

## İNVAJINASYON HASTALARINDA AÇIK CERRAHİ İLE ULTRASONOGRAFİ EŞLİĞİNDE HİDROSTATİK REDÜKSİYONUN MALİYETLERİNİN KARŞILAŞTIRILMASI

### COMPARISON OF THE TREATMENT COSTS BETWEEN OPEN SURGERY AND ULTRASONOGRAPHY - GUIDED HYDROSTATIC REDUCTION OF INTUSSUSCEPTION IN PEDIATRIC CASES

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#### ÖZET

**AMAÇ:** Çocukluk çağında invajinasyon tedavisinde açık cerrahi dışında seçilmiş olgularda farklı tedavi yöntemleri kullanılmaktadır. Ultrasonografi (USG) eşliğinde serum fizyolojik ile hidrostatik redüksiyon bunlardan biridir. Bu çalışmada açık cerrahi ile USG eşliğinde hidrostatik redüksiyonun fatura tutarlarının karşılaştırılması yapılmıştır.

**GEREÇ VE YÖNTEM:** Ocak 2011 – Haziran 2017 tarihleri arasında kliniğimizde invajinasyon tanısı ile tedavi gören 48 olgunun kayıtları geriye dönük olarak incelenmiştir. Olguların yaşları, cinsiyetleri, yatış süreleri, tedavi biçimi ve fatura tutarları değerlendirilmiştir.

**BULGULAR:** Olguların 31'i erkek, 17'si kız olup, yaş ortalaması 48 ay olarak bulunmuştur. 30 olguya açık cerrahi, 18 olguya USG eşliğinde serum fizyolojik ile hidrostatik redüksiyon uygulanmıştır. Açık cerrahi uygulanan olguların ortalama yatış süresi 5,13 gün olup, fatura tutarı 1094.60 Türk Lirası (TL) bulunurken USG eşliğinde serum fizyolojik ile hidrostatik redüksiyon tedavisi uygulanan olguların yatış süresi 2.6 gün, fatura tutarı 841.30 TL olarak bulunmuştur. İki tedavi yöntemi karşılaştırıldığında fatura tutarı ( $p < 0.05$ ) ve yatış süresi ( $p < 0.01$ ) açısından istatistiksel olarak anlamlı fark saptanmıştır.

**SONUÇ:** USG eşliğinde serum fizyolojik ile hidrostatik redüksiyon basit, etkili, güvenilir ve komplikasyon oranı düşük bir tedavi yöntemi olarak bilinmektedir. Bu çalışmada fatura tutarlarının düşük saptanması ile ekonomik bir tedavi yöntemi olduğu saptandı. Çocukluk çağında invajinasyonda genel durum bozukluğu ve peritonit bulguları olmayan tüm olgularda ilk tedavi seçeneği olarak değerlendirilmelidir.

**ANAHTAR KELİMELER:** İnvajinasyon, İntusepsiyon, Maliyet, Açık cerrahi, Hidrostatik redüksiyon

#### ABSTRACT

**OBJECTIVE:** In the treatment of childhood intussusception, in addition to the commonly adopted open surgery, different treatment methods are used in selected cases. One of these treatment methods is ultrasonography (USG)-guided hydrostatic reduction with normal saline. In this study, the treatment cost of open surgery and USG-guided hydrostatic reduction was compared.

**MATERIAL AND METHODS:** The medical records of 48 cases treated in our clinic after the diagnosis of intussusception between January 2011 and June 2017 were reviewed retrospectively. The age, gender, length of hospital stay, treatment modality, and the cost of the treatment of the cases were evaluated.

**RESULTS:** Of the 48 cases, 31 were male and 17 were female, with a mean age of 48 months. Open surgery was performed in 30 cases, and USG-guided hydrostatic reduction with normal saline was performed in 18 cases. The mean length of hospital stay and the cost of treatment were 5.13 days and 1,094.60 TL, respectively for the open surgery cases, and 2.6 days and 841.30 TL for those that underwent USG-guided hydrostatic reduction. When the two treatment methods were compared, a statistically significant difference was found in terms of the cost of treatment ( $p < 0.05$ ) and the duration of hospitalization ( $p < 0.01$ ).

