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# Comparing the Efficacy of Paracetamol, Diclofenac, and Ketorolac on Post-Appendectomy Outcomes in Children and Adolescents

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## Abstract

Acute appendicitis is one of the most frequent abdominal conditions that face children population and needs urgent surgical intervention and appendectomy until now represent standard treatment for uncomplicated cases of appendicitis. Nausea, vomiting and pain after surgery are the most frequent issues facing patients and affecting patient quality of life and responsible for many cases of readmission after surgery. Ketorolac and diclofenac represent the most commonly prescribed non-steroidal anti-inflammatory used in postoperative setting and they cause many side effects as gastrointestinal, kidney and cardiac adverse effect in addition to increased risk of bleeding. Paracetamol is currently among the most frequently prescribed medication worldwide and it can be used safely for all age groups. This study aimed to compare the analgesic efficacy and safety of paracetamol, diclofenac, and ketorolac when used after appendectomy and to assess their efficacy regarding nausea and vomiting in children and adolescents. A randomized, single-blinded, comparative, observational prospective clinical study was carried out on patients diagnosed with acute appendicitis and assigned for emergent appendectomy between October 2018 to May 2019 in Al- Zahraa Teaching Hospital in Al-Najaf province, Iraq.120 patients were randomly distributed into three groups who received diclofenac sodium suppositories (2mg/kg), IV Paracetamol (15mg/ kg every 6 hr.), and IV Ketorolac (0.5mg/ kg) immediately after surgery. All patients were observed for pain, nausea and vomiting and bleeding. Patients received ketorolac had a high percentage of the decrease in pain score between 30 and 60 min. after surgery, while paracetamol was the next and diclofenac sodium was the last. Regarding nausea and vomiting after surgery, ketorolac had higher percentage of the decrease in nausea, vomiting score during first day after surgery followed by diclofenac and paracetamol respectively. The present study also showed that there is no significant difference between groups regarding bleeding after surgery. It is concluded that ketorolac has higher analgesic efficacy compared with paracetamol and diclofenac with no risk of nausea and vomiting and bleeding when used after appendectomy.

**Keywords: Postoperative pain, Ketorolac, Diclofenac, Paracetamol, Appendectomy.**

# دراسة مستقبلية عشوائية سريرية لمقارنة تأثير براسيتامول ودايكلوفيناك وكيتورولاك على نتائج ما بعد عملية استئصال الزائدة الدودية عند الأطفال واليافعين.

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## الخلاصة

التهاب الزائدة الدودية واحد من أكثر الامراض التي تصيب الاطفال والتي تحتاج الى تدخل جراحي سريع وطارئ وتعتبر عملية استئصال الزائدة الدودية العلاج الرئيسي للحالات غير المعقدة من المرض. حصول المضاعفات بعد عملية استئصال الزائدة شيء نادر ويحدث بنسبه ٣٪ من الاطفال في الحالات غير المعقدة. ويعتبر الغثيان والتقيؤ والالم بعد العملية من أكثر المشاكل شيوعا والتي تواجه المرضى وتؤثر على طبيعة حياتهم ومسؤولة عن الكثير من حالات الدخول الى المستشفى بعد العملية. الدايكلوفيناك والكيتورلاوك من أكثر الادوية المضادة للالتهابات غير الستيروئدية صرفا وخصوصا بعد العملية وتملك العديد من الاثار الجانبية كالتآثيرات الجانبية على الجهاز الهضمي والكلى والقلب ومخاطر النزيف بينما البراسيتامول الذي يعتبر من الاكثر الادوية صرفا حول العالم والذي يوصف بامان لكل الفئات العمرية. الهدف من الدراسة هو مقارنة فعالية وآمان البراسيتامول والدايكلوفيناك والكيتورولاك على تسكين الالم وتقييم فعاليتها على تقليل الغثيان والتقيؤ بعد عملية استئصال الزائدة الدودية في الاطفال واليافعين.

