Original Article

Are Only a Few Hours Adequate for Hospitalisation following Mini-Incision Open Appendectomy in Paediatric Patients?

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Abstract

Background: A very short hospital length of stay following an open appendectomy in children with acute simple appendicitis has never been mentioned yet in the literature. The authors reviewed the outcome of these paediatric patients who were treated with the open technique. **Materials and Methods:** In this analytical cohort observational study, we retrospectively reviewed the medical records of the 115 consecutive patients who underwent open appendectomy from June 2017 to July 2021. **Results:** There were 84 patients whose appendices were inflammatory or suppurative and appendectomies were done only through McBurney's point. Of these, the average age was 9.11 ± 2.67 years. The mean length of the incision was 1.95 ± 0.48 cm. Nearly one-third (25/85) were discharged within 3 h following surgery. Of the remaining cases, nine patients were discharged within the same day. There were increased percentages of patients who were eligible for early discharge in each consecutive year. **Conclusion:** The idea of immediate discharge within 3 h seems to be feasible for children with acute simple appendicitis who were treated with open appendectomy. We believe that the practice will be widely acknowledged and proceed to reduce the resources and the expenses in the hospital.

Keywords: Ambulatory, appendectomy, appendicitis, mini-incision, short stay

Introduction

Over the last decades, a surgical technique for the treatment of acute non-complicated appendicitis gradually improves with resultant shorter hospitalisation. Currently, the same-day discharge or ambulatory setting for treating patients with acute simple appendicitis has been shown feasible in clinical practice.[1,2] However, up to the present time, short-term inpatient hospitalisation has been successfully applied mostly in adult patients who were treated by laparoscopic technique. Although these efforts have also been tried to implement in children, the patients demonstrated in these publications were still treated by laparoscopic technique.[3,4] The concept of the post-operative short stay in paediatric patients with acute simple appendicitis following open appendectomy has never been yet mentioned in the literature in the English language.

Recently, we have published a preliminary report of our short-term experience with small incision technique and very short post-operative hospital stay within 12 h.[5] However, the study had many limitations, especially the small number of patients. As a result, as the number has increased, we re-evaluate our data expecting that this study will present a more conclusive result.

Materials and Methods

In this analytical cohort observational study, the medical records of paediatric patients with acute simple appendicitis between June 2017 and July 2021 were retrospectively reviewed. The institutional review board (IRB) granted permission with IRB ID EC 016/62. Informed consent from the participants and/or their legal guardian(s) for participation in this study, to publish the information, and publication of images in an online open-access publication was obtained by sending the mail inquiring consent.

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Received: 11-12-2021 **Revised:** 18-01-2022 **Accepted:** 16-03-2022 **Available Online:** 07-12-2022

Access this article online

Quick Response Code:

Website: www.afrjpaedsurg.org

DOI: 10.4103/ajps.ajps_174_21

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How to cite this article: Sookpotarom P, Chakrapan Na Ayudhya V, Tangsirapat V. Are only a few hours adequate for hospitalisation following mini-incision open appendectomy in paediatric patients? Afr J Paediatr Surg 2023;20:28-33.

Mostly, the diagnosis of acute appendicitis was made on clinical presentations and laboratory results. Before the surgery, a single dose of 10 mg/kg metronidazole and 5 mg/kg gentamicin was given intravenously to all patients.

Selection of our patients

The inclusion criteria include the following:

1. All patients whose gross pathologic findings were acute inflammatory or suppurative.
2. The patients with the skin incision at McBurney's point

The exclusion criteria include all the following:

1. All patients whose gross pathologic findings were gangrenous or perforated
2. Operative difficulties that required an additional midline incision, since this resulted in increasing tissue trauma requiring more time for the patients to improve.

Surgical techniques

All patients were treated by one surgeon (PS) and underwent general anaesthesia. For the small incision technique as previously described in our publication,[5,6] the transverse skin incision length of 1.5–2.5 cm was created at the right lower quadrant with scalpel No. 15. The incision depth was made down to the patient's subcutaneous fat. However, the actual length of the incision might be below 1.5 cm or exceed 2.5, depending on the situation we experienced. For example, a small thin younger patient's incision length was only 1 cm, and a large obese older patient's incision length was 3 cm. In addition, the difficulty during the operation might result in more traction of the wound causing an additional length of the incision. We only used a scalpel, a Metzenbaum scissor, Zen retractors (or Army retractors in some cases), and mosquito clamps for passing through the Scarpa's fascia, aponeurosis, abdominal muscle and entering the peritoneum in all cases without electrocautery. On the account of the small opening, the surgical instruments used to find the caecum or the appendix were non-toothed thumb forceps and Babcock forceps. The technique required experience skill, and sometimes appendix was grasped blindly. Under some circumstances, the author used a digit to help find the appendix and break any soft adhesion surrounding the appendix.