**CONCLUSIONS:** USG-guided hydrostatic reduction with normal saline is known as a simple, effective, and reliable method with a low complication rate. In this study, it was determined that the cost of treatment was low; thus, it is also an economical treatment option. Therefore, it should be considered as the first treatment modality in all cases of childhood intussusception presenting without bad general condition or signs of peritonitis.

**KEYWORDS:** Invagination, Intussusception, Cost, Open surgery, Hydrostatic reduction

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## INTRODUCTION

Intussusception is the invagination of a proximal section of the bowel into the lumen of a more distal portion of the bowel (1 - 3). It is the most frequent cause of bowel obstruction in children aged three to 24 months. The incidence of intussusception ranges from 1 to 4 per 1,000 live births, and the male to female ratio is 3/1-2 (1). Ultrasonography (USG) is a well-known and effective tool for the diagnosis of intussusception, with a diagnostic sensitivity of 98-100% and specificity of 88-100% (4). In selected cases, the USG-guided hydrostatic reduction technique is commonly used as a non-surgical treatment of intussusception. Although the success rate of this treatment method varies, it is mostly over 80% (3). Hydrostatic reduction in intussusception can be performed with barium, air, or a normal saline enema under USG or fluoroscopy (5). For the treatment of intussusception, USG-guided hydrostatic reduction with normal saline was first performed by Kim et al. in 1982 (2, 6). This method has several major advantages (2), such as being effective, easy, fast, and economical (2, 3, 6). In this study, we compared this method with open surgery in terms of the cost of treatment in the treatment of childhood intussusception.

## MATERIAL AND METHOD

The medical records of 48 cases treated for intussusception in our clinic between January 2011 and June 2017 were retrospectively reviewed after the approval of the study by the ethics committee. The age, gender, length of hospital stay, type of treatment, and cost of treatment were evaluated for all cases. The diagnosis of intussusception and USG-guided hydrostatic reduction were performed using a 5-10 MHz linear probe and 2 - 5 MHz convex probes with an ultrasound device (Hitachi EZU-MT 28-S1, Japan). The patients scheduled to undergo USG-guided hydrostatic reduction were sonographically evaluated once more by a radiologist before the procedure. Once the target or pseudokidney sign was observed to continue, a foley catheter was placed in the rectum and fixed after inflating the balloon of the catheter. In agitated and uncontrolled cases, sedation was achieved by intravenous administration of

midazolam (0.5 mg/kg) before the intervention. Normal saline was positioned 100 cm above the patient. The administration of the heated normal saline to the colon and the movement of the fluid in the intestine were monitored by USG. Hydrostatic reduction was considered to be successful if the targeted intussusception appearance disappeared and the passage of fluid from the cecum to the ileum through the ileocecal valve was observed. During the procedure, the patient was monitored for possible complications. The cases that underwent hydrostatic reduction were kept under observation for 24 hours. The patients up to the age of three years old that were referred to the clinic and those with poor general health or signs of peritonitis were treated surgically.

SPSS Statistics v. 20 was used for statistical analysis. Data were obtained as median, mean, and standard deviation (SD) values. The Mann Whitney U test was used to compare the continuous variables and the chi-square test for the comparison of categorical variables.  $P < 0.05$  was considered as the limit of significance.

## Ethical Committee

Approval for the study was obtained from Afyonkarahisar Health Sciences University Clinical Research Ethics Committee on 01.03.2019 (No: 2011-KAEK-2).