الدراسة سريرية مستقبلية عشوائية اجريت على المرضى المشخصين بالتهاب الزائدة الدودية والمرشحين لاجراء عملية استئصال الزائدة الدودية للفترة بين تشرين الاول ٢٠١٨ وايار٢٠١٩ في مستشفى الزهراء التعليمي في محافظة النجف في العراق وتضمنت الدراسة ١٢٠ مريضا وزعوا عشوائيا على ثلاث مجاميع الاولى اخذت براسيتامول وريدي (١٥ملغ/كغم كل ٦ ساعات) والثانيةاخذت تحاميل الدايكلوفيناك (٢ ملغ/كغم) والثالثة اخذت خذوا كيتورولاك وريدي (٠،٥ ملغ/كغم) بعد العملية مباشرة. تمت متابعة المرضى في الدراسة من حيث الالم والغثيان والتقيؤ وحدوث النزف بعد العملية.

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اثبتت الدراسة بان الكيتورولاك يملك النسبة الاكبر من المرضى الذين لديهم اقل درجه الم بعد ٣٠ و ٦٠ دقيقة من العملية يليه البراسيتامول والدايكلوفيناك تتابعا وكذلك اثبتت ان الكيتورولاك يملك النسبة الاكبر من المرضي الذين لديهم اقل درجة للغثيان والتقيؤ في اليوم الاول من العملية يليه الدايكوفيناك ثم البراسيتامول اخيرا. كما اثبتت الدراسة الحالية انه لا يوجد اختلاف واضح بين مجموعات الدراسة فيما يتعلق بحدوث النزف بعد العملية. نستنتج ان الكيتورولاك يملك اعلى فعالية كمسكن الم مقارنة بالبراسيتامول والدايكلوفيناك وبدون خطر الاصابة بالغثيان والتقيؤ والنزف بعد عملية استئصال الزائدة الدودية.

**الكلمات المفتاحية: الم بعد العملية ، كيتورولاك، دايكلوفيناك، براسيتامول، عملية استئصال الزائدة الدودية**

## Introduction

Acute appendicitis is considered one of the most frequent abdominal condition that faces children population and needs an urgent surgical procedure [(1)]. Appendectomy till now represents standard treatment for uncomplicated cases of appendicitis [(2)] . Appendectomy can perform either by open surgery or laparoscopic procedure. It accounts for more than half of the operations that are done in the emergency room and constitutes about 10-30% of pediatric emergency operations[(3,4)]. Surgical treatment of acute appendicitis by open surgery approach is considered a clean-contaminated surgery and still has good outcomes with acceptable complication rate (11.1%) and mortality rate of less than 0.5% which is related to the operation itself [(5-8)]. The complications after appendectomy are rare and include surgical site infection (1.2-12%), intra-abdominal abscess (1.8-8%), small intestine obstruction (0-1.9%) and lesser percent present with stump leakage and stump appendicitis[(9,10)].

Nausea and vomiting (N,V) and pain after surgery are the most frequent issue facing patients[(11,12)]. Previous studies stated that about 30% of patients suffer from mild pain, 30% present with moderate pain and the rest percent 40% suffer from severe pain after surgery [(13)].

Children usually face periods of healing after discharge from hospital and back home, during this period, children have significant postoperative pain which significantly affects the patient's quality of life[(14)]. Many medications are used to treat postoperative pain include opioids, non-steroidal anti-inflammatory drugs (NSAIDs), and paracetamol. However, these medications are not free from side effects, which can produce respiratory depression and gastrointestinal problems [(15)]. The aim of treating postsurgical pain is to achieve good pain control with minimum side effects [(16)].

Post-operative nausea and vomiting (PONV) is one of the common issues in practice of anesthesia, since it causes many complications as surgical wound opening, unplanned admission, delay return to normal activity and dehydration[(17)]. PONV is influenced by many factors, which include personal factors and surgical factors. Pain represents common post-surgical risk factor of PONV[(18)]. After surgery patients favor to have pain rather than (N,V)[(19)].

After hundreds of years of advances, the mainstay of pain therapy is still the opioids, which are considered a very potent pain killer but associated with many unwanted side effects like: respiratory depression, sedation, hypotension, bradycardia, nausea and vomiting (N,V) pruritus and inhibition of bowel function[(16)].

