ClinicSearch

Clinical Research and Studies

Mohammad Reza Farnia*

Open Access

Research Article

A Comparison of The Analgesic Effects of Paracetamol in Combination with Ketorolac with Morphine Alone in Patients with Renal Colic: A Randomized Clinical Trial

Mohammad Reza Farnia *

Emergency department, Imam Reza hospital, Kermanshah, Iran.

***Corresponding Author:** Mohammad Reza Farnia, Emergency department, Imam Reza hospital, Kermanshah, Iran.

Received date: March 06, 2023; Accepted date: March 16, 2023; Published date: March 22, 2023

Citation: Mohammad R. Farnia, (2023), A Comparison of the Analgesic Effects of Paracetamol in Combination with Ketorolac with Morphine Alone in Patients with Renal Colic: A Randomized Clinical Trial, *Clinical Research and Studies*. 2(2); **DOI:**10.31579/2835-2882/015

Abstract

Background: The term renal colic is used to describe a series of acute, short-term, painful attacks that occur as a result of the expulsion and movement of kidney stones. This is primarily caused by urethral obstruction, which leads to increased pressure behind the obstruction site. The treatment for renal colic is non-steroidal anti-inflammatory drugs (NSAIDs) and opioids. In this study, paracetamol plus ketorolac were compared to morphine alone with regard to relieving renal colic pain.

Materials and methods: The present study was a randomized double-blind clinical trial with a sample size of 30 individuals in two groups. The numeric rating scale (NRS) was utilized to compare the severity of pain. The repeated-measures analysis of variance and the independent t-test in SPSS 22 were used to analyse the data.

Findings: A total of 60 patients with renal colic (34 in the drug combination group and 26 in the morphine group) were used as research samples. There was no significant difference between the drug combination group and the morphine group in terms of gender, age, and weight groups, but they were significantly different in terms of pain severity at 15, 30, and 60 minutes after the intervention. Furthermore, there was a significant difference between the drug combination group and the morphine group in terms of pain severity at five times of measurement, before the intervention, and at 0, 15, 30, and 60 minutes after the intervention ($P < 0.05$).

Conclusion: The mean scores of renal colic pain severity were reduced in patients at 0, 15, 30, and 60 minutes after drug intervention, and the reduction in pain severity was greater in the morphine group than in the combination treatment group.

Keywords: paracetamol; ketorolac; morphine; renal colic

Introduction

Renal colic is defined as one or more acute and short-term painful attacks due to kidney stone excretion and movement. Acute renal colic accounts for 0.9% of outpatient hospitals. Reducing pain and eliminating fluid and electrolyte disorders are the basic principles of renal colic treatment.

The drugs, which are used in acute renal colic, are classified into two main categories: non-steroidal anti-inflammatory drugs (NSAIDs) and opioids. Opioids, and more commonly, morphine, are common drugs for relieving the pain of renal colic. Opioids are effective and inexpensive but have severe side effects such as nausea, vomiting, vertigo, respiratory depression, hypotension, and even intolerance or addiction.

NSAIDs are another option for renal colic pain relief because they directly affect the ureters by inhibiting prostaglandin synthesis. Ketorolac is an NSAID with analgesic properties used in adults for the short-term treatment of acute pain that needs opioid analgesics.

Intravenous paracetamol is another analgesic that is widely used in the emergency department to control pain. Also, it has fewer side effects than NSAIDs and opioids, and in some studies, it is considered a more effective and preferable drug to these compounds.

Today, there is a growing desire to use alternative medicine to control acute pain due to the common side effects of opioids.

The effectiveness of NSAIDs and paracetamol in controlling pain caused by renal and biliary colic has been investigated in several studies, but the effect of their combination has not been investigated so far. Therefore, this study seeks to compare the effect of paracetamol plus ketorolac with morphine alone in the treatment of renal colic.

Materials and methods

2-2- Statistical population, sampling method, and sample size

The present study was a double-blind, randomized, single-center, parallel-group clinical trial that was conducted at the patient's bedside.

Sampling method

In this research, first, convenience sampling was performed on individuals who met the inclusion criteria after hospitalization, and then the samples were randomly allocated to two drug groups using the permuted block technique.

