Incidental appendectomy in surgical treatment of ileocolic intussusception in children. Is it safe to perform?

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ABSTRACT

Background. Surgical treatment of ileo-colic intussusception (ICI) has been reported as the second cause of emergency laparotomy in children. The performance of incidental appendectomy after surgical reduction is currently controversial. The aim is to analyse the outcomes of performing incidental appendectomy after surgical ICI reduction with or without associated bowel resection.

Materials and methods. A retrospective study was performed in patients with ICI episodes, who underwent surgical treatment in our institution between 2005-2019. Patients were divided in two groups according to the performance of associated appendectomy (AA group) or not (NA group). Subsequently, a stratified analysis was performed according to the need for bowel resection in both groups. Demographic variables, intraoperative findings, surgical time, hospital stay, postoperative complications and recurrences were analysed.

Results. A total of 101 patients (77 AA group; 24 NA group) were included, without differences in demographics or intraoperative findings. A total of 36 bowel resections were performed (24 group AA; 10 group NA), with no differences in surgical time (55.7 min in group AA vs. 61.2 min in group NA; p = 0.587) or hospital stay (median 5 days in both groups). There were also no differences in postoperative complications or recurrences between the two groups. Stratified analysis showed that bowel resection increases operative time, hospital stay and postoperative complications, regardless of whether associated appendectomy was performed or not.

Conclusions. Incidental appendectomy during surgical treatment of ICI in children is a safe procedure that does not increase operative time, hospital stay, postoperative complications or recurrence.

KEY WORDS: Ileocolic intussusception; Appendectomy; Children; Bowel resection.

APENDICECTOMÍA INCIDENTAL EN EL TRATAMIENTO QUIRÚRGICO DE LA INTUSUSCEPCIÓN ILEOCÓLICA EN NIÑOS. ¿ES SEGURA?

RESUMEN

Objetivo. El tratamiento quirúrgico de la intususcepción ileocólica (IIC) es la segunda causa más frecuente de laparotomía de urgencia en niños. La realización de una apendicectomía incidental tras la reducción quirúrgica sigue siendo motivo de controversia. El objetivo de este trabajo es analizar los resultados obtenidos al llevar a cabo una apendicectomía incidental tras la reducción quirúrgica de una IIC con o sin resección intestinal asociada.

Material y método. Se realizó un estudio retrospectivo en pacientes con episodios de IIC sometidos a tratamiento quirúrgico en nuestro centro entre 2005 y 2019. Los pacientes se dividieron en dos grupos según se llevara a cabo apendicectomía asociada (grupo AA) o no (grupo NA). Posteriormente, se elaboró un análisis estratificado según la necesidad de practicar resección intestinal en ambos grupos. Se analizaron las variables demográficas, los hallazgos intraoperatorios, el tiempo quirúrgico, la estancia hospitalaria, las complicaciones posoperatorias y las recidivas.

Resultados. Se incluyeron un total de 101 pacientes (77 en el grupo AA, y 24 en el grupo NA), sin diferencias en las características demográficas ni en los hallazgos intraoperatorios. Se practicaron un total de 36 resecciones intestinales (24 en el grupo AA; 10 en el grupo NA), sin diferencias en el tiempo quirúrgico (55,7 min en el grupo AA frente a 61,2 min en el grupo NA; p = 0,587) ni en la estancia hospitalaria (mediana de 5 días en ambos grupos). Tampoco se registraron diferencias en términos de complicaciones posoperatorias o recidivas entre los dos grupos. El análisis estratificado mostró que la resección intestinal incrementa el tiempo quirúrgico, la estancia hospitalaria y las complicaciones

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posoperatorias, con independencia de si se lleva a cabo apendicectomía asociada o no.

Conclusión. La apendicectomía incidental durante el tratamiento quirúrgico de la IIC en niños es un procedimiento seguro que no aumenta el tiempo quirúrgico, la estancia hospitalaria, las complicaciones posoperatorias ni las posibilidades de recidiva.

Palabras Clave: Intususcepción ileocólica; Apendicectomía; Niños; Resección intestinal.

