

The severity of renal colic pain: Can it be predicted?

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Cite as: Keskin ET, Bozkurt M, Özdemir H, et al. The severity of renal colic pain: Can it be predicted? *Can Urol Assoc J* 2023 July 11; Epub ahead of print.

<http://dx.doi.org/10.5489/cuaj.8283>

Published online July 11, 2023

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ABSTRACT

Introduction: We aimed to determine whether there was a relationship between the perception of renal colic pain and different psychosocial and physiological factors.

Methods: Between May 2021 and July 2022, we prospectively analyzed 320 patients who were diagnosed with renal colic occurring unilaterally and secondary to a single kidney stone of any size, over the age of 18. Body mass index (BMI), education level, hospital anxiety and depression scale (HADS), somatosensory amplification scale (SAS), and the visual analog scale (VAS) features of stone (diameter, Hounsfield value, and localization) and degree of hydronephrosis were analyzed. Correlation analysis of VAS score and these parameters were completed with Spearman's test. The regression analysis was used to determine the predictive factors of severe pain.

Results: There was no significant difference found between sex and VAS scores of colic pain ($p=0.122$). We found a significant correlation between VAS score and localization of kidney stone, degree of hydronephrosis, and anxiety level of patients. High grade of hydronephrosis and high anxiety level were found to be associated with high VAS scores ($p<0.001$ and $p=0.035$, respectively). It was shown that SAS and level of depression did not correlate with

KEY MESSAGES

- The severity of renal colic pain can be predicted.
- High degree of hydronephrosis and high anxiety level are positively correlated with renal colic pain
- Predicting that the patient will experience severe renal colic pain will be useful in choosing the fastest treatment option for the patient for pain palliation.

pain. Only a high degree of hydronephrosis was found to be a predictive factor for severe pain ($p < 0.01$).

Conclusions: The patient's high anxiety level and a high degree of hydronephrosis were positively correlated with renal colic pain caused by kidney stones. With this study, the severity of pain in patients with a high degree of hydronephrosis and high anxiety can be predicted and may be a criterion to select suitable treatment to reach faster response.

INTRODUCTION

Pain is defined that an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage. Pain perception, a different phenomenon from pain, is defined as a complex feeling caused by inflammatory and neuropathic processes related to physiological tissue destruction. Psychiatric diseases and situations may also affect the level of pain perception regardless of the degree of tissue destruction. The effect of psychosocial differences on pain perception has been demonstrated by recent studies[1,2].

Renal colic pain is a common urological problem. It is defined as a specific type of pain, that occurs especially secondary to renal and ureteral calculi. While the degree of renal colic pain perception may be different in renal colic attacks experienced by the same patient at different times, the perception of pain may differ between different patients for a similar reason[3,4].

Extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL) and retrograde intrarenal surgery (RIRS) are available treatment modalities for renal calculi. The selection of the suitable treatment type is usually determined by factors such as the size, localization, calyceal anatomy and hardness of the stone[5].

In this study, we aimed to determine whether there was a relationship between the perception of renal colic pain and different parameters such as age, sex, features of stone (diameter, Hounsfield value, localization), degree of hydronephrosis and patient's situation of depression, anxiety and somatosensory amplification level.

METHODS

After approval of the Institutional Review Board (approval no: KAEK/21.03.15) and written informed patient consent, a prospective observational study was designed. Between May 2021 and July 2022, among 814 patients, this study was done prospectively with 320 voluntary patients who were diagnosed with renal colic occurring unilaterally and secondary to a single kidney stone of any size, over the age of 18.

Patients who were using any type of psychotropic medications (such as dementia, cognitive disorders, and depression) ($n=12$), patients with a diagnosis of acute pyelonephritis ($n=17$), pregnant patients ($n=1$), patients with a ureteral stent or nephrostomy catheter for any reason ($n=33$), patients had bilateral or multiple stones ($n=42$), patients who used any analgesic drug in the last 24 hours before the renal colic attack ($n=41$), patients who

diagnosed ureteral stone (n=297) and patients who had missing data(n=51) were excluded from our study (Figure 1).