Nonsteroidal anti-inflammatory drugs are a group of medications used in modern medicine to relieve pain and inhibit inflammation[(20)]. The main mechanism by which NSAIDs produce their efficacy is inhibition of prostaglandin synthesis by inhibiting the first enzyme in prostaglandin synthesis which is called *Cyclooxygenase* (COX)[(21)]. NSAIDs are widely used for both children and adults but not without side effects, where they cause gastrointestinal, kidney and cardiac adverse effects in addition to increased risk of bleeding[(22)].

Ketorolac and diclofenac represent the most commonly prescribed NSAIDs used in the postoperative setting. Ketorolac has potent analgesic activity but a moderate anti-inflammatory effect[(23)]. Ketorolac intravenously is used to manage moderate to severe pain after surgery[(24)]. It is considered a reasonable option to avoid the use of opioids in children in addition to decrease the cost of treatment with comparable efficacy to morphine where 0.5-1.5 mg\kg of iv ketorolac has comparable analgesia of 0.1 mg \kg of iv morphine with lowest adverse effect[(25)]. On the other hand, diclofenac has potent analgesic, anti-inflammatory, and antipyretic properties. Diclofenac has a potency greater than other NSAIDs since it is like celecoxib in COX2 selectivity and low risk for bleeding[(22)]. It is used safely in children and is frequently given rectally for acute pain after surgery[(24)].

Paracetamol is currently among the most frequently prescribed medication worldwide. It can be used safely for all age groups and it constitutes step no.1 of the World Health Organization ladder of analgesia[(26,27)]. Paracetamol acts as a good pain reliever and fever reduction but it has no anti-inflammatory action. It differs from opiates since the lack of respiratory depression effect and does not cause addiction also it differs from NSAIDs since the

lack of unwanted gastrointestinal, renal or cardiac side effect[28]. Due to the faster onset of action and good tolerability profile, paracetamol as the I.V route is used currently to relieve pain immediately after surgery[28,29]. Paracetamol works by a mechanism not clearly understood until now even after many years of discovery and clinical use[28] .

The aim of this study was to compare the analgesic efficacy and safety of paracetamol, diclofenac, and ketorolac when used after appendectomy and to assess their efficacy regarding postoperative nausea and vomiting in children and adolescents.

## Patients and Methods

This study was conducted after approval by graduate studies committee of the College of Pharmacy\ University of Baghdad and Scientific and Ethical Committee of Researchers of Al-Najaf Health Directorate and after taking the permission of patient's parents.

A prospective, randomized, single-blinded, comparative, observational clinical trial was carried out on 120 patients diagnosed as acute appendicitis and assigned for emergent appendectomy surgery (mean age was7.5±2.74 years) at Pediatric Surgery Department, Al-Zahraa Teaching Hospital, Al-Najaf province, Iraq. Collecting data and following up was done from October 2018 to May 2019. The number of female patients was 85 (70.8%), while the number of male patients was 35(29.2%).

The follow-up period was one month for each patient and it is done either by phone calls or interviewing with patients when they visited the consultant unit at Pediatric Surgery Department, Al-Zahraa Teaching Hospital postoperatively or at private clinics of a surgeon.

The inclusion criteria for enrolling patients in the study were:

1- Patients diagnosed with acute appendicitis,
2- Aged between 4-14 years with no history of allergy or contraindication to ketorolac, diclofenac or paracetamol.
3- Taking the same analgesia for 3 consecutive days without any rescue analgesic and taking the same antibiotic regime mentioned later in this study.

Exclusion criteria involved

1- Patient who disagree to participate in the study,
2- Patients with known hypersensitivity or contraindication to ketorolac, diclofenac, and paracetamol,
3- Concomitant therapy with warfarin or heparin or high-dose aspirin (>1000 mg/day), those with the established cardiovascular disorder or uncontrolled hypertension and who had received antibiotics within 72 hours of admission.
4- Those with complicated or perforated appendicitis.
5- Patient with less than one month of follow up.