INTRODUCTION

Ileo-colic intussusception (ICI) is one of the most frequent causes of intestinal obstruction in early childhood, that occurs when a bowel segment invaginates into its adjacent distal segment[1]. This telescoping of adjoining intestinal segments is propelled forward by bowel peristalsis leading to bowel obstruction. If intussusception is not promptly treated, increased intraluminal pressure results in vascular compromise, bowel wall ischemia and perforation, with high associated morbidity rates[2]. Screening ultrasound has been established as the imaging modality of choice to confirm or exclude the presence of ICI in children, with high reported sensitivity and specificity[3,4]. Once ICI has been diagnosed, non-operative reduction with pneumatic or hydrostatic enema under fluoroscopic or ultrasound guidance is used as first-line treatment[5]. Surgical intervention is generally indicated when enema reduction fails, when children present symptoms of perforation, shock, or peritonitis or when a pathologic lead point (PLP) is suspected preoperatively[6].

Surgical treatment includes manual or laparoscopic intussusception reduction, the subsequent assessment of the viability of the affected intestine, with resection in cases of necrosis or perforation, as well as the identification and resection of possible PLPs (Meckel's diverticulum, intestinal duplication cysts...)[7,8]. The performance of an associated appendectomy is a controversial aspect, although it has been reported in numerous series of patients[9,10]. To date, only one study has been published, which does not recommend its performance due to an increase in hospital stay and associated economic costs[11]. However, in this study only uncomplicated ICI were analyzed, excluding those patients in whom bowel resection was performed.

The aim of this study was to analyse the outcomes of performing incidental appendectomy after surgical reduction of both uncomplicated and complicated ICI episodes, and to compare these results in patients who have undergone bowel resection or not.

METHODS

A retrospective study was performed in patients with ICI episodes diagnosed by ultrasound, who underwent surgical treatment in our institution between January 2005 and December 2019. Patients were divided in two groups according to those who had surgical reduction of intussusception with associated appendectomy (AA group) and those who had surgical reduction alone with no appendectomy (NA group). Subsequently, a stratified analysis was performed according to the need for bowel resection in both groups. The performance of appendectomy and/or bowel resection in each patient was determined by the responsible surgeon according to the intraoperative findings in each case.

Admission notes, operational records and discharge reports of the patients included in the study were reviewed. Demographic characteristics, time since symptoms onset, reason for surgical reduction, intraoperative findings (presence of pathological lead point, need of bowel resection, resected bowel segment, resection length and type of anastomosis), surgery time, length of hospital stay, postoperative complications and recurrence rate were recorded. In group AA patients, macroscopic and microscopic histological analysis of the resected cecal appendix was performed. Patients with missing data were excluded. The study protocol was conformed to the guidelines of the 1975 Declaration of Helsinki and was approved by the institutional review board.

For statistical analysis, data were collected in Microsoft Excel software version 2010 (Redmond, WA, USA), and analyzed with SPSS Statistic version 22 (Chicago, IL, USA). To check whether variables were normally distributed, Kolmogorov-Smirnoff and Shapiro-Wilk tests were used. For continuous variables normally distributed, Student t-test of independent samples was used, and were expressed as mean and standard deviation. To analyze continuous data not normally distributed, Mann-Whitney test was used, and were expressed as median and interquartile range (Q1-Q3). Discrete variables were expressed as frequency and percentage, and were analyzed by Chi square test, or Fisher's test when the first one could not be applied. Odds ratios (OR) were calculated with 95% confidence intervals. All statistical calculations were performed with two tails and the statistical significance was established with a value of $p < 0.05$.

RESULTS

A total of 101 patients (66 males, 35 females), with a median age of 15 months (Q1-Q3, 7-25) were included. Flowchart for the selection of patients is shown in Figure 1. Median time since symptoms onset referred by parents was about 24 hours (Q1-Q3, 12-60). Non-effective enema reduction was the most frequent reason for surgical treatment, which occured in 68 patients (67.3%), followed by PLP visualization on ultrasound (24.8%). Six patients (5.9%) showed signs of peritonitis on arrival at Emergency