Samples and sampling

The minimum sample size was estimated to be approximately 20 per group, but 30 people were evaluated in each group to increase the validity of the results. The sample size was calculated according to the following equation:

$n_1= (\sigma^2 (z_{(1-\alpha/2)} +z_{(1-\beta)}) ^2)/ (\mu_2-\mu_1) ^2$ n1=n2

μ_1: The mean pain severity score reduction in the paracetamol group

α=0.05: Type I error

μ_2: The mean pain severity score reduction in the morphine drug group

1-β= 0.8: The test power

σ^1= 18.52: The standard deviation of the pain severity score in the paracetamol group

σ^2=17.37: The standard deviation of the pain severity score in the morphine group

This sample size was calculated using PASS 11 as the software for sample size measurement.

2-3- Inclusion and exclusion criteria

Inclusion criteria

- The age older than 18 years and younger than 65 years
- Having flank pain, either clinically or paraclinically, (having evidence of kidney or urinary stone disease in the last 12 months) in favor of kidney tissue pain
- Pain score greater than three on the Numeric Rating Scale (NRS)
- Not receiving analgesics in the last six hours
- Possessing full consciousness (GCS=15)
- No previous entry into the study

Exclusion criteria

- Diagnosed renal, hepatic, and cardiac failure
- Diagnosed allergy to opioids, paracetamol, or ketorolac
- Pregnancy
- Transplant patients
- Unstable vital signs, and systolic blood pressure of less than 90 mmHg
- Evidence of peritoneal irritation

2-4- The project method

Patients who presented to the emergency department with flank pain were immediately examined by a physician and included in the study if they had flank pain, evidence of kidney or urinary stones (within the last 12 months), and pain of renal origin with a pain score of equal to or greater than three on the NRS.

Patients received a full explanation about the study and possible side effects of prescribed drugs, and if they agreed to participate in the project, they signed written informed consent forms before participating in the study.

The physician completed a questionnaire containing patient characteristics and demographic information. Also, vital signs, history of addiction, consumption of analgesics in the last six hours, history of drug allergy, history of underlying diseases, and paraclinical measures were recorded. Furthermore, the possible side effects of drugs and rates of pain recurrence were recorded in the two groups.

The numeric rating scale (NRS) and initial pain severity (before receiving drugs) were measured and recorded at 0, 15, 30, and 60 minutes after prescription.

Intervention method

The patients were divided into two groups using the random block method. There were four blocks, of which two blocks belonged to the control group and two blocks belonged to the intervention group, and the numbers assigned to the patients to be placed in the blocks were randomly chosen by the computer.

The first group (at time zero) received 0.1 mg/kg intravenous morphine, and 100 cc N/S was infused within 15 minutes. The second group received 30 mg of ketorolac intravenously, and 1000 mg of paracetamol and 100 cc of N/S were infused within 15 minutes. The prescribed paracetamol was APOTEL brand, with each ampoule containing 1000 mg in 6.7 ml. According to the manufacturer's instructions, the drug was infused within 15 minutes in 100 cc of N/S solution.

The pain score was obtained and recorded by the physician using the NRS at 0, 15, 30, and 60 minutes. The NRS was measured and recorded by the same physician at 0, 15, 30, and 60 minutes after drug administration. A reduction in pain score of 4 or more compared to the initial score, or a reduction in the pain score to less than 3 was considered a response to the treatment and drug effectiveness.

If patients continued to complain of pain after 60 minutes or requested more pain relief at any time during the study due to pain, fentanyl was administered intravenously at a dose of 0.75 µg/kg according to the emergency monitoring specialist. Patients were monitored for 60 minutes.

Blinding and randomization method

The drugs were prepared by a person who was not involved in the study but was in charge of emergency medicine medical records. Medicines were prepared in similar packages, marked only with numbers. The drugs were injected by a nurse, who did not know the content or types of prescribed drugs. This was based on the order of patients' visits and randomization using the permuted block technique. The physician, who recorded the pain score, also did not know the type of drugs prescribed.

2-5- research tools

Standard Numeric Rating Scale (NRS)

The NRS is the simplest method of pain evaluation, in which patients give a score of 0–10 for their pain severity where 0 means complete painlessness, 10 means the most imaginable pain, and 5 refers to moderate pain (65). Most of the patients were well familiar with these criteria (66). This tool is quick and easy to use, making it suitable for those who are unable to write or cannot verbally express their pain. The pain score was set as mild pain (1-3), moderate pain (3-7), and severe pain (7-10).

2-6- Data analysis

After data collection, descriptive statistics methods such as mean and standard deviation were used for organizing and summarizing quantitative data, and frequency and percentage were utilized for qualitative data. Furthermore, the independent t-test and chi-square test were used to compare the two groups regarding demographic variables. The repeated-measures analysis of variance (ANOVA) was used to compare the pain severity in two groups at different times. Moreover, the consensus table analysis methods were used to compare the complications in the two groups. The significance level was considered 0.05, and SPSS 22 software was used for data analysis.

