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# Evaluating Effectiveness of Intravenous Magnesium Sulfate As a Treatment in Acute Renal Colic Patients Attending Suez Canal University Hospital Emergency Department

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## Abstract

*Background:* Renal colic is one of the most sever forms of pain in humans. Renal colic affects nearly 1.2 million people each year and accounts for nearly 1% of all hospital admissions. Having a family member with a history of stones doubles there rates.

*Aim of Study:* To evaluate the effectiveness of intravenous magnesium sulfate as an adjunct treatment in acute renal colic pain in patients who are not responding to conventional treatment (NSAIDs or Opioids) at the Emergency Department and to evaluate the role of I.V magnesium sulfate in diminishing the need for additional doses of NSAIDs or opioids in treatment of acute renal colic.

*Material and Methods:* This study designed as a randomized clinical trial. Patients (18-60 years) having acute renal colic pain attending E.R and not responding to traditional treatment (30mg of intravenous ketorolac added to 10ml saline) and they are divided into two groups including 96 subjects: First Group included (48 patients) is the standard treatment group using NSAIDs, second group included (48 subjects) is the intervention group using Mg Sulphate. Vital signs to all patients including pulse rate, blood pressure (systolic/diastolic), respiratory rate, $O_2$ saturation%, temperature (Celsius) and Severity of patient's pain by visual analogue scale (VAS) was measured twice to each group in the study periods 30 minutes after beginning of treatment and 60 minutes later.

*Results:* 96 cases were randomly allocated to intervention or control group. There was a significant statistical difference in between study groups regarding pain severity at 30 and 60 minutes; the intervention group showed much better pain relief on VAS than the control group.

***Key Words:*** *Intravenous magnesium sulfate – Acute renal colic – visual analogue scale.*

## Introduction

**RENAL** colic is one of the most sever forms of pain in humans. Renal colic affects nearly 1.2 million people each year and accounts for nearly 1% of all hospital admissions. Having a family member with a history of stones doubles there rates [1].

The actual pain attack reaching it's peak in most patients within 2 hours of onset. It is caused by acute partial or complete ureteric obstruction due to calculus in most majority of cases. Renal colic usually begins in the upper lateral mid back over the costovertebral angle occasionally subcostally. It radiates inferiorly and anteriorly toward the groin [2].

Ureteric obstruction causes increase in the intra luminal pressure of the collecting system, stretching it, and stimulating nerve endings in lamina popira which causes smooth muscle of the wall of the ureter to contract to try to move the stone. In prolonged isotonic contractions lactic acid production will increase which irritate both slow-type A and fast type C fibers which contributes in increasing the pain **[1,3]**.

This increased pressure leads to increasing the production and local release of prostaglandins which results in dilation of blood vessels and diuresis resulting in a further increase in the pressure inside the kidney and play a role in development of edema around the stones **[4]**.

Opioids and NSAIDs are the main drugs in treatment of renal colic. Opioids have no effect on the cause of pain while they may have contractile effects on the ureteral tone but they are addictive and may have side effects such as nausea, vomiting, constipation and drowsiness and in higher doses, they can even cause respiratory depression **[5]**. NSAID, on the other hand, having a direct effect on prostaglandins release, pain relief by reducing renal pressure and diuresis. They may also reduce

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the edema of ureter around the stones [4]. However, these drugs may induce some secondary regulatory responses in the kidney leading to some obstructions [6]. Considering that renal colic can be caused by peristalsis movements above the point of obstruction, it is hypothesized that it is possible to control the patient pain by preventing the contraction movements in the ureters. Tocolytic drugs such as magnesium sulfate can be effective in this matter as it prevents calcium from entering the smooth muscle cell membrane, activating adenylatecyclase and c-AMP, and increases the uptake of calcium by sarcoplasmic network [7]. Reducing acetylcholine in the nerve terminals, magnesium sulfate can also decrease muscle contractions [6,12]. Magnesium sulphate is also a N-methyl D-aspartate "NMDA" receptor antagonist been tried to control pain by modifying mechanism of central hypersensivity and to subsequently decrease analgesic requirements including opioid consumption [8]. Magnesium sulfate has been previously investigated as a possible adjuvant for post-operative analgesia [8-11].