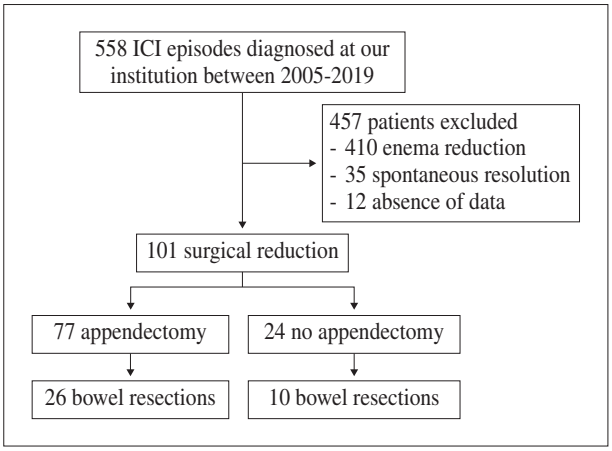

Figure 1. Flowchart for the selection of patients.

Department, and after confirming ICI diagnosis by ultrasound, they were operated on. Two patients (2%) presented haemodynamic instability (hypotension) when attempting enema reduction, and were also operated on. No significant differences were observed in demographics, time since symptoms onset and reasons for surgical reduction between the two groups, which are compared in table I.

Regarding the intraoperative findings, ICI was observed in 88 patients (87.1%) that was surgically reduced by laparotomy (Rockey-Davis incision). Thirteen patients (12.9%) had no intraoperative evidence of intussusception, although the presence of indirect findings, including distal edematous terminal ileum with areas of bowel wall indentation, was suggestive of spontaneous reduction.

Bowell resection was performed in 36 patients in whom PLP (Meckel's diverticulum or ileal duplication cyst), areas of necrosis or perforation were observed. Surgery time was slightly longer in NA group, with no significant difference with AA group. The median hospital stay was 5 days in both groups. Post-operative complications were reported in 6 patients, where surgical intervention was required. No difference in the recurrence rate was observed between the two groups. Regarding the histological analysis of the cecal appendix in the AA group, no characteristic macroscopic alterations were observed. However, microscopic analysis showed the presence of distinct edema in the wall of the appendix in 25 patients (32.5%), in whom an inflammatory infiltrate was observed in the mucosa and submucosa, with associated periapendicitis. Both groups had more than 8 years of median follow-up, with no differences between them. Intraoperative findings, bowel resection rate, hospital stay, postoperative complications, recurrence rate and follow-up time in both groups are shown in table II.

Stratified analysis by subgroups according to the need for bowel resection showed that in patients who did not require bowel resection, associated incidental appendectomy did not lead to an increase in surgery time, hospital stay or recurrence rate. There were also no differences in demographic variables or time since symptoms onset between the two groups, as shown in table III.

When stratified analysis on patients who required bowel resection was performed, no significant differences were observed in demographic data either. Ileo-ileal resection was performed in 32 patients, with end-to-end anastomosis. In 4 AA group patients, ileo-caecal resection was performed, with ileo-colic anastomosis, also end-to-end. NA group patients presented a longer bowel resection length than those in AA group, although this difference was not statistically significant. There was neither significant difference in surgery time between the two groups. The median hospital stay was 8 days in both groups. Postoperative complications were the same as those reported previously. Stratified analysis by subgroups in patients with bowel resection is shown in table IV.

DISCUSSION

Surgical treatment of intussusception has been reported as the second cause of emergency laparotomy in children,

Table I. Demographics, time since symptoms onset and reasons for surgical reduction in both groups.

	AA group (n = 77)	*NA group (n = 24)*	*p-Value*
Age (months); median (Q1-Q3)	15 (8-25.5)	16 (6-27.5)	0.901
Gender; n (%)			0.255
• Male	48 (62.3%)	18 (75%)	
• Female	29 (37.7%)	6 (25%)	
Time since symptoms onset (hours); median (Q1-Q3)	24 (8-48)	30 (9,5-72)	0.169
Reason for surgical reduction, n (%)			0.201
• Ineffective enema reduction	56 (72.7%)	12 (50%)	
• PLP finding in US	15 (19.5%)	10 (41.7%)	
• Peritonitis	4 (5.2%)	2 (8.3%)	
• Hemodynamic instability	2 (2.6%)	0	

AA: associated appendectomy group; NA: non-appendectomy group; Q1-Q3: interquartile range; PLP: pathological lead point.