Findings

A total of 60 patients with renal colic (34 in the drug combination group and 26 in the morphine group) were used as samples in this study, and most of the samples were male (about 62%). The minimum age was 22 and the maximum was 65 years in the drug combination group, and the minimum age was 24 and the maximum was 65 years in the morphine group. Furthermore, the minimum weight was 55 and the maximum was 90 kg in the drug combination group, and the minimum weight was 63 and the maximum was 95 kg in the morphine group.

The Kolmogorov-Smirnov test indicated that age and weight had a normal distribution. The mean age was 45.4 years in the drug combination group and 44.5 years in the morphine group, but the independent t-test did not indicate any significant difference between these two treatment groups (P= 0.077). The mean weight was 74.7 kg in the drug combination group and 77.4 kg in the morphine group, but the independent t-test did not indicate any significant difference between these two groups (P = 0.233).

2-3- Descriptive findings

In this section, the personal characteristics of renal colic patients in the two groups, the drug combination and morphine groups, were examined.

Personal Characteristics	Drug combination	Morphine	Total	P-value				
	Number	Percentage	Number	Percentage	Number	Percentage		
Sex	Female	16	47.1	7	26.9	23	38.3	0.112
	Male	18	52.9	19	73.1	37	61.7	
Age group (year	Under 30	3	8.8	5	19.2	8	13.3	0.522
	30-40	9	26.5	4	15.4	13	21.7	
	41-50	12	35.3	8	30.8	20	33.3	
	Over 50	10	29.4	9	34.6	19	31.7	

Table 1: Personal characteristics of renal colic patients in the drug combination and morphine groups

Group

According to the results of the chi-square test, there was no significant difference between the drug combination and morphine groups in terms of sex. Most of the samples were male in both the drug combination and morphine groups so about 73% of the patients in the morphine group were male.

Based on the chi-square test results, there was no significant difference between the drug combination and morphine groups in terms of the patient's age groups. Most of the samples were over 40 years old in both the drug combination and morphine groups, meaning that only about 9% of patients were under 30 years of age in the drug combination group.

Group

Weight (kg)	Drug combination	Morphine	Total	P-value			
	Number	Percentage	Number	Percentage	Number	Percentage	
Under 60 kg	4	6.7	0	0	4	6.7	0.123
60-70	7	11.7	4	6.7	11	18.3	
71-80	11	18.3	15	25.0	26	43.3	
Over 80	12	20.0	7	11.7	19	31.7	
Total	34	56.7	26	43.3	60	100	

Table 2: Personal characteristics of renal colic patients in both drug combination and morphine groups

According to the results of the Chi-square test, there was no significant difference between the drug combination and morphine groups in terms of weight. There was no patient with a weight of 60 kg in the morphine group. Most of the patients weighed more than 70 kg.

3-3- Analytical findings

This section compares the mean pain severity scores in renal colic patients between the drug combination and morphine groups before the intervention and at 0, 15, 30, and 60 minutes after the intervention using the repeated-measures ANOVA.

According to the Kolmogorov-Smirnov test, the null hypothesis for the normal distribution of pain severity scores indicated that the null hypothesis for the normal distribution of scores in the drug combination and morphine groups was confirmed. Mauchly's sphericity test was used to examine compliance with the covariance matrix equality assumption. Results indicated the significant variance of the drug combination and morphine groups (P = 0.000); hence, the assumption of the equality of variances was rejected and the Greenhouse-Geisser statistic was used for analysis.

Pain severity	Drug combination	Morphine	P-value		
	Mean	Sd	Mean	Sd	
Before intervention	10.0	0.000	10.0	0.000	1.00
0 minutes after intervention	9.8	0.387	9.9	0.368	0.820
15 minutes after intervention	7.9	1.08	5.8	0.981	0.000
30 minutes after intervention	5.0	1.06	3.1	0.909	0.000
60 minutes after intervention	1.6	1.13	0.46	0.706	0.000

Table 3: Comparison of the mean pain scores of renal colic patients before the intervention, 0, 15, 30, and 60 minutes in the drug combination and morphine groups

According to the independent t-test, there was no significant difference between renal colic patients in the drug combination and morphine groups in terms of pain severity before the intervention and at 0 minutes after the intervention.