## RESULTS

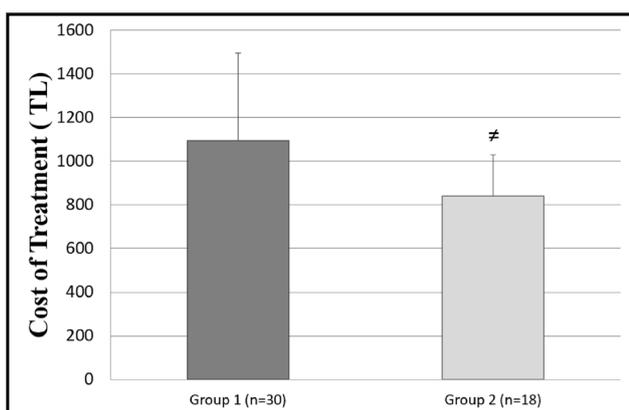
A total of 48 cases, 31 (64.6%) male and 17 (35.4%) female, with a mean age of  $47.81 \pm 43.02$  months were included in the study. There was no significant difference between the open surgery and reduction groups in terms of age or gender ( $p = 0.418$  and  $0.815$ , respectively; Table 1). Thirty patients underwent open surgery and 18 cases USG-guided hydrostatic reduction with normal saline. Of the open surgery cases, 28 were treated using manual reduction, and two using both manual reduction and resection anastomosis. The mean length of hospital stay and cost of treatment was  $5.13 \pm 1.99$  days and  $1,094.60 \pm 400.84$  Turkish liras (TL), respectively for the open surgery group and  $2.6 \pm 0.90$  days and  $841.30 \pm 187.36$  TL, respectively for the group that underwent USG-guided hydrostatic reduction with normal saline (**Figure 1**). When

the two treatment methods were compared, a statistically significant difference was found in the cost of the treatment ( $p = 0.027$ ) and hospitalization time ( $p < 0.001$ ) (**Table 1**).

**Table 1:** Comparison of the patients' demographic data, length of hospital stay, and cost of treatment

	Group 1 (n = 30)	Group 2 (n = 18)	Total (n = 48)	p
Gender (F/M), n(%)	11 (36.7)/19 (63.3)	6 (33.3)/12 (66.7)	17(35.4)/31 (64.6)	0.815*
Age, months (Mean $\pm$ SD)	46.93 $\pm$ 46.53	49.27 $\pm$ 37.67	47.81 $\pm$ 43.02	0.418#
Hospital stay, days (Mean $\pm$ SD)	5.13 $\pm$ 1.99	2.66 $\pm$ 0.90	4.20 $\pm$ 2.05	0.000#
Cost of treatment, TL (Mean $\pm$ SD)	1094.60 $\pm$ 400.84	841.30 $\pm$ 187.36	999.61 $\pm$ 356.64	0.027#

Group 1: Patients that underwent open surgery, Group 2: Patients that underwent USG-guided hydrostatic reduction with normal saline, SD: Standard deviation  
\* chi-square test, # Mann Whitney U test



**Figure 1:** Comparison of the cost of treatment. **Group 1:** patients that underwent open surgery. **Group 2:** Patients that underwent USG-guided hydrostatic reduction with normal saline. The cost of treatment of Group 1 was significantly higher than that of Group 2 ( $p = 0.027$ ). **TL:** Turkish lira

## DISCUSSION

The current treatment of choice for intussusception in cases presenting without signs of deep shock and/or peritonitis is non-surgical treatment methods (7, 8). The classical non-surgical treatment method of intussusception is the reduction provided by the rectal administration of barium enema (3, 6, 9). The treatment of intussusception by hydrostatic enema was first described and implemented by Hirschsprung in 1876. In 1926, Hipsley further developed this procedure by the administration of barium at a maximum height of 1 meter (1). Barium enema reduction has been performed for a long time under fluoroscopy for the treatment of intussusception, and some health centers continue to use this procedure today (10). However, this technique has gradually become less popular due to common complications, such as chemical peritonitis and adhesions caused by the perforation of the colon during the procedure (11). Another non-surgical treatment method

for intussusception is pneumatic reduction (2), which is performed by applying air at a pressure of 80 - 120 mmHg rectally under fluoroscopy. Pneumatic reduction is an easily and quickly applied method with less risk of peritoneal contamination (12). However, the reliability of this method has recently been questioned, with studies suggesting that it poses a higher risk of perforation and tension pneumoperitoneum (2).