Patients were taken to a room where they could be alone during the visit. Height and weight were measured and body mass index (BMI) was calculated. Education level (recorded as year) and having a previous renal colic episode were recorded. Tests including the hospital anxiety and depression scale (HADS), Somatosensory Amplification Scale (SAS) and the visual analog scale (VAS) were completed. The maximum diameter(mm), localization(renal pelvis or calyx) and Hounsfield(HU) value of the stone and the degree of hydronephrosis of the kidney(0-4) were measured by non-contrast computed tomography scan (CT).

Visual analog scale (VAS)

The VAS is used to assess the severity of a patient's pain. It is recorded between 0 to 10 (0= no pain, and 10= most severe pain). Patients are asked about the pain they perceived. The value shows the severity of pain perceived by the patient. Severe pain was accepted as 8-9-10 points [6].

Hospital anxiety and depression scale (HADS)

To assess anxiety and depressive symptoms in a general medical population. HADS consists of two subscales: HADS-A, designed to detect anxious states, and HADS-D, designed to detect depressive states. HADS-A and HADS-D consist of 7 items with a 4-point ordinal response format. Total scores range from 0 to 21 in each subscale, with higher scores indicating higher levels of anxious or depressive state[7].

Somatosensory amplification scale (SAS)

The scale was developed by Barsky to study the normal somatic senses of a person. The SAS is filled in by patients to investigate their somatosensory amplification with 10 items. These items are scored on a five-point scale from 1 to 5 with higher scores indicating greater somatosensory amplification[8].

Statistical assessment of data

In this study, data obtained from personal information forms and scales were transferred to a computer by SPSS (Statistical Package Programme for Social Sciences 22.0) program, and the data were analyzed by this program. The level of significance was determined as $p < 0.05$. The data obtained were presented as arithmetic mean \pm standard deviation, while quantitative data were presented as number %. Each group was tested with Kolmogorov–Smirnov test to investigate the normal distribution of the obtained data. Mann–Whitney U-test was used for data because of age, education year, BMI, stone parameters, VAS, SAS and HADS were found without normal distribution. Correlation analysis of VAS score was completed with Spearman's methods and reported with correlation coefficient(cc). The univariate and multivariate regression analysis was used to determine the predictive factors of severe pain.

RESULTS

Among 320 patients with confirmed kidney Stones, 72.1% of patients were male. There is no significant difference found between sex and VAS scores of colic pain ($p=.122$). All other demographic data, features of stone and results of questionnaires were shown in table 1.

When the patients were evaluated according to gender, they were similar in terms of age, BMI, education level, stone characteristics and VAS score. SAS, HADS-A and HADS-D scores were statistically significantly higher in women (respectively, $p<0.01$). (Table 1) Factors that correlated with VAS scores were evaluated (Table 2). We found a significant correlation between VAS score and localization of kidney stone, degree of hydronephrosis and anxiety level of patients. High-grade of hydronephrosis and high level of anxiety were found associated with high VAS scores ($p<.001$ and $p=.035$, respectively). The pain caused by renal pelvis stones was found to be more than the pain caused by calyx stones ($p<0.01$). Age, sex, BMI, years of education, diameter and Hounsfield value of stone were not found to correlate with VAS score. Also, it was shown that SAS and level of depression did not correlate with the pain.

Factors that could be predictive of severe pain (8, 9 and 10 points of VAS score) were evaluated with regression analysis (Table 3). Only a high degree of hydronephrosis was found to be a predictive factor for severe pain ($p<0.01$) by using both univariate and multivariate analysis (Table 3).