According to the independent t-test, there was a significant difference between the drug combination and morphine groups in terms of pain severity at 15, 30, and 60 minutes after the intervention.

Group	Name of test	Value	F	Df assumption	Df error	P-value
Drug combination	Pillai's trace	0.987	551.042	4	30	0.000

	Wilks' lambda	0.013	551.042	4	30	0.000
	Hotelling trace	73.47	551.042	4	30	0.000
	Roy's largest root	73.47	551.042	4	30	0.000
Morphine	Pillai's trace	0.996	1235.567	4	22	0.000
	Wilks' lambda		1235.567	4	22	0.000
	Hotelling trace		1235.567	4	22	0.000
	Roy's largest root		1235.567	4	22	0.000

Table 4: The results of multivariate analysis of variance for the difference in mean scores of renal pain severity in the drug combination and morphine groups before the intervention, immediately after the intervention, and at 15, 30, and 60 minutes after the intervention

The results of the repeated-measures ANOVA and significance levels of all tests for the intra-group effects indicated that there was a significant difference among the five measurement stages in the drug combination group (P<0.000). Furthermore, the results of the repeated-measures ANOVA and significance levels of all tests for the intra-group effect indicated that there was a significant difference among the five measurement stages in the morphine group (p<0.000).

Group	Source of changes	Sum of square	Df	Mean square	F	P-value
Drug combination	Factor	1715.682	2.581	664.621	791.658	0.000
	Error	71.518	85.188	0.840		
Intervention	Factor	1812.385	2.774	653.394	1230.725	0.000
	Error	36.815	69.345	0.531		

Table 5: The results of repeated-measures ANOVA in the drug combination and morphine groups in five stages before the intervention, immediately after the intervention, and at 15, 30, and 60 minutes after the intervention

According to the results of the above table, there was a significant difference among the five measurement times before the intervention and at 0, 15, 30, and 60 minutes after the intervention in terms of pain severity within the drug combination group at a level of P > 0.05.

As well as, there was a significant difference among the five measurement times before the intervention and at 0, 15, 30, and 60 minutes after the intervention in terms of pain severity within the morphine group.

A Bonferroni post hoc test was utilized to find out at which measurement stage (before the intervention and at 0, 15, 30, and 60 minutes after the intervention) there was a difference between the two groups in terms of pain severity. Table 6 presents the results.

Table 6: Results of the Bonferroni post hoc test for pairwise comparison of the mean renal pain severity score in drug combination and morphine groups in five stages: before the intervention, immediately after the intervention, and at 15, 30, and 60 minutes after the intervention

Group	Reference stage	Comparison stage	Mean difference	Standard error	P-value
Drug combination	Before the intervention	Immediately after the intervention	0.176	0.066	0.120
		15 minutes after the intervention	2.147	0.185	0.000
		30 minutes after the intervention	4.971	0.182	0.000
		60 minutes after the intervention	8.382	0.194	0.000
	Immediately after the intervention	15 minutes after the intervention	1.971	0.196	0.000
		30 minutes after the intervention	4.794	0.206	0.000
		60 minutes after the intervention	8.206	0.214	0.000
	15 minutes after the intervention	30 minutes after the intervention	2.824	0.149	0.000
		60 minutes after the intervention	6.235	0.179	0.000
	30 minutes after the intervention	60 minutes after the intervention	3.412	0.169	0.000
Morphine	Before the intervention	Immediately after the intervention	0.154	0.072	0.430
		15 minutes after the intervention	4.192	0.192	0.000
		30 minutes after the intervention	6.885	0.178	0.000
		60 minutes after the intervention	9.538	0.138	0.000
	Immediately after the intervention	15 minutes after the intervention	4.038	0.204	0.000
		30 minutes after the intervention	6.731	0.180	0.000

		60 minutes after the intervention	9.385	0.158	0.000
	15 minutes after the intervention	30 minutes after the intervention	6.692	0.164	0.000
		60 minutes after the intervention	5.346	0.175	0.000
	30 minutes after the intervention	60 minutes after the intervention	2.654	0.183	0.000

The above table shows no significant difference between mean scores of pain severity in the combination group before and immediately after the intervention, but the difference in the mean pain severity scores was significant in the combination group before the intervention and 15, 30, and 60 minutes after the intervention. The difference between the mean scores of pain severity was also significant between 15 minutes after the intervention and 30 and 60 minutes later. There was also a significant difference in mean scores of pain severity between 30 and 60 minutes after the intervention.