Patients fulfilling the eligibility criteria were blindly and randomly allocated into one of the three groups, each group contained 40 patients. The randomization was done by the preparation of a list on the computer by the researcher that was coded to contain only the number and the name of the drug without knowledge of the patients and surgeons. After the surgery was done, the patient takes the same drug that presents in the list according to the number present in the previously prepared list.

Group (A): patients received Paracetamol 15 mg /kg every 6 hrs (intravenously), Group (B): patients received diclofenac 2 mg/kg per rectal route twice daily (In order to determine the amount of medication needed per dose in patient taking diclofenac suppositories, the suppository was scraped-off by using sharp surgical blade, sectioned longitudinally then weighted by using Radwang® electronic balance), and Group (C): patients received Ketorolac 0.5 mg /kg (intravenously)once daily . The patients were transferred to the recovery room and received analgesia immediately after surgery and continue to use it for three days. The patients receive the same antibiotics regime (the antibiotic regimen was continued for five days after surgery and it consisted of IV ceftriaxone with a daily dose of 50 mg/ kg and IV metronidazole with a dose of 7.5 mg/ kg every 8 hr.).

The data collection sheet designed by the researcher to obtain information related to the patient directly from him or from his relatives.

Postoperative pain, and (N,V) were assessed by using a validated scale or asking patients and the data were obtained by direct interview with the patients on the first day (day of surgery at the hospital).

Postoperative pain was assessed in each group by using the Faces Pain Scale-Revised (FPS-R)[30,31], which is considered as a self-report measure of pain intensity that was developed to be used in children with age range of 4-16 years. This scale contains six face expression with different emotion scores (0, 2, 4, 6, 8 and 10), the child should be referred to face express that coordinate with his/her pain feeling. The patients assessed their pain intensity by using this scale at 30 minutes and 60 minutes after surgery and the score was recorded.

Postoperative Nausea and vomiting were assessed using Baxter Animated Retching

Faces (BARF)[32] which is characterized by six characters with different degrees of vomiting (0, 2, 4, 6, 8 and 10) that represent the severity of (N,V) in a manner to make this scale easy to be administered by a child. The patients should be referred to expressions that matched their feelings. The assessment of (N,V) was done at the end of the first 24 hr. postoperatively. Also, taken into consideration if the antiemetic was prescribed, the type and name and the dose should be taken.

The postoperative wound bleeding was also assessed for over one month after surgery.

***Statically analysis***

Data were summarized, analyzed and presented using Statistical Package for the Social Sciences (SPSS) version 23 software for windows. Numeric data were expressed as mean± standard deviation and range, whereas, categorical data like frequency were expressed as number and percentages. Fisher's exact test (Chi square test could not be applied) was used to assess the statistical significance in distribution between different discrete variables (*P-values< 0.05*) were considered to be statistically significant.

The calculation of percentage of change was achieved according to following equation:

% change = Original Number - New Number ÷ Original Number × 100

If answer is a negative number, then this is a percentage increase while a positive number indicates percentage decrease.

## Results

Demographic characteristic of the study showed for the total of 120 patients, 85 (70.83%) of patients were male and 35 (29.17%) were female patients (in table 1).

Regarding pain score at 30 min. after surgery, there is a significant difference between groups of study (p-value <0.05) as showed in (table 2) and (fig.1), the highest frequency of patients in the ketorolac group (77.5%) was found at score 2, the highest frequency of patients in the diclofenac group (42.5%) at score 2whereas the highest frequency of patients in paracetamol group (37.5%) was seen at score 4.

Regarding pain score at 60 min. after surgery, there is a significant difference between groups of study (p-value >0.05) as showed in (table 3) and (fig.2), the highest frequency of patients in ketorolac group (72.5%) was found at score 0, regarding diclofenac, the highest frequency of patients (62.5%) presented at score 2 while the highest frequency of patients in paracetamol group (37.5%) was seen at score 6.

