Original Article

Evaluation of the Outcome of Right Subumbilical Transverse Incision Approach for the Management of Complicated Appendicitis in Paediatric Age Group – A Multi-Institutional Retrospective Study

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Abstract

Aim: The aim is to evaluate the outcome of right subumbilical transverse incision approach for the management of complicated appendicitis in paediatric age group. **Materials and Methods:** This is a retrospective multi-institutional study which was conducted in the Department of Paediatric Surgery, I Q City Medical College and Hospital, Durgapur, West Bengal, India and the Department of Paediatric Surgery, Rajiv Gandhi Super Speciality Hospital/Raichur Institute of Medical Sciences, Raichur, Karnataka, India. In this study, a review of 77 paediatric patients operated for complicated appendicitis using a right subumbilical transverse incision approach was done for a period of 3 years (from December 2017 to December 2020). All patients had proven complicated appendicular pathology like appendicular perforation, appendicular abscess or complicated appendicular lumps on ultrasonography or computed tomography scan, which mandated exploration. **Results:** There was no mortality. Average operative time was 1 h 48 min (ranging from 58 min to 3 h 12 min). Average length of hospital stay was 9 days (ranging from 5 days to 13 days). There was no incidence of fecal fistula. Seventeen (22%) patients developed superficial surgical site infection which subsided with regular dressings. There was no incidence of wound dehiscence or burst abdomen. Five (6.5%) patients required the incision to be extended beyond the midline to the left side to deal with the pathology and to access the entire peritoneal cavity. Nine (11.6%) patients required loop ileostomies, which was fashioned on the lateral aspect of the transverse incision. Only one patient had a doubtful caecal injury which was repaired and loop ileostomy was done. Six patients (7.7%) had adhesive intestinal obstruction postoperatively, of which three required re-exploration. There was no incidence of incisional hernia or any stoma-related complications. **Conclusion:** Complicated appendicitis is a condition which lacks standardisation of approach for management, and is inherently associated with complications. However, with a more logical incision and intra-operative approach we can keep the complications to minimum and improve outcomes to great extent in those patients requiring surgical intervention. We have been using the subumbilical transverse incision in all sizes of patients ranging from small children to adolescents with excellent results, and we believe that the same approach can be applied even in adult patients in similar clinical scenarios.

Keywords: Acute appendicitis, appendicular abscess, appendicular lump, complicated appendicitis, perforated appendicitis

Introduction

Acute appendicitis is the most common surgical emergency in children and adolescents.[1] If it is recognised early, the procedure either open or laparoscopic is simple and recovery is fast and uneventful. However if there is a delay in the diagnosis, the disease can present with severe complications where the mode of treatment (conservative or surgical) and approach to surgery (laparoscopic or open) are very difficult to determine. Although uncommon in pre-school children, it may present at any age. The lifetime risk of developing appendicitis is

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7%–8%, with a peak incidence in the teenage years.[2] Nearly one-third of children with appendicitis have perforation at the time of surgical treatment.[3,4] It affects males more frequently than females.[5] Complicated appendicitis is a clinically difficult condition to manage and there is no standardisation of approach in its management.[6-8] Due to dreaded complications (such as faecal fistula, intra-abdominal abscess, wound dehiscence and incisional hernia) associated with the surgery of this condition, conservative[9] and percutaneous[10] procedures have also been advocated in its management. However, there are many patients who present very late with localised or generalised peritonitis and even with intestinal obstruction where surgical intervention becomes mandatory.[11,12]

Except some patients who are candidates for laparoscopic intervention, many patients require exploratory laparotomy for the management of complicated appendicitis.[13] The standard open approach for appendicectomy such as McBurney's and Lanz are not sufficient for the management of complicated appendicitis as they do not provide adequate exposure and there is an increased incidence of faecal fistula if these approaches are forced in this clinical situation. The standard approach for laparotomy in older children is a midline incision and in smaller children classically a right supra-umbilical transverse incision is used, both incisions are quite away from the actual pathology and require a lot of retraction and tissue handling, which might increase the complication rates. In this study, we will be evaluating the outcomes of laparotomy done by right subumbilical transverse incision for complicated appendicitis in paediatric patients.

Materials and Methods

This is a retrospective multi-institutional study which was conducted in the Department of Paediatric Surgery, I Q City Medical College and Hospital, Durgapur, West Bengal, India and the Department of Paediatric Surgery, Rajiv Gandhi Super Speciality Hospital/Raichur Institute of Medical Sciences, Raichur, Karnataka, India. Through this study, we aim to standardise the surgical approach to the management of complicated appendicitis in paediatric patients by using a right subumbilical transverse incision. We used this approach for managing 77 patients with complicated appendicitis over a period of 3 years (from December 2017 to December 2020) and the data were examined retrospectively. All patients had proven complicated appendicular pathology like appendicular perforation, appendicular abscess or complicated appendicular lumps on ultrasonography or computed tomography (CT) scan, which mandates exploration. Clinically, all patients had features of localised or generalised peritonitis at the time of surgery.

Patients with simple appendicular lumps without any features of peritonitis which improved on conservative management were not included in the study and they all underwent interval appendicectomy either laparoscopic or open after 6 weeks. Only those appendicular lumps were included in this study that had frank signs of localised or generalised peritonitis or did not improve on a conservative trial of 48 h, as reflected by rising total leucocyte counts, increase in pain or new onset of localised guarding or rigidity.

All patients were stabilised by administering intravenous (IV) fluids and IV antibiotics and confirming adequate urine output before taking them for surgery.