The results also indicated no significant difference between mean scores of pain severity in the morphine drug group before and immediately after the intervention, but the difference in mean scores of pain severity in the morphine drug group was significant before the intervention and 15, 30, and 60 minutes after the intervention. There was also a significant difference between the mean scores of pain severity in the morphine group 15 minutes after the intervention and 30 and 60 minutes after the intervention. The mean scores of pain severity were also significantly different between 30 and 60 minutes after the intervention.

According to the figure above, the mean scores of renal colic pain severity were decreasing in all five stages of pain severity measurement, and there was no significant difference in pain severity between the drug combination and morphine groups before the intervention.

The mean scores of renal colic pain severity were also decreased in patients 0, 15, 30, and 60 minutes after drug intervention. According to the figure, the reduction in pain severity was higher in the morphine group than in the combination group.

Discussion and Conclusion

The research objectives are summarized in four objectives as follows:

The first objective: The comparison of the demographic variable's distribution in the drug combination and morphine groups

There was no significant difference between the drug combination and morphine groups regarding age, sex, and different weight groups.

The second objective: Determining the pain severity in the drug combination group 0, 15, 30, and 60 minutes after the intervention

The mean scores of pain severity were 10, 9.8, 7.9, 5, and 1.6, respectively, in the drug combination group at 0, 15, 30, and 60 minutes after the intervention. According to the results, the mean scores of pain severity decreased over time in the drug combination group; hence, the drug combination was effective in reducing the pain severity of renal colic patients.

The third objective: Determining the pain severity in the morphine group at 0, 15, 30, and 60 minutes after the intervention

The mean scores of pain severity were 10, 9.9, 5.8, 3.1, and 0.46, respectively, in the morphine group at 0, 15, 30, and 60 minutes after the intervention. According to the results, the mean scores of pain severity were decreased in the morphine group over time; hence, morphine was effective in reducing the pain severity of renal colic patients.

The fourth objective: Comparison of pain severity in the drug combination and morphine groups at different times

There was no significant difference in the pain severity of renal colic patients between the drug combination and morphine groups before the intervention; hence, the differences after the intervention were due to the effects of the drugs. Furthermore, there was no significant difference in pain severity between the drug combination and morphine groups for renal colic patients at 0 minutes after the intervention. However, there was a significant difference between the drug combination and morphine groups in terms of pain severity at 15, 30, and 60 minutes after the intervention.

There was no significant difference between mean scores of pain severity in the combination group before and immediately after the intervention. The results also indicated that the difference between the mean scores of pain severity before and immediately after the intervention was not significant in the morphine group.

The difference between the mean scores of pain severity was significant in the drug combination group before the intervention and 15, 30, and 60 minutes after the intervention. The difference between the mean scores of pain severity 15 minutes after the intervention and 30 and 60 minutes later was also significant. Moreover, there was a significant difference in mean scores of pain severity between 30 and 60 minutes after the intervention.

The difference between the mean scores of pain severity was significant in the morphine group before the intervention and 15, 30, and 60 minutes after the intervention. The difference between the mean scores of pain severity was also significant 15 minutes after the intervention and 30 and 60 minutes after the intervention. There was also a significant difference in mean scores of pain severity between 30 and 60 minutes after the intervention.

4-3- Conclusion

The mean scores of renal colic pain severity were decreased in both the drug combination and morphine groups at 0, 15, 30, and 60 minutes after drug intervention, and the reduction in pain severity was higher in the morphine group than in the drug combination group.

4-4- Research Limitations

The patients may not cooperate properly to assess pain intensity due to pain restlessness. It was avoided by talking to them and assuring them that they would never be deprived of effective and adequate analgesics. Also, a separate bed was prepared in the emergency department for quick drug prescription and providing appropriate medical services to patients.

References

1. Baskin L, Tanagho E, McAninch J. (2008). Smith's General Urology.
2. Anderson RA. 2002. A complementary approach to urolithiasis prevention. World journal of urology. 20(5):294-301.
3. Ye Z, Zeng G, Yang H, Li J, Tang K, et al. (2020). The status and characteristics of urinary stone composition in China. BJU international. 125(6):801-809.
4. Zeng G, Mai Z, Xia S, Wang Z, Zhang K, et al. (2017). Prevalence of kidney stones in China: an ultrasonography based cross-sectional study. BJU international. 120(1):109-116.
5. Kheyfets V. (2018). Features of urolithiasis in patients of advanced and senile age. Advances in Gerontology Uspekhi Gerontologii.31(3):368-373.
6. D'Costa M, Pais VM, Rule AD. (2019). Leave no stone unturned: defining recurrence in kidney stone formers. Current opinion in nephrology and hypertension. 28(2):148.