**Table 1. Demographic characteristics of the study groups.**

| | | Diclofenac sodium (n=40) | Paracetamol (n=40) | Ketorolac (n=40) | total |
|---|---|---|---|---|---|
| **Age(years) Mean ± SD Range (min-max)** | | 6.75±2.9 (4-14) | 6.73±2.48 (4-13) | 8.76±2.33 (5-13) | 7.41±2.73 (4-14) |
| **Weight (kg) Mean ± SD** | | 22.85±7 | 22.85±6.09 | 26.29±5.76 | 24±6.46 |
| **Body mass index (BMI)(kg/m$^2$) Average ± SD** | | 17.8±2.53 | 17.06±2.67 | 17.17±2.09 | 17.34 ±2.46 |
| **Gender** | **Male No.(%)** | 32(80%) | 27(67.5%) | 26(65%) | 85 (70.83%) |
| | **Female No.(%)** | 8(20%) | 13(32.5%) | 14(35%) | 35 (29.17%) |
| **Residency** | **Urban No.(%)** | 23(57.5%) | 24(60%) | 22(55%) | 69 (57.5%) |
| | **Rural No.(%)** | 17(42.5%) | 16(40%) | 18(45%) | 51(42.5%) |
| **Family History** | **Positive No.(%)** | 11(27.5%) | 10(25%) | 7(17.5%) | 28 (23.33%) |
| | **Negative no.(%)** | 29(72.5%) | 30(75%) | 33(82.5%) | 92 (76.67%) |
| **Work** | **No work No.(%)** | 23(57.5%) | 22(55%) | 10(25%) | 45(37.5%) |
| | **Part time student No.(%)** | 17(42.5%) | 18(45%) | 30(75%) | 75(62.5%) |

**Table 2. Pain score after 30 minutes of surgery for the study groups.**

| | **Diclofenac Sodium No. (%)** | **Paracetamol No. (%)** | **Ketorolac No. (%)** | **p-value** |
|---|---|---|---|---|
| **Number2of1patients at1score 0** | 0(0%) | 2(5%) | 5(12.5%) | **5.4823E-8[a]** |
| **Number1of1patients at1score 2** | 17(42.5%) | 8(20%) | 31(77.5%) | |
| **Number of patients at score 4** | 15(37.5%) | 15(37.5%) | 4(10%) | |
| **Number of patients at score 6** | 5(12.5%) | 10(25%) | 0(0%) | |
| **Number of patients at score 8** | 3(7.5%) | 5(12.5%) | 0(0%) | |
| **Number of patients at score 10** | 0(0%) | 0(0%) | 0(0%) | |
| a : fisher's exact test | | | | |

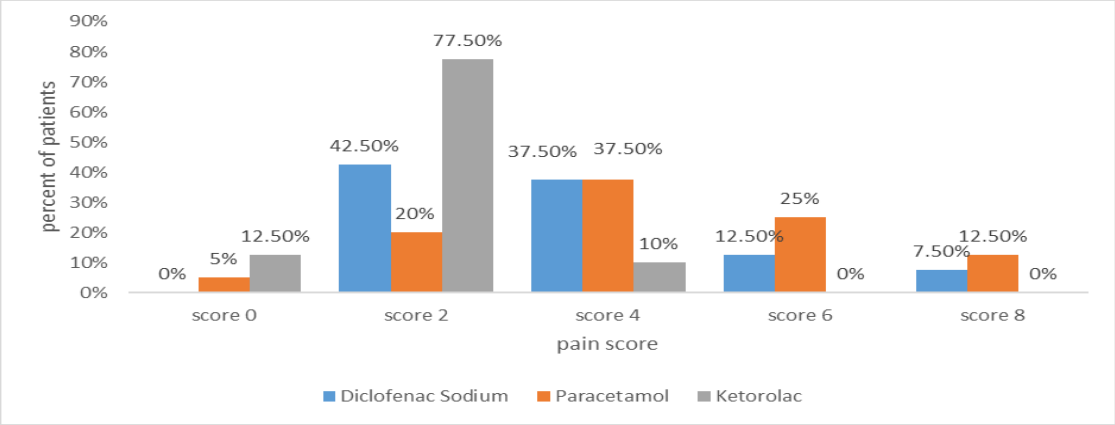


**Figure 1. Percent of the frequency of pain score for the study groups after 30 minutes of surgery.**
Note: There are (0%) at score 10 of all three groups,