Table II. Intraoperative findings, bowel resection, hospital stay, postoperative complications, recurrence rate and follow-up time.

	AA group (n = 77)	*NA group (n = 24)*	*p-Value*
Intraoperative findings; n (%)			0.354
• Ileocolic intususception	67 (87%)	21 (87.5%)	
• Mesenteric adenitis	36 (46.8%)	5 (20.8%)	
• Meckel's diverticulum	16 (20.8%)	5 (20.8%)	
• Ileal duplication cyst	3 (3.9%)	2 (8.3%)	
• Necrosis	15 (19.5%)	6 (25%)	
• Perforation	4 (5.2%)	0	
• No findings	10 (13.0%)	3 (12.5%)	
Surgical procedure; n (%)			0.480
• Open reduction	41 (53.2%)	11 (45.8%)	
• Bowel resection	26 (33.8%)	10 (41.7%)	
• No reduction/ resection	10 (13%)	3 (12.5%)	
Surgery time (minutes); mean ± SD	55.7 ± 10.5	61.2 ± 15.8	0.587
Hospital stay (days); median (Q1-Q3)	5 (3-8)	5 (3,5-9)	0.244
Postoperative complications; n (%)			0.262
• Anastomosis dehiscence	1 (1.3%)	0	
• Wound dehiscence	0	1 (4.1%)	
• Intestinal obstruction	1 (1.3%)	1 (4.1%)	
• Evisceration	0	1 (4.1%)	
• Bowel perforation	0	1 (4.1%)	
Recurrence rate; n (%)	4 (5.2%)	1 (4.1%)	0.841
Follow-up time (years); median (Q1-Q3)	8.3 (5.4-11.3)	8.6 (4.8-12.1)	0.747

AA: associated appendectomy group; NA: non-appendectomy group; SD: standard deviation; Q1-Q3: interquartile range.

Table III. Stratified analysis by subgroups in patients without bowel resection.

Patients without bowel resection	*AA group (n = 51)*	*NA group (n = 14)*	*p-Value*
Age (months); median (Q1-Q3)	10 (8-25)	10 (6-22)	0.634
Gender; n (%)			0.175
• Male	30 (58.8%)	11 (78.6%)	
• Female	21 (41.2%)	3 (21.4%)	
Time since symptoms onset (hours); median (Q1-Q3)	18 (8-40)	16 (8-48)	0.371
Surgical procedure; n (%)			0.880
• Open reduction	41 (80.4%)	11 (78.6%)	
• No reduction (no ICI)	10 (19.6%)	3 (21.4%)	
Surgery time (minutes); mean ± SD	44.2 ± 15.4	40.5 ± 10.1	0.236
Hospital stay (days); median (Q1-Q3)	3 (2-4)	3 (2.5-4)	0.189
Recurrence rate; n (%)	4 (5.2%)	1 (4.1%)	0.841

AA: associated appendectomy group; NA: non-appendectomy group; SD: standard deviation; Q1-Q3: interquartile range.

after intestinal obstruction, and leads to increased morbidity and mortality[12]. This study analyzes the role of associating appendectomy after surgical reduction of the invaginated intestinal segment and bowel resection in patients with associated necrosis, perforation or PLPs. The performance of incidental appendectomy after surgical ICI reduction is currently controversial due to the scarce scientific evidence published in the literature. To date, there is only one reported study on this issue, which does not recommend the routine performance of appendectomy in the surgical treatment of ICI, due to increased hospital stay and the resulting increased economic costs[11]. However, this study has several limitations, as it does not analyse episodes of ICI requiring bowel resection, excludes patients older than 5 years and does not record histopathological data of resected cecal appendix.

To the best of our knowledge, we report one of the largest single institution series of patients comparing inci-

Table IV. Stratified analysis by subgroups in patients with bowel resection.