DISCUSSION

Pain perception, a different phenomenon from pain, is defined as a complex feeling caused by physiological tissue destruction and the psychosocial situation of patients. We also evaluated the psychosocial characteristics of the patients and the characteristic features of the kidney stone, which affect the pain perception of patients with kidney stones. Previous recent studies have only analyzed physiological factors that may affect the level of pain perception in renal colic; to the best of our knowledge, our study is the first to evaluate the psychosocial factors that affect the perception of pain in renal colic patients [9].

Many studies had been worked on the relationship between age and pain, but this topic has not been fully explained. Currently, some studies have shown a significant relationship, whereas many other studies have proposed that there is no significant relationship between age and pain[10,11]. Pickering et al[12] found that pressure-sensitive nociception decreased with age in males but according to our study we didn't find any correlation between age and colic pain ($p=.187$). Another study showed greater visual analog scale pain intensity in older patients with rheumatoid arthritis compared with patients younger, and a decrease in deep pain tolerance[13]. To explain the different pain perceptions in older patients, some authors have suggested decreasing inflammatory processes, loss of primary afferent fibers, reduction of visceral and/or brain pain receptors with age, or more relative pain indifference resulting from a history of other painful problems. This different impact of age on the perception of visceral and somatic pain also could be explained by differences in changes related to age in fibers that mediate painful sensations. One study has suggested that elderly patients rely

predominantly on C fiber input and that younger patients use additional Ad fiber input [14]. We did not find a significant relationship between pain and age in our study.

In our study, we did not find a significant relationship between education level, BMI and pain. Similar to our study, there are publications reporting that there is no relationship between education level and pain threshold[15]. Conflicting results have been shared about the relationship between obesity and pain. Unlike our results, Maffiuletti et al showed that obesity is associated with an increase in the pain threshold[16].

In recent years, it has been investigated whether there is a connection between gender and pain. In our study, we found no difference in the perception of renal colic pain between males and females. Similarly, no difference was found between males and females in terms of pain perception in another study[17]. Although Paquet et al found that women manifested greater pain intensity levels than men for pancreatitis, headache/migraine, and extremity fracture diagnoses [18]. Additionally, in a review of 172 articles researching the perception of the pain threshold for pressure was lower in females than in males, but the pain thresholds for cold and ischemic pain were reported to be comparable among males and females [1].

The state of anxiety causes an increase in the sensitivity of pain. This situation has been shown in experimental pain studies for many years. While experiencing the pain, emotional stimulation is important and emotional changes affect pain tolerance. Anxiety has been shown to cause an increase in hyperalgesia. High anxiety level before the medical procedures in both children and adults increases the pain after the procedure[19,20]. The relationship between depression and an individual's pain threshold is controversial. A research study indicates that depression may lead to an increase in comorbid pain. One of the reasons for this is that depression may increase the sensitivity to experimental pain but the relationship between depression and pain has not been fully explained. In another study, it was shown that depression increases the pain threshold [21,22]. Duddu et al showed that somatosensory amplification correlated with several general indicators of distress, including anxious and depressive symptoms[23]. Somatosensory amplification was found that it might be related to increased pain sensitivity by Cioffi et al[24]. Conversely, in a recent study, there was no relationship between somatization levels and pain levels[25]. According to our study, we found that the anxiety, depression and somatosensory amplification scores of females were found higher than males. Although anxiety score was positively correlated with pain perception of renal colic, it was not found a predictor of colic pain in our study. On the other hand, we did not find a significant relationship between pain and the level of depression. In addition, we did not detect depression as a predictor of pain level.

There is no clear data in the literature on which parameters affect the perception of renal colic pain. We analyzed multiple parameters that could affect the pain level such as age, sex, radiological signs and psychosocial factors. Among all these parameters, we showed using multivariate analysis that only the degree of hydronephrosis could predict severe pain. We showed that the patient's anxiety and depression status, level of somatosensory amplification, age, and sex failed to predict the patient's severe renal colic pain.