## Material and Methods

*Study design:*

This is a randomized clinical trial. After obtaining patient consent with an explanation regarding the purpose, methods, effects, and complications and written informed approval by the Hospital Ethics Committee.

*Study population:*

*Inclusion criteria:*

Adult patients (18-60 years) having acute renal colic pain attending to the Emergency room (ER), Both Sex, Pain severity >5 based on visual analogue scale (VAS) who met all the inclusion criteria in the Suez Canal University Hospitals from April 2018 – August 2018 and who have acute loin pain not responding to traditional treatment (30mg of intravenous ketorolac added to 10ml saline) and An Emergency Medicine Specialist divided these patients into 2 groups; randomly by Hospital record number (last digit; odd to group 1, even to group 2. They are divided into two groups. Group 1 is the standard treatment group using NSAIDs the patients will be treated with 30mg of intravenous ketorolac and 100ml intravenous normal saline within 15 minutes). Group 2 is the intervention group using Mg Sulphate. (Fifteen mg per Kg of intravenous magnesium sulfate 50% in 100ml normal saline will be infused within 15 minute).

*Exclusion criteria:* History of seizure, any heart, liver, kidney or metabolic disease, fever (oral temperature >38 Celsius), Systolic blood pressure less than 90mm), Hematuria, pregnancy, Consumption of any analgesics before presenting to ED, History of addiction, and having taken calcium channel blockers, patients with acute loin pain responding to conventional treatment in the first hour and Patients know to have hypersensitivity to magnesium sulphate.

## Results

This study designed as a randomized clinical trial. Adult patients (18-60 years) having acute renal colic pain attending to the Emergency room who met all the inclusion criteria and not responding to traditional treatment (30mg of intravenous ketorolac added to 10ml saline) and they are divided into two groups including 100 subjects: Group 1 included (48 subjects) is the standard treatment group using NSAIDs [the patients will be treated with 30mg of intravenous ketorolac and 100ml intravenous normal saline within 15 minutes]. Group 2 included (48 subjects) is the intervention group using Mg Sulphate (Fifteen mg per Kg of intravenous magnesium sulfate 50% in 100ml normal saline will be infused within 15 minute), there were 4% drop out subjects in this study. There was no significant statistical difference among the two groups for age, Height, Weight, BMI, Vital signs to each group: Pulse rate, blood pressure (systolic/diastolic), respiratory rate, O2 saturation%, temperature (Celsius) in the study periods 30 and 60 minutes after intervention.

Fig. (1) shows that there was a significant statistical difference in between study groups regarding pain severity. In the control group (group 1) pain severity after 30 minutes intervention was $5.15 \pm 1.11$ while in the intervention group (using Mg sulphate) (group 2) was $4.73 \pm 1.16$ and in the control group (group 1) pain severity after 60 minutes intervention was $3.67 \pm 1.36$ while in the intervention group (using Mg sulphate) (group 2) was $3.17 \pm 1.29$.

Tables (5,6) show Distribution of the studied cases according to 2ry line treatment protocol (morphine addition) and patients needing hospital admission among the study population in both groups. In group 1 (standard treatment), number of patients needing 2ry line treatment protocol (morphine addition) were 10 subjects representing 10% of the study population while in group 2 (intervention treatment) number of patients needing 2ry line treatment protocol (morphine addition) were 6 subjects representing 6% of the study population.