Patients with bowel resection	*AA group (n = 26)*	*NA group (n = 10)*	*p-Value*
Age (months); median (Q1-Q3)	15 (6.5-26.5)	16 (5-65)	0.639
Gender; n (%)			0.964
• Male	18 (69.2%)	7 (70%)	
• Female	8 (30.8%)	3 (30%)	
Time since symptoms onset (hours); median (Q1-Q3)	48 (24-72)	60 (36-72)	0.270
Resection length (cm); median (Q1-Q3)	10 (7-18)	15 (8,5-27,5)	0.354
Bowel anastomosis; n (%)			0.381
• Ileo-ileal	22 (84.6%)	10 (100%)	
• Ileo-colic	4 (15.4%)	0	
Surgical time (minutes); mean ± SD	67.2 ± 11.4	71.5 ± 20.1	0.336
Hospital stay (days); median (Q1-Q3)	8 (7-9)	8 (8-12.5)	0.189
Recurrence rate; n (%)	0	0	–

AA: associated appendectomy group; NA: non-appendectomy group; SD: standard deviation; Q1-Q3: interquartile range.

dental appendectomy in patients with ICI requiring surgical reduction with or without associated bowel resection. In our study AA and NA groups were similar regarding demographic characteristics, time since symptoms onset and the reason for surgical reduction, so they can be considered comparable. In both groups, the main indication for operative reduction was failed enema reduction, in more than half of the patients, these findings being similar to those reported by other authors[8,13]. No intraoperative differences were observed between the two groups. After performing laparotomy, ICI was observed in 87% of patients in both groups, which was manually reduced and PLPs or areas of necrosis or perforation were resected. The rate of negative intraoperative findings was 13%, in which no ICI was observed, in line with that reported by Kanglie et al.[14]. In these patients, appendectomy was performed in 10 cases (AA group).

Performing appendectomy in AA group did not lead to an increase in hospital stay, postoperative complications or recurrence rate. Stratified analysis by subgroups according to the need for bowel resection showed an increase in both operative time and hospital stay, independently of the incidental appendectomy performance. In patients who do not undergo bowel resection, resumption of oral tolerance occurs 6 hours after surgery, whether surgical reduction alone or in conjunction with appendectomy. Bowel resection is the one that leads to the most delayed restart of oral tolerance, in our centre it is performed after observing bowel movement, normally between the 2nd and 5th postoperative day. All postoperative complications reported in this study occurred in patients who required bowel resection, regardless of whether appendectomy was performed or not. Performing bowel resection carries an increased risk of both infectious complications (wound infection, dehiscence or evisceration) and anastomotic complications (leakage or dehiscence). Therefore, bowel resection increases operative time, hospital stay and postoperative complications in patients with ICI requiring surgical treatment.

The results of our study show that incidental appendicectomy does not influence the postoperative outcome of ICI and can be considered a safe procedure, although there are arguments against its performance, mainly based on the theoretical infectious and recurrence risk associated with this procedure. Recurrent intussusception occurs in 10-15% of cases, mainly after enema reduction, with recurrence after surgical reduction being uncommon, less than 5% in our study[15,16]. Postoperative intussusceptions have been also described after appendectomy, in which an inverted appendiceal stump could become the lead point of a recurrent ICI[17,18]. In these patients, appendiceal stump is in theory at risk for perforation during postoperative enema, although no cases of this complication have been reported. In addition, when bowel resection is not required, the performance of incidental appendectomy means that the operation becomes a clean-contaminated surgery, with a theoretical increased infectious risk. In addition, non-infectious risks of bleeding and future bowel obstruction associated with appendectomy alone have been reported[19]. However, clinical outcomes such as bleeding, perforation, bowel obstruction and recurrence rate have not been described.

The simultaneous performance of incidental appendectomy has many advantages, such as the elimination of the risk for future appendicitis, which is the most common paediatric surgical emergency with a lifetime risk of 7-8%[20]. Incidental appendectomy during open surgical reduction of intussusception allows avoiding future diagnostic confusion for acute appendicitis in the setting of a right lower quadrant incisión[10]. During the follow-up period of our study, no acute appendicitis has been described in the NA group after surgical reduction of the intussusception, but the follow-up time is still short due to the young age at