Our study has some limitations. Firstly we analyzed only kidney stone-related pain, not ureteral stones. Ureteral stones were not included in the study, with the hypothesis that the

severity of pain described by the patient could not be evaluated objectively, since pain caused by ureteral stones may be accompanied by pain reflecting towards the testis or scrotum. Secondly, we have a limited number of patients to analyze separately stone at calyx. The number of patients who will examine the stones in the upper middle and lower calyx separately is limited. Thirdly, to make a more objective evaluation, we included only patients with single and unilateral kidney stone in our study. The number of patients with bilateral and/or numerous stones is too high to be ignored, and these patients have not been evaluated with our study. Fourthly, we performed the SAS and HADS questionnaires at the outpatient clinic when the patient presented with renal colic pain. Due to the patient's current colic pain, the patient's reaction to the anxiety and depression questions may change. It would be more acceptable for the patient to complete these questionnaires when renal colic pain is not present.

CONCLUSIONS

We found that the patient's high anxiety level and a high degree of hydronephrosis were positively correlated with renal colic pain caused by kidney stones. We also showed that an increasing degree of hydronephrosis can predict particularly severe pain. We think that with this study, the severity of pain in patients with a high degree of hydronephrosis and high anxiety can be predicted and may be a criterion to select suitable treatment for wanting to reach a faster response.

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FIGURES AND TABLES

Figure 1. Flowchart of patients were included to study.