Table (1): Comparison between the two studied groups according to demographic data.

| | Group 1 (n=48) | | Group 2 (n=48) | | *p* |
|---|---|---|---|---|---|
| | No. | % | No. | % | |
| *Sex:* | | | | | |
| Male | 27 | 56.3 | 29 | 60.4 | 0.679 |
| Female | 21 | 43.8 | 19 | 39.6 | |
| *Age (years):* | | | | | |
| Mean ± SD | 31.94±8.08 | | 31.96±8.29 | | 0.990 |

Table (2): Comparison between the two studied groups according to Height, Weight & BMI.

| | Group 1 (n=48) | Group 2 (n=48) | *p* |
|---|---|---|---|
| Height (cm) Mean ± SD | 162.56±6.82 | 161.25±5.95 | 0.318 |
| Weight (kg) Mean ± SD | 69.79± 12.90 | 68.38± 1 1.49 | 0.571 |
| BMI (kg/m$^2$) Mean ± SD | 26.41 ±4.72 | 26.68±5.21 | 0.787 |

Tables (3): Comparison between the two studied groups according to Vital sings "clinical".

| | Group 1 (n=48) Mean ± SD | Group 2 (n=48) Mean ± SD | *p* |
|---|---|---|---|
| *Pulse (beat/m):* | | | |
| Before intervention | 77.17±7.86 | 78.19±8.13 | 0.533 |
| 30 minutes after intervention | 76.67±7.71 | 77.02±8.01 | 0.826 |
| 60 minutes after intervention | 76.31±7.53 | 76.42±8.04 | 0.948 |
| *R.R (breath/m):* | | | |
| Before intervention | 15.94±1.12 | 16.15±1.17 | 0.374 |
| 30 minutes after intervention | 15.50±0.92 | 15.50±0.95 | 1.000 |
| 60 minutes after intervention | 15.27±0.87 | 15.25±0.86 | 0.906 |
| *Temperature (celsius):* | | | |
| Before intervention | 37.43±0.05 | 37.43±0.05 | 0.829 |
| 30 minutes after intervention | 37.33±0.13 | 37.33±0.13 | 0.808 |
| 60 minutes after intervention | 37.36±0.09 | 37.37±0.10 | 0.829 |
| *Systolic B.p:* | | | |
| Before intervention | 116.88±6.24 | 117.92±6.51 | 0.426 |
| 30 minutes after intervention | 116.25±6.06 | 116.67±6.30 | 0.742 |
| 60 minutes after intervention | 115.42±5.82 | 115.42±5.82 | 1.000 |
| *Diastolic B.p:* | | | |
| Before intervention | 76.04±4.94 | 76.67±4.76 | 0.530 |
| 30 minutes after intervention | 75.83±5.39 | 75.83±5.39 | 1.000 |
| 60 minutes after intervention | 75.21±5.45 | 75.0±5.46 | 0.852 |
| *O2 saturation:* | | | |
| Before intervention | 97.81±0.73 | 97.79±0.71 | 0.888 |
| 30 minutes after intervention | 97.81±0.73 | 97.79±0.71 | 0.888 |
| 60 minutes after intervention | 97.81±0.73 | 97.79±0.71 | 0.888 |

Tables (4): Comparison between the two studied groups according to pain severity.

| Pain severity | Group 1 (n=48) | Group 2 (n=48) | *p* |
|---|---|---|---|
| Before intervention Mean ± SD | 6.85±0.74 | 6.85±0.90 | 0.913 |
| 30 minutes after intervention Mean ± SD. | 5.15±1.11 | 4.73±1.16 | 0.042* |
| 60 minutes after intervention Mean ± SD. | 3.67±1.36 | 3.17±1.29 | 0.036* |

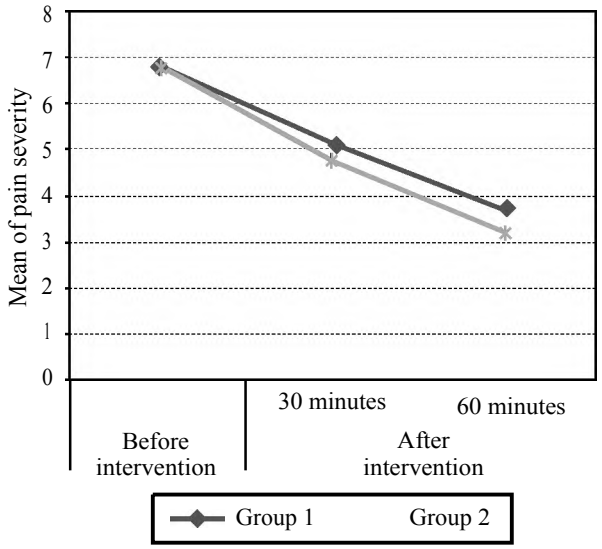


Fig. (1): Comparison between the different studied periods according to pain severity Group 1: Standard treatment Group 2: Intervention treatment Magnesium sulphate.