7. Cupisti A, Morelli E, Meola M, Barsotti G. (1998). A proposito di nefrolitiasi ed ipertensione arteriosa. Giornale di Tecniche Nefrologiche e Dialitiche. 10(2):29-31.
8. Radimer K, Bindewald B, Hughes J, Ervin B, Swanson C, et al. (2004). Dietary supplement use by US adults: data from the National Health and Nutrition Examination Survey, 1999–2000. American journal of epidemiology. 160(4):339-49.
9. Stamatelou KK, Francis ME, Jones CA, Nyberg Jr LM, Curhan GC. (2003). Time trends in reported prevalence of kidney stones in the United States: 1976–1994. Kidney international. 63(5):1817-1823.
10. Han H, Segal AM, Seifter JL, Dwyer JT. (2015). Nutritional management of kidney stones (nephrolithiasis). Clinical nutrition research. 4(3):137-152.
11. Simforoosh N, Soltani MH, Shemshaki H, Hashemi MB, Dadpour M, et al. (2020). Symptom Resolution and Recurrence Outcomes after Partial versus Total Laparoscopic Adrenalectomy: 13 years of Experience with Medium-Long Term Follow up. Urology Journal. 18(02):165-170.
12. Qu LG, Chan G, Gani J. (2020). Clinician training level impacts prescribing practices for the conservative management of acute renal colic: a contemporary update. Int Urol Nephrol.
13. Al-Terki A, El-Nahas AR, Abdelhamid U, Al-Ruwaished MA, Alanzi T, et al. (2020). Development and validation of a score for emergency intervention in patients with acute renal colic secondary to ureteric stones. Arab J Urol. 18(4):236-240.
14. Travaglini F, Bartoletti R, Gacci M, Rizzo M. (2004). Pathophysiology of reno-ureteral colic. Urologia internationalis. 72(Suppl. 1):20-23.
15. Shafi ST, Anjum R, Shafi T. (2017). Clinical predictors of an abnormal ultrasound in patients presenting with suspected nephrolithiasis. Pak J Med Sci. 33(3):545-548.
16. Mora B, Giorni E, Dobrovits M, Barker R, Lang T, et al. (2006). Transcutaneous electrical nerve stimulation: an effective treatment for pain caused by renal colic in emergency care. The Journal of urology. 175(5):1737-1741.
17. Bretland PM. (1972). Acute ureteric obstruction: a clinical and radiological study: Appleton-Century-Crofts.
18. Gandhi A, Hashemzehi T, Batura D. (2019). The management of acute renal colic. British Journal of Hospital Medicine. 80(1):C2-C6.
19. Manjunath A, Skinner R, Probert J. (2013). Assessment and management of renal colic. BMJ. 346.
20. Portis AJ, Sundaram CP. (2001). Diagnosis and initial management of kidney stones. American family physician. 63(7):1329.
21. Kasper D, Fauci A, Hauser S, Longo D, Jameson J, et al. (2015). Harrison's principles of internal medicine, 19e: Mcgraw-hill New York, NY, USA.
22. Hazhir S, Badr YAA, Darabi JN. (2010). Comparison of intranasal desmopressin and intramuscular tramadol versus pethidine in patients with renal colic. Urology journal. 7(3):148.
23. Berthelot JM, Darrieutort-Lafitte C, Le Goff B, Maugars Y. (2015). Strong opioids for noncancer pain due to musculoskeletal diseases: Not more effective than acetaminophen or NSAIDs. Joint Bone Spine. 82(6):397-401.
24. Morteza-Bagi HR, Amjadi M, Mirzaii-Sousefidi R. (2015). The Comparison of Apotel plus Low Dose of Morphine and Full Dose of Morphine in Pain Relief in Patients with Acute Renal Colic. Addict Health. 7(1-2):66-73.
25. Sirous A, PAZOUKI S, GOUDARZI D, Yavari M, BABAEI E, et al. (2008). Evaluation of the effects of oral Ketamine as an adjuvant drug in the treatment of renal colic.
26. REZA KB, Safarinezhad M, Markazi MN, Valimanesh H, Abd Elahian M. (2004). The comparison of the efficacy of common pain management in acute renal colic.