The appendix was identified, lifted outside and double ligated with 1-0 or 2-0 silk suture. The appendectomy was cut with scalpel No. 11. The stump was cleaned with pure phenol and 70% alcohol solution. Inversion of the stump was not performed. Following the appendectomy, the 4 × 4 gauzes were unfolded and rolled longitudinally for swabbing. The peritoneum was closed with the purse-string technique with a 3-0 (or 2-0) polyglactin suture. Diluted lidocaine (1–2 mg/kg) was injected at sheath and fat. Finally, the subcuticular sutures with 5-0 polyglactin sutures completed the operation.

Criteria for early discharge

Following the surgery, all patients were observed and monitored for any post-operative complications such as unstable vital signs or bleeding for approximately 1 h in the recovery room and then transferred back to the paediatric ward. At this point, they were evaluated whether they can recover from the general anaesthesia and be able to resume their diet at home. The term 'a few hours' in the study is defined as within 3 h. The criteria for discharge which was modified from previous publications are as follows:[7,8]

1. Clinical improvement
    - Vital signs stable for at least 60 min with body temperature <38°C
    - Reversal of anaesthesia with consciousness regained completely
    - Mild to moderate pain
    - No bleeding or oozing from the wound
    - Minimal nausea or vomiting
    - Ability to walk to the toilet for voiding [Figure 1].
2. No difficult event during operation nor prolonged operative time (≤60 min)
3. The consultation time is daytime (before 7 PM)
4. Agreement from both patient and parents, if any disagreement occurred, the patient will be discharged as their desire.

If the patient's operation was completed at night-time or there was no agreement from the patient or parents, the other criteria will never be considered. All patients were instructed about their diet and adverse symptoms. Contact information (including an appointment) was given before discharge. Only oral paracetamol was given before discharge. The wound with water-proof dressing was placed until follow-up approximately 2 weeks after discharge unless there were any complications, and the wound was re-evaluated. The two weeks' time frame was scheduled according to the pathological result reports.

The descriptive statistics were presented as median, mean and standard deviation. The categorical variables were shown as the number of cases and percentage. The Chi-square test or Fisher's exact test was used to analyse the categorical variables, $P < 0.05$ was the cut-off value to determine statistical significance. The data were analysed with the SPSS software version 26.0 (SPSS Inc., IBM, NY, USA).

Results

There were 115 appendectomies. Of these, three were excluded on account of the unusual position of the appendix due to midgut malrotations, an additional five patients were excluded due to misdiagnosis, and 23 patients whose appendices were necrotised (3) or perforated (20). The remaining 84 patients who underwent open appendectomy were acute inflammatory or suppurative appendicitis; the demographic data are shown in Table 1. The median patients' age was 9.04 years (range 3.1–14.1 years). The length of the incision was measured intraoperatively after the wound closure; the mean length was 1.95 ± 0.48 cm (range 1.2–3.5 cm). The mean depth of cutaneous fat assessed during the operation was 2.09 ± 1.19 cm (range 0.5–5.5 cm). There was a correlation between the length of the incision and fat thickness ($R^2 = 0.82$



Figure 1: Screenshot capture of a video recorded showing an ability in a 4-year-old boy to walk to void approximately 90 min following surgery