which the intussusception occurred (15-16 months of age), so longer-term follow-up will be necessary to determine this aspect. Other reasons supporting the performance of appendectomy associated with surgical reduction of the ICI are reported by multiple reports describing an abnormal appendix which serves as a lead point for intussusception[21,22], as well as numerous cases of ICIs in which an inflamed appendix is thought to be the lead point[23,24]. Appendiceal intussusception has also been described, although it is much more uncommon[25,26]. In our study, more than 30% of the resected appendices had histological evidence of submucosal inflammation and periappendicitis, although macroscopically they appeared normal. Other authors have described microscopic abnormalities in apparently non-inflamed appendices in similar proportions[27,28]. Performing appendectomy avoids both possible secondary acute appendicitis and subsequent intussusception. Furthermore, persisting adenovirus in the appendix has also been related to recurrent intussusception, acting as a reservoir and causing a persisting lead point for intussusception[29,30]. Therefore, removing the appendix may help decrease the potential risk of recurrent intussusception.

This study has several limitations, mainly those derived from being a unicentric study as well as those of its retrospective design features. In addition, it was difficult to standardise the operative approach for children needing surgical reduction, due to the different experience of the paediatric surgeons at our children's hospital. Another limitation is the possibility that some of the reductions were performed by less experienced radiologists, yielding an unsuccessful reduction when, in the hands of an experienced radiologist, it would have been a successful reduction. Nevertheless, the enema reduction in our centre has an effectiveness of over 85%. Finally, the rate of acute appendicitis in NA group patients at long-term follow-up is unknown. Multi-centre studies with a greater number of patients and prospective and randomised design may be useful to minimise these biases.

CONCLUSION

Incidental appendectomy during surgical ICI treatment in children may be considered as a safe procedure that does not increase operative time, hospital stay, postoperative complications or recurrence. It eliminates the lifetime risk of acute appendicitis and possible confounding diagnoses of abdominal pain episodes. However, further prospective studies with long-term follow-up are still needed.

REFERENCES

1. Lochhead A, Jamjoom R, Ratnapalan S. Intussusception in children presenting to the emergency department. Clin Pediatr. 2013; 52: 1029-33.
2. Ekenze SO, Mgbor SO. Childhood intussusception: the implications of delayed presentation. Afr J Paediatr Surg. 2011; 8: 15-18.
3. Bartocci M, Fabrizi I, Valente I, Manzoni C, Speca S, Bonomo L. Intussusception in childhood: role of sonography on diagnosis and treatment. J Ultrasound 2015; 18(3): 205-11.
4. Ko HS, Schenk JP, Tröger J, Rohrschneider WK. Current radiological management of intussusception in children. Eur Radiol 2007; 17: 2411-21.
5. Wong CWY, Chan IHY, Chung PHY, Lan LCL, Lam WWM, Wong KKY, et al. Childhood intussusception: 17-year experience at a tertiary referral centre in Hong Kong. Hong Kong Med J. 2015; 21(6): 518-23.
6. Marsicovetere P, Ivatury SJ, White B, Holubar SD. Intestinal intussusception: Etiology, diagnosis, and treatment. Clin Colon Rectal Surg. 2017; 30(1): 30-9.
7. Ntoulia A, Tharakan SJ, Reid JR, Mahboubi S. Failed intussusception reduction in children: correlation between radiologic, surgical, and pathologic findings. AJR Am J Roentgenol. 2016; 207(2): 424-33.
8. Wong CWY, Jin S, Chen J, Tam PKH, Wong KKY. Predictors for bowel resection and the presence of a pathological lead point for operated childhood intussusception: A multi-center study. J Pediatr Surg. 2016; 51(12): 1998-2000.
9. Zhang Y, Wang Y, Zhang Y, Hu X, Li B, Ming G. Laparoscopic ileopexy versus laparoscopic simple reduction in children with multiple recurrences of ileocolic intussusception: A Single-Institution retrospective cohort study. J Laparoendosc Adv Surg Tech A. 2020; 30(5): 576-80.
10. Vilallonga R, Himpens J, Vandercruysse F. Laparoscopic treatment of intussusception. Int J Surg Case Rep. 2015; 7: 32-4.
11. Wang A, Prieto JM, Ward E, Bickler S, Henry M, Kling K, et al. Operative treatment for intussusception: Should an incidental appendectomy be performed? J Pediatr Surg. 2019; 54: 495-9.
12. Sinha CK, Rye E, Sunderland R, Rex D, Nicholls E, Okoye B. The need for Paediatric Emergency Laparotomy Audit (PELA) in the UK. Ann R Coll Surg Engl. 2020; 102: 209-13.
13. Lessenich EM, Kimia AA, Mandeville K, Li J, Landschaft A, et al. The frequency of postreduction interventions after successful enema reduction of intussusception. Acad Emerg Med. 2015; 22(9): 1042-7.
14. Kanglie MMNP, de Graaf N, Beije F, Brouwers EMJ, Theuns-Valks SDM, Jansen FH, et al. The incidence of negative intraoperative findings after unsuccessful hydrostatic reduction of ileocolic intussusception in children: A retrospective analysis. J Pediatr Surg. 2019; 54(3): 500-6.
15. Kim JH, Lee JS, Ryu JM, et al. Risk factors for recurrent intussusception after fluoroscopy-guided air enema. Pediatr Emerg Care. 2018; 34(7): 484-7.
16. Ye X, Tang R, Chen S, Lin Z, Zhu J. Risk factors for recurrent intussusception in children: A systematic review and meta-analysis. Front Pediatr. 2019; 7: 145.
17. Hamada Y, Fukunaga S, Takada K, Sato M, Hioki K. Postoperative intussusception after incidental appendicectomy. Pediatr Surg Int. 2002; 18: 284-6.
18. La Salle AJ, Andrassy RJ, Page CP, Henry DA, Buckley CJ. Intussusception of the appendiceal stump. Clin Pediatr (Phila). 1980; 19(6): 432-5.

