

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

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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 over the age of 18 who were diagnosed with renal colic occurring unilaterally and secondary to a single kidney stone of any size. 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 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 criteria 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 shockwave 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

KEY MESSAGES

- 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 pain palliation.

patient’s situation of depression, anxiety, and somatosensory amplification level.

METHODS

After institutional review board approval (KAEK/21.03.15) and written, informed patient consent, a prospective observational study was designed. Between May 2021 and July 2022, we prospectively analyzed 320 of the total 814 patients over the age of 18 who were diagnosed with renal colic occurring unilaterally and secondary to a single kidney stone of any size. Exclusion criteria included: patients who were using any type of psychotropic medications for conditions 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 24 hours before the renal colic attack (n=41); patients who were diagnosed with ureteral

stone (n=297); and patients who had missing data (n=51) (Figure 1).

Height and weight were measured and body mass index (BMI) was calculated. Education level (recorded as year completed) 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 unit (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

The VAS is used to assess the severity of a patient’s pain. It is recorded from 0–10 (0=no pain, 10=most severe pain). The value shows the severity of pain perceived by the patient. Severe pain was accepted as 8–10 points.⁶

Hospital anxiety and depression scale

HADS is used 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 seven items with a four-point ordinal response format. Total scores range from 0–21 in each subscale, with higher scores indicating higher levels of anxious or depressive states.⁷

Somatosensory amplification scale

SAS is a 10-item questionnaire filled in by patients to investigate their somatosensory amplification. These items are scored on a five-point scale, 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 ± 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 age, education year, BMI, stone parameters, VAS, SAS, and HADS were found without normal distribution. Correlation analysis

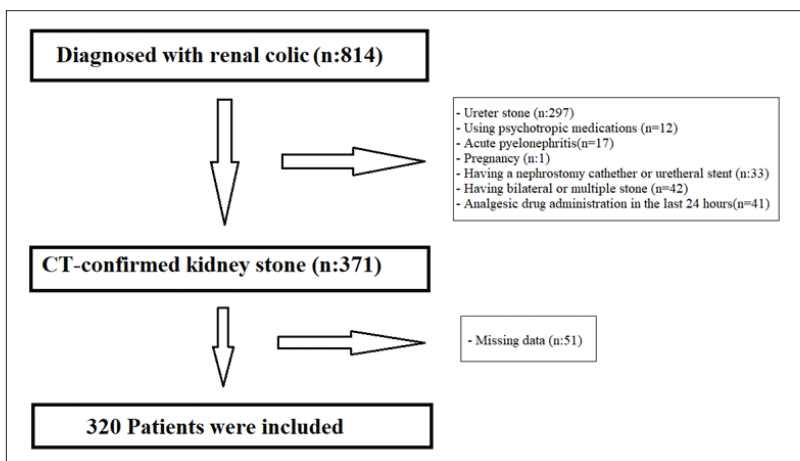


Figure 1. Flowchart of patients were included to study. CT: computed tomography.

of VAS score was completed with Spearman's methods and reported with correlation coefficient (cc). Univariate and multivariate regression analyses were used to determine the predictive factors of severe pain.

RESULTS

Among 320 patients with confirmed kidney stones, 72.1% of patients were male. There was no significant difference between sex and VAS scores of colic pain (p=0.122). All other demographic data, features of stones, and results of questionnaires are 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 (all 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 to be associated with high VAS scores (p<0.001 and p=0.035, respectively). The pain caused by renal pelvic stones was found to be more than the pain caused by calyx stones (p<0.01). Age, sex, BMI, years of education, diameter, and HU 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 pain.

Factors that could be predictive of severe pain (8–10 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 analyses (Table 3).

DISCUSSION

Pain perception is a different phenomenon from pain. 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

Several studies have attempted to define the relationship between age and pain; some have shown a significant relationship, whereas many others have proposed there is no significant relationship.^{10,11} Pickering et al found that pressure-sensitive nociception decreased with age in males,¹² and another study showed greater VAS pain intensity in older patients with rheumatoid arthritis compared with patients younger, and a decrease in deep pain tolerance.¹³ In our study, we found no correlation between age and renal colic pain (p=0.187).

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 scale; HADS-A: hospital anxiety and depression scale-anxiety; HADS-D: hospital anxiety and depression scale- depression; HU: Hounsfield units; SAS: somatosensory simplification scale; VAS: visual analog scale.

To explain the different pain perceptions in older patients, some authors have suggested a 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 could also be explained by differences in changes related to age in fibers that mediate painful sensations. One

Table 2. Correlation of VAS score

	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 scale-anxiety; HADS-D: hospital anxiety and depression scale-depression; HU: Hounsfield units; SAS: somatosensory amplification scale; VAS: visual analog scale.

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.

We also did not find significant links between education level, BMI, and pain. Similarly, there are publications reporting 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, Maffioletti et al showed that obesity is associated with an increase in the pain threshold.¹⁶

Regarding gender-specific pain perception, while Daoust et al found that women manifested greater pain intensity levels than men for pancreatitis, headache/migraine, and extremity fracture diagnoses,¹⁷ we found no such difference in our study — results that are similarly to another recent study.¹⁸ Additionally, in a review of 172 articles on the perception of pain, the threshold was lower in females than in males; however, the pain thresholds for cold and ischemic pain were reported to be comparable among males and females.¹

We did find a link between anxiety and increase pain sensitivity — a situation that has been shown in experimental pain studies for many years. While experiencing

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	0.553				

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.

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 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 and not fully elucidated. There is research that indicates depression may lead to an increase in comorbid pain. One of the reasons postulated for this is that depression may increase the sensitivity to experimental pain. Other studies have shown that depression increases pain threshold.^{21,22} Duddu et al showed that somatosensory amplification correlated with several general indicators of distress, including anxious and depressive symptoms.²³ Cioffi et al found that somatosensory amplification might be related to increased pain sensitivity.²⁴ Conversely, a recent study showed no relationship between somatization and pain levels.²⁵ According to our study, the anxiety, depression, and somatosensory amplification scores of females were higher than those of males. Although anxiety score was positively correlated with pain perception of renal colic, we did not find it to be a predictor of colic pain. In addition, we did not detect depression as a significant 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 pain level, such as age, sex, radiological signs, and psychosocial factors. Among 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 severe renal colic pain.

Limitations

Our study has some limitations. First, 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. Second, we had a limited number of patients for which we could analyze calyx stone separately; the number of patients whose upper middle and lower calyx stones can be examined separately is limited. Third, for 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. Finally, we performed the SAS and HADS questionnaires at the outpatient clinic when patients presented with renal colic pain, which could bias response (i.e., the patient's reaction to the anxiety and depression questions may be different in the moment pain is being experienced).

CONCLUSIONS

We found that high anxiety level and a high degree of hydronephrosis were positively correlated with renal colic pain caused by kidney stones. In particular, we also showed that an increasing degree of hydronephrosis can predict severe pain. Based on these results, the severity of pain in patients with a high degree of hydronephrosis and high anxiety may be criteria to select suitable treatment to reach a faster response.

COMPETING INTERESTS: The authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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