Tables (5): Distribution of the studied cases according to 2ry line treatment protocol in Group 1: Standard treatment (n=48).

| Pain severity | No. | % |
|---|---|---|
| *2ry line treatment protocol (morphine addition):* | | |
| No | 38 | 79.2 |
| Yes | 10 | 20.8 |

Tables (6): Distribution of the studied cases according to 2ry line treatment protocol in Group 2: Intervention treatment Magnesium sulphate (n=48).

| Pain severity | No. | % |
|---|---|---|
| *2ry line treatment protocol (morphine addition):* | | |
| No | 42 | 87.5 |
| Yes | 6 | 12.5 |

## Discussion

Seeking the best analgesic for renal colic is an ongoing process and an ideal pain killer should have the ability to rapidly and effectively cease

the pain with a high safety profile and no significant interaction with other pharmacological agents and so adding magnesium sulfate as adjunct treatment of standard protocol of renal colic management could be effective in reducing the patient's pain and need for additional dose of morphine without disturbing hemodynamic measures. This study evaluated the effectiveness of intravenous magnesium sulfate as an adjunct treatment in acute renal colic pain in patients who are not responding to conventional treatment.

In the current study there was no significant statistical difference regarding the age and sex which agrees with Hassan Soleimanpour and colleagues studies that reported no significant statistical difference regarding the age and sex.

Also there was no significant differencein this current study regarding: Height, weight and BMI in this current study which agrees with Mu Tsun Shih and colleagues studies that reported no significant statistical difference regarding Height, weight and BMI.

Also there was no significant differencein this current study regarding vital signs including (Systolic & Diastolic blood pressure, pulse, Respiratory Rate) in the control group Before intervention, 30 & 60 minutes after intervention in this current study which agrees with Nistal-Nuño Band colleagues studies that reported no significant statistical difference regarding vital signs including (Systolic & Diastolic blood pressure, pulse, Respiratory Rate) regarding ketorolac administration in preoperative total abdominal hysterectomy.

Also there was no significant differencein this current study regarding vital signs including (Systolic & Diastolic blood pressure, pulse, Respiratory Rate) in the intervention group before intervention, 30 & 60 minutes after intervention in this current study which agrees with MohariShariatand colleagues studies that reported no significant statistical difference regarding (pulse, Respiratory Rate) regarding Mg sulphate administration in Postoperative Pain in Major non Laparoscopic Gastrointestinal Surgeries.

Also pain severity on Visual analogue scale improved much better in the intervention group; in the control group (group 1) pain severity after 30 minutes intervention was $5.15 \pm 1.11$ while in the intervention group (using Mg sulphate) (group 2) was $4.73 \pm 1.16$ and in the control group (group 1) pain severity after 60 minutes intervention was $3.67 \pm 1.36$ while in the intervention group (using Mg sulphate) (group 2) was $3.17 \pm 1.29$.

Which shows a significant statistical difference in between study groups regarding pain severity in the intervention group in this current study which agrees with Abolfazl Jokar and colleagues studies that reported significant statistical difference regarding pain severity on Visual analogue scale using Mg sulphate **[12]**.

Also agrees with kumar and colleagues studies that reported significant statistical difference regarding Effect of intravenous magnesium sulphate in pain severity on postoperative pain following spinal anesthesia **[8]**.

In this study we used Fifteen mg per Kg of intravenous magnesium sulfate 50% in 100ml normal saline will be infused within 15 minutes without any subsequent infusion. Other studies have also use $MgSO_4$ bolus does and they found that it was were effective for postoperative pain relief after orthopaedic and gynaecological surgery, but in addition they used continuous infusion or repeat bolus in addition to initial bolus such as in (Ryu et al., 2008), (Seyhan et al., 2006). The above dosage has been reported to be safe without any adverse effects. In conclusion, there was a significant statistical difference in between study groups regarding pain severity as pain severity on Visual analogue scale improved much better in the intervention group than in the control group; so magnesium sulfate can be used as an adjunct drug in treatment of patients suffering from renal colic.