27. Aganovic D, Prcic A, Kulovac B, Hadziosmanovic O. (2012). Clinical decision making in renal pain management. Acta Informatica Medica. 20(1):18.
28. Jebali C, Boukadida L, Chabaane W, Haj Ali A, Ousgi A, et al. (2017). Ketoprofen versus Diclofenac sodium in the treatment of renal colic. Tunis Med. 95(4):286-289.
29. Zanza C, Longhitano Y, Lin E, Luo J, Artico M, et al. (2020). Intravenous Magnesium - Lidocaine - Ketorolac Cocktail for Postoperative Opioid Resistant Pain: A Case Series of Novel Rescue Therapy. Rev Recent Clin Trials.
30. Afshar K, Jafari S, Marks AJ, Eftekhari A, MacNeily AE. (2015). Nonsteroidal anti-inflammatory drugs (NSAIDs) and non-opioids for acute renal colic. Cochrane Database Syst Rev. (6):CD006027.
31. Moran CP, Courtney AE. (2016). Managing acute and chronic renal stone disease. Practitioner. 260(1790):17-20, 2-3.
32. Pathan SA, Mitra B, Straney LD, Afzal MS, Anjum S, et al. (2016). Delivering safe and effective analgesia for management of renal colic in the emergency department: a double-blind, multigroup, randomized controlled trial. Lancet. 387(10032):1999-2007.
33. Jahr JS, Lee VK. Intravenous acetaminophen. (2010). Anesthesiology Clinics. 28(4):619-645.
34. Azizkhani R, Pourafzali SM, Baloochestani E, Masoumi B. (2013). Comparing the analgesic effect of intravenous acetaminophen and morphine on patients with renal colic pain referring to the emergency department: A randomized controlled trial. Journal of research in medical sciences: the official journal of Isfahan University of Medical Sciences. 18(9):772.
35. Bultitude M, Rees J. (2012). Management of renal colic. Bmj. 345.
36. Masoumi K, Forouzan A, Asgari Darian A, Feli M, Barzegari H, et al. (2014). Comparison of clinical efficacy of intravenous acetaminophen with intravenous morphine in acute renal colic: a randomized, double-blind, controlled trial. Emergency medicine international.
37. Berben SA, Meijs TH, van Dongen RT, van Vugt AB, Vloet LC et al. (2008). Pain prevalence and pain relief in trauma patients in the Accident & Emergency department. Injury. 39(5):578-585.
38. Todd KH, Ducharme J, Choiniere M, Crandall CS, Fosnocht DE, et al. (2007). Pain in the emergency department: results of the pain and emergency medicine initiative (PEMI) multicenter study. The journal of pain. 8(6):460-466.
39. Fwu C-W, Eggers PW, Kimmel PL, Kusek JW, Kirkali Z. (2013). Emergency department visits, use of imaging, and drugs for urolithiasis have increased in the United States. Kidney international. 83(3):479-486.
40. Bektas F, Eken C, Karadenız O, Goksu E, Cubuk M, et al. (2009). Intravenous paracetamol or morphine for the treatment of renal colic: a randomized, placebo-controlled trial. Annals of emergency medicine. 54(4):568-574.
41. Serinken M, Eken C, Turkcuer I, Elicabuk H, Uyanik E, et al. (2012). Intravenous paracetamol versus morphine for renal colic in the emergency department: a randomized double-blind controlled trial. Emergency Medicine Journal. 29(11):902-905.
42. Teichman JM. (2004). Acute renal colic from ureteral calculus. New England Journal of Medicine. 350(7):684-693.
43. Dolatabadi AA, Memary E, Kariman H, Gigloo KN, Baratloo A. (2017). Intranasal desmopressin compared with intravenous ketorolac for pain management of patients with renal colic referring to the emergency department: a randomized clinical trial. Anesthesiology and pain medicine. 7(2).
44. Jalili M, Entezari P, Doosti-Irani A, Masoomi R, Mirfazaelian H. (2016). Desmopressin effectiveness in renal colic pain management: Systematic review and meta-analysis. The American Journal of Emergency Medicine. 34(8):1535-1541.