**Table 3. Pain score after 60 minutes of surgery for the study groups.**

| | Diclofenac Sodium No. (%) | Paracetamol No. (%) | Ketorolac No. (%) | p-value |
|---|---|---|---|---|
| Number of patients at score 0 | 2(5%) | 7(17.5%) | 29(72.5%) | **1.1719E-13[a]** |
| Number of patients at score 2 | 25(62.5%) | 15(37.5%) | 11(27.5%) | |
| Number of patients at score 4 | 11(27.5%) | 6(15%) | 0(0%) | |
| Number of patients at score 6 | 2(5%) | 9(22.5%) | 0(0%) | |
| Number of patients at score 8 | 0(0%) | 3(7.5%) | 0(0%) | |
| Number of patients at score 10 | 0 (0%) | 0(0%) | 0(0%) | |
| **a : Fisher's exact test** | | | | |

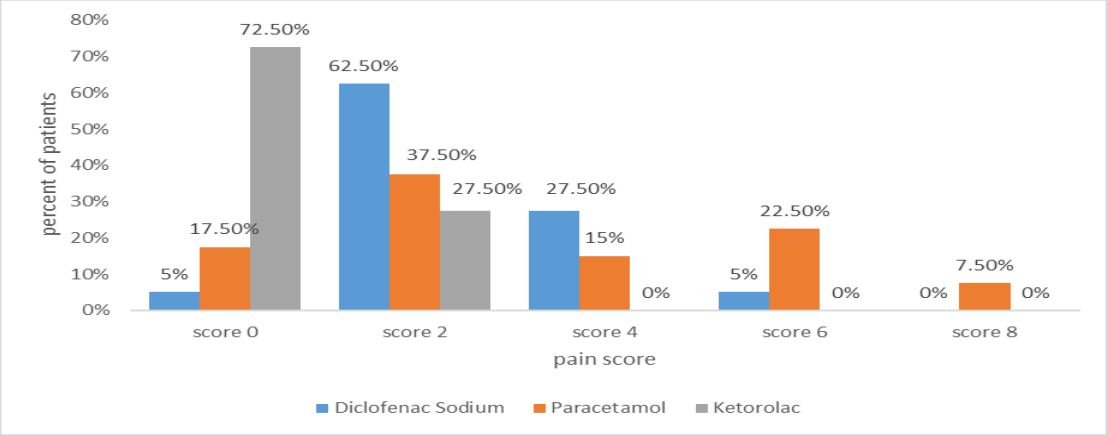


**Figure 2.Percent of the frequency of pain score for the study groups after 60 minutes of surgery.**

Note: There are (0%) at score 10 of all three groups

According to the percent of differences in pain score, (table 4) and (fig.3) shows that a high percentage of the decrease in pain score between 30 and 60 min. after surgery was seen in the ketorolac group while paracetamol was next and diclofenac sodium was the least.

**Table 4. Percent of changes in pain score between 30 minutes and 60 minutes for the study group.**

| | Diclofenac sodium | Paracetamol | Ketorolac |
|---|---|---|---|
| **Percent of changes in patients at score 0** | 0% | - 250% | - 480% |
| **Percent of changes in patients at score 2** | - 47% | - 87.5% | 64% |
| **Percent of changes in patients at score 4** | 27% | 60% | 100% |
| **Percent of changes in patients at score 6** | 60% | 10% | 0% |
| **Percent of changes in patients at score 8** | 100% | 40% | 0% |
| **Percent of changes in patients at score 10** | 0% | 0% | 0% |
| % change = Original Number - New Number ÷ Original Number × 100 | | | |