19. Linnaus ME, Ostlie DJ. Complications in common general pediatric surgery procedures. Semin Pediatr Surg. 2016; 25(6): 404-11.
20. Rentea RM, Peter SDS, Snyder CL. Pediatric appendicitis: state of the art review. Pediatr Surg Int. 2017; 33: 269-83.
21. Chua TC, Gill P, Gill AJ, Samra JS. Ileocecal intussusception caused by an Appendiceal neoplasm. J Gastrointest Surg. 2016; 20(4): 867-8.
22. Laalim SA, Toughai I, Benjelloun EB, Hassani Ibn Majdoub K, Mazaz K. Appendiceal intussusception to the cecum caused by mucocele of the appendix: Laparoscopic approach. Int J Surg Case Rep. 2012; 3(9): 445-7.
23. Kikuchi N, Miyakura Y, Takahashi J, Takayama N, Tamaki S, Ishikawa H, et al. Intussusception secondary to descending colon lipoma presenting with simultaneous acute appendicitis. J Surg Case Rep. 2018; 2018(7): rjy152.
24. Ozan E, Atac GK. An extremely rare coexistence: acute appendicitis and multiple intussusceptions in an adult. Pol J Radiol. 2016; 81: 265-7.
25. Ochoa Chaar CI, Wexelman B, Zuckerman K, Longo W. Intussusception of the appendix: comprehensive review of the literature. Am J Surg. 2009; 198(1): 122-8.
26. Samuk I, Nica A, Lakovski Y, Freud E. Appendiceal intussusception: A diagnostic challenge. Eur J Pediatr Surg. 2018; 28(1): 30-3.
27. Phillips AW, Jones AE, Sargen K. Should the macroscopically normal appendix be removed during laparoscopy for acute right iliac fossa pain when no other explanatory pathology is found? Surg Laparosc Endosc Percutan Tech. 2009; 19(5): 392-4.
28. Chiarugi M, Buccianti P, Decanini L, Balestri R, Lorenzetti L, Franceschi M, et al. What you see is not what you get. A plea to remove a 'normal' appendix during diagnostic laparoscopy. Acta Chir Belg. 2001; 101(5): 243-5.
29. Porter HJ, Padfield CJ, Peres LC, Hirschowitz L, Berry PJ. Adenovirus and intranuclear inclusions in appendices in intussusception. J Clin Pathol. 1993; 46(2): 154-8.
30. Grynspan D, Rabah R. Adenoviral appendicitis presenting clinically as acute appendicitis. Pediatr Dev Pathol. 2008; 11(2): 138-41.