:

The presence of diabetes mellitus, high serum creatinine level, postoperative pain and postoperative urinary tract infections were identified as independent factors that prolong LoS.

Recommendation:

Factors that prolong LoS should be identified early as it will reduce health care expenditures and work burden on medical staff.

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