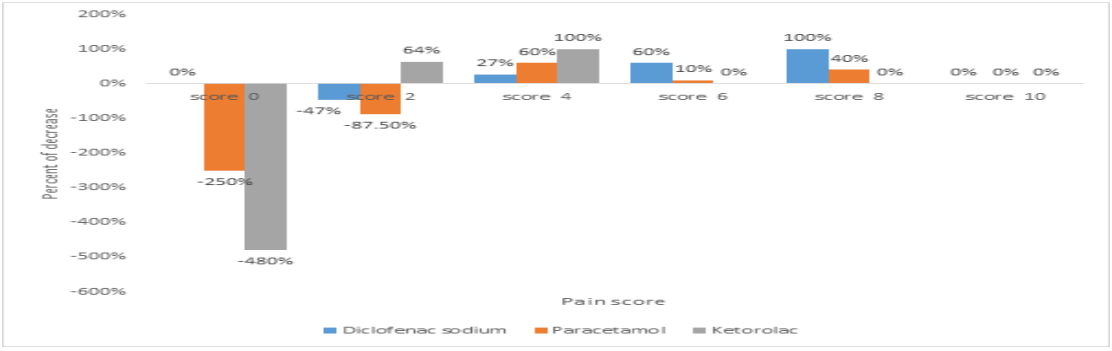


**Figure 3. Percent of changes in pain score between 30 minutes and 60 minutes of surgery for the study groups.**

Regarding (N,V) score after surgery, there is a significant difference between the groups of study (p-value <0.05) as shows in (table 5) and (fig.4), highest frequency of patients in ketorolac group (82.5%) found at score 2, regarding diclofenac sodium highest frequency of patients (37.5%) presented at score 4 while highest frequency of patients in paracetamol group (27.5%) seen at score 4.

**Table 5. Nausea and vomiting score for the study group.**

| | **Diclofenac sodium No. (%)** | **Paracetamol No. (%)** | **Ketorolac No. (%)** | **P-value** |
|---|---|---|---|---|
| **Number of patients at score 0** | 0(0%) | 8(20%) | 5(12.5%) | **1.3951E-8[a]** |
| **Number of patients at score 2** | 19(47.5%) | 9(22.5%) | 33(82.5%) | |
| **Number of patients at score 4** | 15(37.5%) | 11(27.5%) | 2(5%) | |
| **Number of patients at score 6** | 3(7.5%) | 8(20%) | 0(0%) | |
| **Number of patients at score 8** | 1(2.5%) | 3(7.5%) | 0(0%) | |
| **Number of patients at score 10** | 2(5%) | 1(2.5%) | 0(0%) | |
| a : Fisher's exact test | | | | |

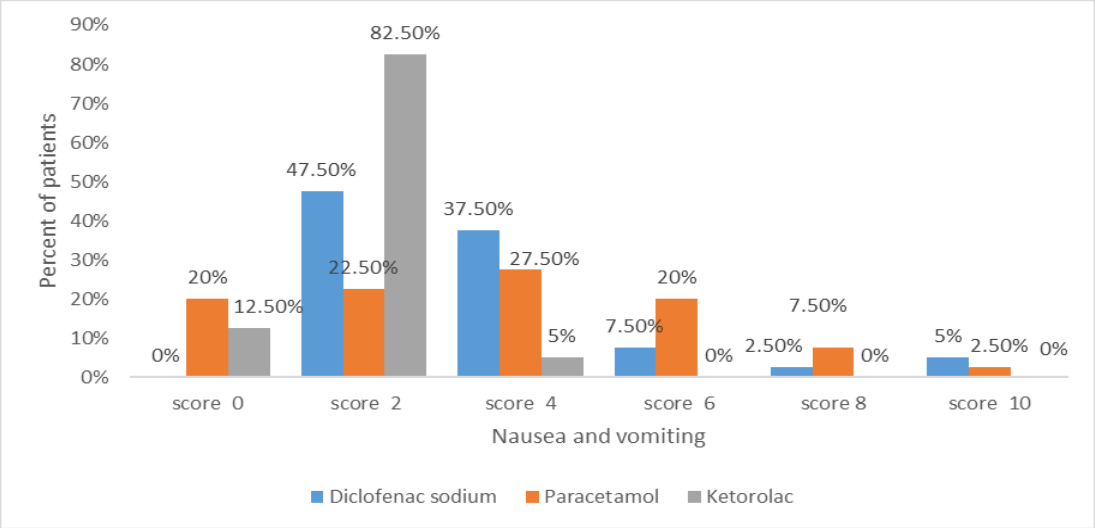


**Figure 4. Percent of frequency of nausea and vomiting score for the study groups.**

Regarding bleeding after surgery, there is no significant difference between the number of patients with bleeding when compared to the number of patients without bleeding (p<0.05) as shown in (table 6).