45. Morteza-Bagi HR, Amjadi M, Mirzaii-Sousefidi R. (2015). The comparison of Apotel plus a low dose of morphine and a full dose of morphine in pain relief in patients with acute renal colic. Addiction & Health. 7(1-2):66.
46. Pathan SA, Mitra B, Straney LD, Afzal MS, Anjum S, et al. (2016). Delivering safe and effective analgesia for management of renal colic in the emergency department: a double-blind, multigroup, randomized controlled trial. The Lancet. 387(10032):1999-2007.
47. O'MALLEY PA. (2013). Intravenous Acetaminophen—Progress in Relief of Pain?: Implications for Clinical Nurse Specialist Practice. Clinical Nurse Specialist. 27(4):179-181.
48. Bosshard P, Stritt K, Roth B. (2020). [Overview of ureteral stone management]. Rev Med Suisse. 16(717):2321-2324.
49. Wertli MM, Reich O, Signorell A, Burgstaller JM, Steurer J, et al. (2017). Changes over time in prescription practices of pain medications in Switzerland between 2006 and 2013: an analysis of insurance claims. BMC Health Serv Res. 17(1):167.
50. Lefterova A, Getov I. (2004). Study on consumers' preferences and habits for over-the-counter analgesics use. Cent Eur J Public Health. 12(1):43-45.
51. Jirsa M, Hykes P. (1973). [Paracetamole test for conjugation capacity of the liver (author's transl)]. Cas Lek Cesk. 112(44):1362-1364.
52. Liang Y, Li J, Pan W. (2020). Family satisfaction in the intensive care unit: The influence of disease severity, care relationship, patient anxiety, and patient pain. Intensive Crit Care Nurs. 102995.
53. Fassassi C, Dove D, Davis A, Butt M, Masoudi A, et al. (2020). Analgesic efficacy of morphine sulfate immediate release vs. oxycodone/acetaminophen for acute pain in the emergency department. Am J Emerg Med.
54. Russo F, Milanesi N, Cartocci A, Bruzziches F, Tronconi G, et al. (2020). Dupilumab in Elderly Patients with Severe Atopic Dermatitis. Dermatitis. Ahead of Print.
55. Rodriguez CS. (2001). Pain measurement in the elderly: a review. Pain Manag Nurs. (2):38-46.
56. Ghafouri HB, Abazarian N, Yasinzadeh M, Modirian E. (2020). Intravenous Paracetamol vs Intranasal Desmopressin for Renal Colic in the Emergency Department: A Randomized Clinical Trial. Pain Med.
57. Nikouyeh M, Vakili M, Hajimaghsoudi M, Bagherabadi M, Saadatyar A. (2020). Effect of Nebulized Morphine vs. Intravenous Morphine in Decreased Pain in Renal Colic Patient. SSU_Journals. 27(9):1893-1900.
58. Cenker E, Serinken M, Uyanık E. (2018). Intravenous paracetamol vs ibuprofen in renal colic: a randomized, double-blind, controlled clinical trial. Urolithiasis. 46(4):369-373.
59. Al B, Sunar MM, Zengin S, Sabak M, Bogan M, et al. (2018). Comparison of IV dexketoprofen trometamol, fentanyl, and paracetamol in the treatment of renal colic in the ED: A randomized controlled trial. The American Journal of Emergency Medicine. 36(4):571-576.
60. Entezari Asl M, Ghazi A, MirzaRahimy T. (2015). comparative study of the infusion of ketorolac and acetaminophen in reducing postoperative pain and opioid consumption in patients undergoing orthopedic surgery of the lower limbs. Anesthesiology and Pain. 9(1):31-43.
61. SHAKER SH, MOSADEGH R, JALALI F, ZAVAREH M. (2017). Comparison of intravenous morphine and ketorolac in renal colic patients admitted to Firoozgar and Hazrat Rasoul e Akram hospitals.
62. Khalili G, Salimianfard M, Zarehzadeh A. (2016). Comparison between paracetamol, piroxicam, their combination, and placebo in postoperative pain management of upper limb orthopedic surgery (a randomized double-blind clinical trial). Adv Biomed Res. 5:114.
63. Serinken M, Eken C, Turkcuer I, Elicabuk H, Uyanik E, et al. (2012). Intravenous paracetamol versus morphine for renal colic in the emergency department: a randomized double-blind controlled trial. Emerg Med J. 29(11):902-905.
64. Bektas F, Eken C, Karadeniz O, Goksu E, Cubuk M, et al. (2009). Intravenous paracetamol or morphine for the treatment of renal colic: a randomized, placebo-controlled trial. Ann Emerg Med. 54(4):568-574.
65. Upadhyay C, Cameron K, Murphy L, Battistella M. (2014). Measuring pain in patients undergoing hemodialysis: a review of pain assessment tools. Clinical kidney journal. 7(4):367-372.
66. Dijkers M. (2010). Comparing quantification of pain severity by verbal rating and numeric rating scales. The journal of spinal cord medicine. 33(3):232-242.