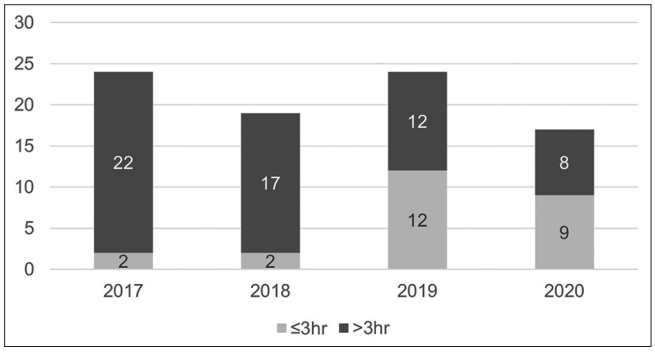


Figure 2: Percentage of patients who were eligible for our criteria in each year

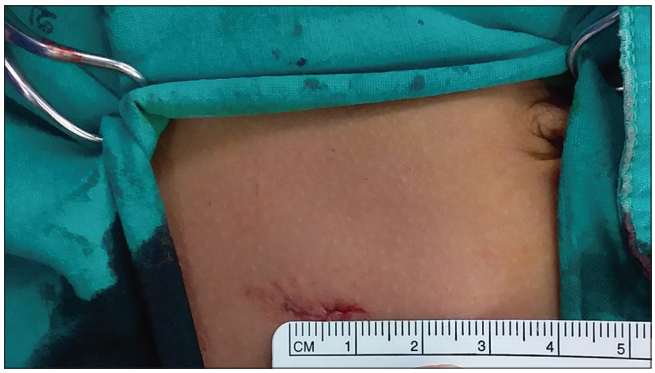


Figure 3: The smallest length of incision in the study

and $P = 0.01$). The average operative time from incision to wound closure was 38.7 ± 18.7 min (range 10–110 min). Twenty-five patients were discharged from the hospital within 3 h (mean of 1.52 ± 0.59 h and range of 0.55–2.5 h) and nine patients who were discharged from the hospital within the same day (mean of 4.5 ± 1.44 h and range of 3.05–7 h). There were increased percentages of patients who were discharged within a few hours each consecutive year [Figure 2]. The data in Table 2 show that the factor of age, white blood cell count (WBC), wound length, and operative time was not the factors that influence the decision for early discharge. In the remaining 50 patients, the reasons why they were not discharged on the same day are shown in Table 3.

Table 1: Demographic data

	n or mean±SD	Percentage or range
Age (year) (median)	9.04	3.06-14.11
Sex (male)	71	49.30%
BMI	18.15±4.3	11.8-34.6
Body temperature (°C)	37.5±0.9	36-40.7
WBC ($\times 10^3$)	15.82±7.11	5.34-49.42
Neutrophil (%)	78.87±10.88	45-94.1
Abdominal wall fat thickness (cm)	2.09±1.19	0.5-5.5
Wound length (cm)	1.95±0.48	1.2-3.5
Operative time (min)	38.68±18.75	10-110
Time to discharge (h)	9.46±8.25	0.55-52.3
Stage of appendicitis		
Inflamed appendicitis	57	67.90%
Suppurative appendicitis	27	32.10%
Discharge within 3 h	25	29.80%

WBC: White blood cell count, BMI: Body mass index, SD: Standard deviation

Discussion

Acute appendicitis is one of the most common surgical conditions. Improvement in the treatment results in a shortened hospital length of stay. Currently, the basis of ambulatory surgery can be widely applied to patients treated with appendectomy.[9-15] However, the basis is reportedly successful only in patients who were treated with a laparoscopic approach. The success of this basis has never been reported yet in patients whose operation was an open appendectomy. As we have found in our preliminary report,[5] a prolonged admission time before surgical consultation and a high percentage of patients

Table 2: Compare between patients who can discharge within 3 h after the operation, and patients who can discharge more than 3 h after the operation

	≤3 h		>3 h		*P*
	n or mean±SD	Percentage or range	*n* or mean±SD	Percentage or range	
Age	8.82±2.51	4.06-14.08	9.24±2.75	3.06-14.11	0.5
Sex (male)	14	56%	28	47.50%	0.47
BMI	18.97±3.75	13.9-26.6	17.81±4.49	11.8-34.6	0.54
Body temperature (°C)	37.4±0.7	36-39	37.6±1%	36-40.7	0.41
WBC ($\times 10^3$)	16.35±8.36	7.24-49.4	15.59±6.58	5.34-47.6	0.27
Neutrophil (%)	76.2±10.5	48.9-90.6	80±10.9	45-94.1	0.18
Fat thickness (cm)	2.2±1.22	0.5-5.5	2.04±1.19	0.5-5	0.21
Wound length (cm)	1.98±0.48	1.2-2.8	1.94±0.49	1.3-3.5	0.21
Operative time (min)	33.8±1.14	20-65	40.75±2.08	10-110	0.74
Stage					
Inflamed appendicitis	20	80%	37	62.7%	0.12
Suppurative appendicitis	5	20%	22	37.3%	