**Table 6.Bleeding after surgery.**

| | Diclofenac sodium | Paracetamol No. (%) | Ketorolac No. (%) | *P*-value |
|---|---|---|---|---|
| Patients with bleeding | 1(3%) | 0(0%) | 1(3%) | **1[a]** |
| Patients without bleeding | 39(97%) | 40(100%) | 39(97%) | |
| a : Fisher's exact test | | | | |

## Discussion

Acute appendicitis is a common health problem in children and after appendectomy patients need medications to relieve their pain and nausea and vomiting. As shown in the demographic data**,** male gender was greater than female. This finding is in concordance with many studies which stated that appendicitis is more common among males[33-35]. The mean age of patients enrolled in this study was 7.41±2.73 years, this finding ties well with many studies that showed a high frequency of appendicitis between 7-19 years[36-38]. This may be explained by the effect of life stress in this group of patients as a type of psychological trauma[39] while, it is difficult to explain that in children under the age of 7 years , who have a lower incidence. In the present study, the majority of patients had a negative family history, this does not agree with most of the studies showing family history as an important parameter in predicting acute appendicitis[40-43]. This finding may be due to the methodology characteristics of this study.

In the present study, ketorolac has a higher analgesic efficacy when compared to paracetamol and diclofenac used post-appendectomy. This clearly appeared in three previous studies done in different countries showing that ketorolac had a higher analgesic effect than diclofenac and paracetamol after surgery[44-46], and also agrees with another retrospective study in 2016 showing that ketorolac after appendectomy significantly decreases the pain score during the first day of surgery in pediatric patients[47]. This conclusion was also presented with different surgical procedures both in adults[48-50] and children[47,50]. Another study in Korea showed that iv paracetamol (1g) has the same level of pain relief after surgery as iv ketorolac (30 mg) in patients who underwent thyroidectomy, this made paracetamol an effective alternative to ketorolac in case of mild to moderate pain after surgery[51]. Ketorolac and diclofenac have similar analgesic efficacy in another study[52]. This result may explain the high analgesic potency of ketorolac where it differs from other NSAIDs that it is used for management of moderate to severe pain after surgery and the role of intravenous dosage form where ketorolac has a rapid onset of an action (30 minutes)[53].

In the present study, ketorolac less with nausea and vomiting than diclofenac and paracetamol. This result is in concordance with another study in 2012 that showed ketorolac's effect to decrease (N,V) after surgery[54] while, another study stated that the use of 30 mg ketorolac produces a superior analgesia and antiemetic effect after mixed ambulatory surgeries when compare with 4 mg of dexamethasone and 12 mg of betamethasone[55]. The ability of ketorolac to decrease the rate of (N,V) may be related to its potent analgesic activity to reduce (N,V) which is associated with pain and decrease the need for antiemetic agents after surgery.

The present study showed that there is no significant difference between patients who had bleeding and those without in all groups of the study. These finding is supported by a previous cohort study involve 35 hospitals with participants take 10,272 injectable ketorolac courses[56]. The present study showed that there is a little association between use of ketorolac and overall bleeding risk and this risk increases with increasing the dose of ketorolac[57]. This finding also presented in another three systemic studies that state there is no significant association between the use of NSAIDs rather than aspirin and bleeding risk[58-60]. The other two studies stated that ketorolac is considered a good choice for patients after surgery since it is not associated with risk of bleeding after surgery[61,62].

This study had several laminations must be mentioned. It was conducted in a single pediatric center that may limit the generalization of results to all Iraqi people. Dealing with children is very difficult especially in expressing and assessing pain and N/V feelings by using self-reporting pain and N/V scores. In addition, it was difficult to communicate with children and their parents after surgery.

**Conclusions:** Intravenous ketorolac has higher analgesic efficacy comparing with i.v paracetamol and rectal diclofenac with low risk of (N,V) when used in children undergoing appendectomy.

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