Both methods of intussusception reduction (barium enema or pneumatic) are performed under fluoroscopy, and therefore expose the patient and the medical team to a significant amount of radiation (2, 4, 6). For this reason, the USG-guided hydrostatic reduction method gained more popularity (13) and researchers experimented with the use of tap water, normal saline, or Ringer lactate solution during this procedure (14). USG-guided hydrostatic reduction of intussusception by normal saline enema was first performed by Kim et al. in 1982. (15) In our clinic, this technique began to be implemented in 2013. Prior to this date, all patients were treated operatively. Therefore, the number of patients surgically treated in this study for intussusception was significantly higher. In a study conducted in Ethiopia, Wakjira et al. (5) stated that USG-guided hydrostatic reduction is noticed too late in most developing countries and is only successfully implemented after providing the necessary conditions. In addition, the authors referred to the substantial number of articles published in developing countries, such as India, Turkey, and Egypt, and the success rates were reported to increase from 67% to 95.5%. For the successful application of USG-guided hydrostatic reduction, a USG device and experienced radiologist need to be available any time of the day. It was only when these conditions were met in our hospital that we were able to adopt USG-guided hydrostatic reduction with normal saline in all patients with intussusception with favorable outcomes. There was no recurrence in any of the patients. Open surgery was performed by the manual reduction in 28 patients and manual reduction and resection anastomosis in two patients. The higher rate of patients treated with open surgery may be because USG-guided hydrostatic reduction could

not be undertaken within the first three years due to the lack of necessary conditions. Many studies in the literature referred to USG-guided hydrostatic reduction as an easy, fast, effective, and reliable method (1 - 4). There are also publications suggesting that it is an economical procedure (2, 3, 16); however, to the best of our knowledge, no researcher has comparatively investigated different methods for the treatment of intussusception in terms of the cost. In the current study, the cost of treatment for intussusception patients that underwent open surgery and those that underwent USG-guided hydrostatic reduction with normal saline were compared. The cost of treatment was found to be statistically significantly lower in the hydrostatic reduction group compared to the open surgery group ( $p = 0.027$ ). The lower cost of treatment in this procedure can be explained by the shorter hospital stay and the absence of additional costs related to surgery and medication. In a study conducted in Germany in 2016, Gfroerer et al. (17) emphasized that hydrostatic reduction of intussusception was more effective and reliable when performed by pediatric surgeons. The authors also stated that in Germany, USG training is part of specialization training for pediatric surgery. Implementation of USG-guided hydrostatic reduction only by pediatric surgeons may further reduce the invoice. However, under current conditions in Turkey and many countries in the world, there is still a need for an experienced radiologist to be present during this procedure. The success rate of USG-guided hydrostatic reduction has increased significantly with the coordination established between pediatric surgeons and radiologists.

In this study, the incidence of intussusception was 35.4% in females and 64.6% in males. These results are consistent with the male to female ratio of 2:1 or 3:1-2 in the literature (1,3,18). Although intussusception is most common in infancy, its highest incidence may continue until the age of three (19). In this study, the mean age of the patients was 48 months, which is relatively higher than previous studies in the literature. The absence of radiation risk in USG-guided hydrostatic reduction of intussusception with normal saline is particularly important for pe-

diatric cases. Possible complications during the procedure can be detected and treated immediately. (3) The probability of perforation during this procedure is very low (0.17-0.26%) (14). No perforation occurred in any of the 18 patients in this study. In recent publications, mortality due to intussusception has been reported as zero (1, 20). Today, USG is used to make a rapid diagnosis and to plan the treatment in patients with this condition. In this study, none of the patients died.

The limitations of this study are that hydrostatic reduction could not be performed in patients with poor general condition and signs of peritonitis. In addition, information about the leading points that may cause intussusception was not included in this study. The leading point can be examined in the hydrostatic reduction group and included in the study criteria in future studies.

In conclusion, USG-guided hydrostatic reduction of intussusception with normal saline presents as not only an effective and safe method with a low complication rate but also an economical treatment option. With these advantages, this procedure has become more popular worldwide, especially in developing countries. USG-guided hydrostatic reduction with normal saline should be considered as the first treatment option in appropriate pediatric intussusception cases.

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