WBC: White blood cell count, BMI: Body mass index, SD: Standard deviation

Table 3: The reasons why the patients needed over-night hospital stay

Nighttime or raining	High fever	Drowsiness	Severe vomiting	Severe pain	Difficult operation	No agreement
35	14	1	2	1	12	8

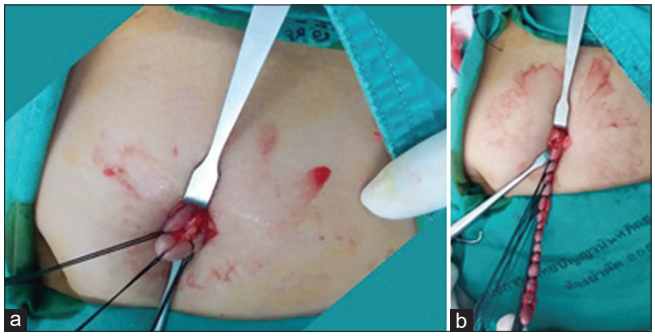


Figure 4: (a and b) Sequential traction sutures were applied in a patient with appendicitis, retrocecal type

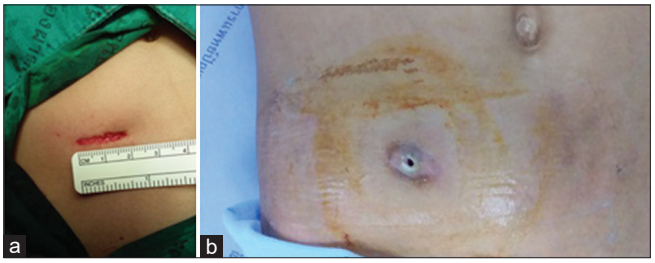


Figure 5: (a) Contusion at the edge of both sides of incision presented following a procedure with which too much effort is required. (b) The chronic wound infection in a patient who was suspected of having a retention of fecalith

presented their symptoms and come to the hospital at night largely impact the possibility of ambulatory surgery policy. In addition, with the nature of the disease, a certain appointment to the outpatient office like other elective surgical conditions is nearly impossible. To determine an appropriate policy to shorten the hospitalisation duration of the disease, maybe the term 'ambulatory surgery' does not work. As a result, at this time, we re-evaluate our increased data with a basis of immediate discharge rather than with the previously used one.

The outcomes demonstrated in the study might be a result of some factors that enhance our patients' recovery. The no usage of electrocautery can reduce tissue damage; the haemostasis was achieved by compression and suturing. The use of local anaesthesia before abdominal wall closure can reduce post-operative pain. The particularly important factor that improves post-operative recovery is the author (P.S)'s small incision technique with which the overall tissue damage can be reduced. The small wound size that is comparable to the size generated by the laparoscopic technique might be the explanation for why these patients recovered rapidly. In this series, we have a new smallest incision length [Figure 3]. With the author's experience and opinion, some obstacles will be presented to other surgeons should this technique be implemented into general practice. Like other surgical skills, a learning curve is required. Some difficult situations such as the retrocecal or subcecal position of the appendix are the conditions in which an author's technique will help. Sequential traction sutures approximately 0.5–1 cm apart retrograde from base to appendiceal tip could deliver such type of appendix pass through the small opening [Figure 4a and b].

At times, we might experience a situation in which the surgeon's digit is needed delving inside to find the appendix, or sometimes for breaking adhesions and freeing the appendix from surrounding structures. If too much effort is used, some cutaneous contusions will indispensably occur [Figure 5a]. Fortunately, this occurrence reduced over time. In addition,

perforation which could be found at any time can cause a problematic event especially when accompanied by a fecalith. In at least two cases in our experience, while trying to remove the appendix from a small opening cause to break the fecalith which can leave a very small fraction of it, and results in chronic wound infection [Figure 5b]. However, this will be improved with prolonged recovery. Another obstacle would be the pressure from the co-workers surrounding the surgeon. When a difficult operation occurs, the surgeon might be asked to extend the skin incision from the personnel (e.g., assistants, scrub nurses or anaesthetic nurses). For this circumstance, the surgeon must be firm. After we retracted the incision with greater force, additional space of the opening will appear.

The previous studies in adults showed that the factors of younger age, fewer comorbidities, lower body mass index, lower preoperative C-reactive protein level and shorter operative time led to early discharge.[10,12,14] A previous study in paediatric patients stated that the reasons for patients staying overnight included late surgery end time, post-operative pain, and nausea or emesis.[16] Our study revealed that age, WBC count, wound length, operative time and stage of appendicitis were not the components that influence early discharge.