*Conclusion:*

Renal colic is one of the most sever forms of pain in humans. Renal colic usually begins in the upper lateral mid back over the costovertebral angle occasionally subcostally. Opioids and NSAIDs are the main drugs in treatment of renal colic. Opioids have no effect on cause of pain while they may have contractile effects on the ureteral tone but they are addictive and may have side effects such as nausea, vomiting, constipation and drowsiness and in higher doses, they can even cause respiratory depression. NSAID, on the other hand, having a direct effect on prostaglandins release, pain relief by reducing renal pressure and diuresis. They may also reduce the edema of ureter around the stones. However, these drugs may induce some secondary regulatory responses in the kidney leading to some obstructions.

So seeking new drugs to relief acute renal colic was obligatory. Tocolytic drugs such as magnesium sulfate can be effective in this matter as it prevents calcium from entering the smooth muscle cell membrane, activating adenylatecyclase and c-AMP,

and increases the uptake of calcium by sarcoplasmic network. Reducing acetylcholine in the nerve terminals, magnesium sulfate can also decrease muscle contractions.

So we conducted this study to evaluate the effect of Magnesium sulphate as adjunct treatment in acute renal colic patients; there was a significant statistical difference in between study groups regarding pain severity; the intervention group showed much better pain relief on VAS than the control group.

*Recommendations:*

1- Usage of Mg sulphate in acute renal colic in patients not responding to conventional ttt.

2- Clinical randomized trial should increase to see the therapeutic effect of Mg sulphate on pain relief and reducing opioid consumption.

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# تقييم فعالية سلفات الماغنسيوم كعلاج إضافى فى آلام الكلى المغصية الحادة بقسم الطوارىء بمستشفيات جامعة قناة السويس


المغص الكلوى هو واحد من أشد أشكال آلام فى البشر حيث يصيب ما يقرب من مليون ومئتى ألف شخص كل عام ويمثل حوالى واحد بالمائة من جميع حالات دخول المستشفى.

طرق البحث: أقيمت الدراسة فى مستشفى جامعة قناة السويس. تم تقسيم المرضى عشوائياً إلى مجموعتين. المجموعة الأولى: سيتم علاج المرضى بثلاثون ملغ من كيتورولاك فى الوريد ضاف على مائة مل من المحلول الملحى فى الوريد وذلك فى غضون ١٥ دقيقة المجموعة الثانية: خمسة عشر ملغ لكل كيلو غرام من سلفات الماغنسيوم بتركيز خمسون بالمئة فى الوريد سيتم اضافتهم فى ١٠٠ مل من المحلول الملحى وذلك بغضون ١٥ دقيقة.

سيتم رصد لكل مجموعة فى الدراسة كلا من: العلامات الحيوية ومعدل النبض وضغط الدم (الانقباضى / الانبساطى)، ومعدل التنفس وتشبع الأكسجين، ودرجة الحرارة (مئوية) وشدة آلم المريض من خلال مقياس المقارنة المرئى لقياس درجة الاحساس بالآلم وسيتم قياسهم مرتين لكل مجموعة على فترتين: بعد ثلاثين دقيقة وبعد ستين دقيقة من بداية العلاج.

نتائج الدراسة: تبين بعد عمل الدراسة أن سلفات الماغنسيوم الوريدى يعمل بشكل فعال فى علاج آلام الكلى المغصية الحادة ويمكن الاعتماد عليه كعلاج إضافى فى آلام الكلى المغصية.

توصيات الدراسة: نوصى بإجراء دراسة لعدد أكبر من مرضى آلام الكلى المغصية الحادة لمتابعة مدى كفاءة وفعالية سلفات الماغنسيوم الوريدى فى علاج آلام الكلى المغصية الحادة والاعتماد عليه كعلاج إضافى فى آلام الكلى المغصية.