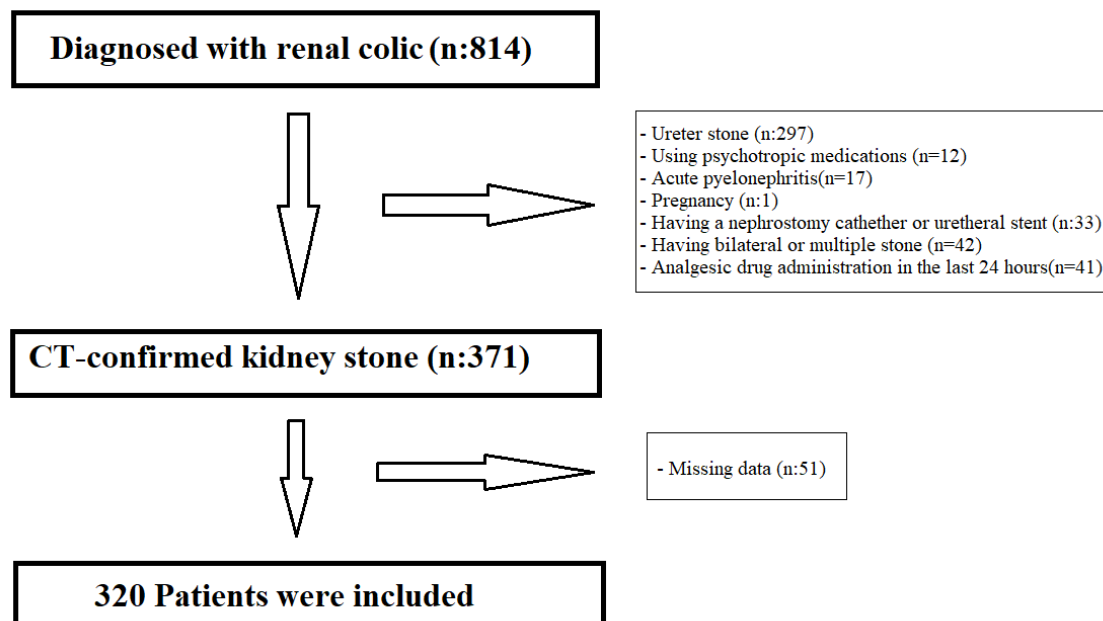


Table 1. Sociodemographic, stone, and pain features of patients

	Male (n=231, 71.1%)	Female (n=89, 28.9%)	p
Age, years (mean ± SD)	42.1±10.5	45.9±11.7	0.058
Education, years (mean ± SD)	9.5±4.1	8.9±4.3	0.259
BMI, kg/m ² (mean ± SD)	26.5±3.6	30.2±.7	0.051
Stone location			
Renal pelvis	125 (54.2%)	32 (36%)	
Renal calyx			
Upper calyces	44 (19%)	22 (24.7%)	
Middle calyces	46 (19.9%)	21 (23.6%)	
Lower calyces	16 (6.9%)	14 (15.7%)	
Stone diameter, mm (mean ± SD)	14.1±7.2	14.4±6.8	0.757
Stone, HU (mean ± SD)	989±278	1037±282	0.153
Hydronephrosis, n (%)			

Grade 0	71 (30.7%)	33 (37.1%)	
Grade 1	80 (34.6%)	24 (27%)	
Grade 2	60 (26%)	19(21.3%)	
Grade 3	20 (8.7%)	13(14.6%)	
Grade 4	0 (0%)	0 (0%)	
Previous renal colic episodes, n (%)			
Yes	49 (21.2%)	8 (9%)	
No	182 (78.8%)	81 (91%)	
VAS score (mean ± SD)	6.49±2.4	6.9±2.6	0.122
SAS (mean ± SD)	26±5.6	29.9±10.2	0.001
HADS (mean ± SD)			
HADS-A	7.26±3.1	9.44±5.5	0.001
HADS-D	8.4±4.2	10.7±5.2	0.001

BMI: body mass index; HADS: hospital anxiety and depression scala; HADS-A: hospital anxiety and depression scala – anxiety; HADS-D: hospital anxiety and depression scala – depression; HU: Hounsfield units; SAS: somatosensory simplification scale; VAS: visual analog scale.

	VAS score	
	Correlation coefficient	p
Age (year)	-0.074	0.187
Sex (male/female)	0.087	0.122
BMI (kg/m ²)	0.017	0.763
Education (year)	0.005	0.924
Stone location (pelvis or calyx)	-0.227	0.001
Stone diameter (mm)	0.035	0.529
Stone hounsfield value (HU)	0.049	0.382
Hydronephrosis (grade 0–4)	0.213	0.001
Previous renal colic episodes	-0.05	0.373
SAS	0.103	0.065
HADS-A	0.118	0.035
HADS-D	0.103	0.067

*Spearman correlation. BMI: body mass index; HADS-A: hospital anxiety and depression scala – anxiety; HADS-D: hospital anxiety and depression scala – depression; HU: Hounsfield units; SAS: somatosensory amplification scale; VAS: visual analog scale.

Table 3. Predictive factors for severe pain (8, 9, and 10 point of VAS score) using regression analysis

	Univariate model				Multivariate model			
	OR	95% CI		p	OR	95% CI		p
		Lower	Upper			Lower	Upper	
Age	-0.019	0.956	1.006	0.138				
Sex	0.383	0.813	2.646	0.203				
BMI	0.001	0.949	1.057	0.956				
Education year	0.015	0.955	1.078	0.633				
Stone location (pelvis or calyx)	-0.580	0.298	1.051	0.071				
Stone diameter (mm)	0.037	0.996	1.080	0.077				
Stone hounsfield value (HU)	0.001	0.999	1.001	0.531				
Hydronephrosis (grade 0–4)	0.465	1.184	2.139	0.002	0.527	1.335	2.150	0.001
Previous renal colic episodes	-0.390	0.350	1.307	0.245				
SAS	0.021	0.943	1.016	0.270				
HADS-A	0.072	0.993	1.162	0.074				
HADS-D	.023	.949	1.102	.553				

BMI: body mass index; CI: confidence interval; HADS-A: hospital anxiety and depression scale – anxiety; HADS-D: hospital anxiety and depression scale – depression; HU: Hounsfield units; OR: odds ratio; SAS: somatosensory amplification scale; VAS: visual analog scale.