However, if we subgroup the time into the first and the second 2-year period, we will discover that over half of the patients in the latter period could be discharged immediately. This increased number could be explained by the change in the mind of the parents and the author's team. Over the years, the team gradually accept this concept until they found that not only this will reduce their workload, but also the parents will save their expenses in the hospital. Up to date, all nurses at duty at our in-patient ward will help to clarify the concept of immediate discharge to the parents. The parents' mindset is another difficulty to deal with. As shown in Table 3, the belief that admission is needed exists even in health personnel. There are two children in the study whose both mothers are physicians working at the same author's hospital, a two-night stay is required in both cases. The confidence of both parents and the therapeutic team on this concept is of paramount importance affecting the change or a shift of paradigm concerning the treatment of this very common surgical condition.

There is a developed trick that significantly helps explain to parents before entering the operating room. With permission, we recorded a short video of a patient walking to the toilet shortly after the operation and used them as an adjunct tool when counselling with the parents. At the present day, almost all patients with acute simple appendicitis who are without any surgical difficulty or problems due to anaesthesia can successfully be discharged back to their homes for recovery. As we have discussed earlier, the only common hurdle for this concept is the night-time presentation or the time that results in the operation to be completed at night. Although there is a concept of postponing and avoiding the operation at night so that the patient can be put into immediate discharge policy,[16,17] we think that it is not safe for the patient who received the delayed treatment as well as will prolong the pain. In addition, early discharging after the night operation is not feasible for paediatric patients.

The concern that shorter hospital stays after surgery associated with higher complications were found in older patients, patients with higher American Society of Anaesthesiologists class, and long operative time. Instead, the studies in children revealed that the ambulatory anaesthesia episodes for children under 15 years old have increased significantly over the years; nevertheless, the anaesthesia can be done securely due to the advancement of surgical and anaesthetic techniques.[17] The operations can be done safely, and patients who underwent general anaesthesia with the early discharge have similar complication rates and readmission rates to those with an overnight stay.[12,16,18] Besides no readmission due to anaesthesia cause was observed.[2,7,19] We are also aware of this problem, so we strictly follow the criteria for early discharge that the patient must regain full consciousness with stable vital signs after the operation before leaving the hospital. The result of the study showed that no anaesthesia complication was found with our criteria for early discharge.

Even though there is not much cost-benefit difference between the period of discharge within 3 h compared to same-day discharge, we are demonstrating that early discharge is possible in open appendectomy as in laparoscopic appendectomy. The surgeon did not rush the patient to be discharged, there must be an agreement from both patient and parents, and they seem delighted to leave the hospital. Regarding the concern about the parents' feelings or satisfaction. Although we did not construct a form to collect these data as conducted in other studies,[3,20-23] at the time of follow-up, there was no negative feedback from any parent or caregiver. Interestingly, there was a notable case in our study. Since our in-patient ward does not allow for male persons to stay along the night with patients, the patient and his single father were quite happy to go back home for recovery following an hour after surgery.

The concept of early discharge was defined as <12 h, 12–24 h and <24 h with the lowest number as 3 h after the operation has been implemented for years in adult patients who are treated with laparoscopic appendectomy.[2,7,10,14,16,19] We ought to admit that the laparoscopic method is not financially and technically possible for every hospital, particularly many hospitals in undeveloped and developing countries. The appropriate treatment for patients with acute simple appendicitis in these areas is still the open technique which requires much fewer resources compared to the laparoscopic mean. The only requirement for them is the surgical skill which we have emphasised that every surgeon can learn and perform so that the other surgeons can perform as fluently as we do. The early discharge in open appendectomy in children was reported as 12–24 h or <24 h, but none as low as 3 h after the operation as our study.[24,25] As a result, we think that this study would be valuable for surgeons and paediatric patients.

Conclusion

According to our outcomes, the concept of immediate discharge seems to be possible for children with acute simple appendicitis who were treated with open appendectomy that was carefully selected by using the author's exclusion criteria and criteria for early discharge. We expect that the practice will be widely accepted and distributed so the parents would save their expenses in the hospital as well as many resources would be reduced.

Acknowledgements

We deeply thank Dr. Paisarn Vejchapipat, MD, Ph.D., for some precious comments in this study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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