Outcome measurement was done in terms of duration of surgery, duration of hospital stay, intra-operative events (which included-requirement of extra assistant for retraction to complete the procedure, need to extend the incision beyond the midline, injury to caecum or ileum while separating structures from the appendicular lump, and requirement for ileostomy) and post-operative events (which included-uneventful recovery, superficial wound infection, deep wound infection/wound dehiscence, intra-abdominal collection or abscess, adhesive intestinal obstruction, faecal fistula, ileostomy related complications, incisional hernia and mortality).

Surgical procedure and intra-operative approach

After the patient was anaesthetised (general anaesthesia was used for all the patients), the bladder was catheterised with appropriate size Foley's catheter (if not catheterised preoperatively). The abdomen was palpated under anaesthesia for the presence of any appendicular lump, and its location and extent were roughly noted. Irrespective of the preoperative abdominal ultrasonography, CT or clinical examination findings, 61 of our 77 patients (79%) revealed some lump formation diffuse or discrete when palpated under anaesthesia. A right subumbilical transverse incision was made, starting from the midline about 2.5 cm below the umbilicus extending transversely till about 2.5 cm above the right anterior superior iliac spine [Figure 1]. The medial extent of the incision was extended across the midline as required during the procedure [Figure 1]. After incising the skin and the subcutaneous fat, the anterior rectus sheath was reached, incision was made over the anterior rectus sheath to expose the right rectus muscle. The rectus muscle was separated and lifted from the underlying posterior rectus sheath with the help of an artery forceps. The rectus muscle was then divided with the help of a cautery using coagulation current. The posterior rectus sheath was then lifted with the help of two artery forceps and incised to expose the peritoneum, which was also divided to enter into the peritoneal cavity. As soon as the peritoneal cavity was opened, the characteristics of the peritoneal fluid were noticed and if frankly purulent, was collected and sent for culture and sensitivity. After entering into the peritoneal cavity, a finger was put inside the peritoneal cavity and any adhesions of the underlying lump or the bowel loops with the anterior abdominal wall was very gently broken without damaging the adherent structures. Once the adhesions were broken, the anterior abdominal muscles were incised for the entire length of the incision with the help of a cautery using coagulation current. As the incision was located exactly over the pathological area, very little retraction was required and a very good exposure of the appendicular lump and the surrounding bowel loops was

achieved without undue handling of the edematous and friable adherent bowel loops [Figure 2a and b]. With very gentle combination of finger dissection, hydrodissection and using the tip of the metal suction tube, adhesions were broken without causing serosal injury. All the pus pockets were opened, the anatomy of the appendix was delineated, the site of appendicular perforation was noticed and the condition of the appendicular base and the adjoining caecum was also noticed. The mesentery of the appendix was also delineated.

If the appendix had been freed completely and the base was healthy [Figure 3], a routine appendicectomy was done. If there was an appendicolith palpable at the base of the appendix, it was gradually milked out into a more distal location of the appendix without damaging its walls before performing appendicectomy. Patients who were found to have retrocaecal appendix where the tip could not be delivered, a retrograde approach was taken where the base of the appendix was ligated and divided first with gradual ligation of the appendicular mesentery and progressing towards the tip.

If the appendix was found to be perforated at the base and the surrounding caecal wall was healthy [Figure 4a], after removing the appendix, a primary repair of the caecal wall was done with interrupted 4-0 polyglactin sutures. However if the appendix was perforated at the base and the surrounding caecal wall was found to be unhealthy and edematous [Figure 4b], then the appendix was removed along with the site of perforation, unhealthy areas were trimmed and a primary repair of the caecal wall was done with interrupted 4-0 polyglactin sutures, and in addition, a loop ileostomy was also done at about 15 cm from the ileo-caecal junction at the lateral end of the same incision [Figure 5].

If the appendix was found to be retrocaecal and subserosal for its entire length with no definite plain between the appendicular and the intestinal walls and It appeared that any attempt to separate the two structures would cause gross injury to the intestinal walls, no further attempt of dissection was made, peritoneal lavage was given, drain placed and the abdomen was closed.

If after entering the peritoneal cavity the appendicular lump was found too dense to be released without causing any injury, any further dissection was stopped, peritoneal lavage was given, drain placed and the abdomen closed. Interval appendicectomy was then done in these patients after 6 weeks through the same incision.

If on starting the dissection of the appendicular lump appearing separable initially, was subsequently found to be too dense to proceed safely, then any further dissection was stopped. If we were sure that our initial attempt to dissect the appendicular lump had not damaged any structures, then simply peritoneal lavage was given, drain placed and the abdomen was closed. However, if the anatomy was not very clear after proceeding with the initial dissection and any part of caecum or terminal ileum appeared to have been damaged, then loose intermittent sutures were put over the doubtful structure, lavage given, drain placed and a loop ileostomy was made over the lateral aspect of the same incision.

Patients presenting very late with features of generalised peritonitis or with features of intestinal obstruction were also approached with the same incision with the extension of the medial end of the incision by about 3–4 cm beyond the midline to the opposite side [Figure 1].

The abdomen was closed with interrupted polyglactin sutures in a single layer taking bites over the anterior and posterior rectus sheath along with the peritoneum in the medial aspect of the incision and over the three layers (external oblique aponeurosis, internal oblique muscle and transversus abdominis muscle) and the peritoneum on the lateral aspect of the incision. The subcutaneous fat layer was then closed. In patients with the frank purulent collection and with thick subcutaneous fat layer, an additional corrugated rubber drain was also placed in this layer [Figure 6]. The skin was closed with mattress sutures.

For the patient who required ileostomy, a loop ileostomy was fashioned on the lateral aspect of the same subumbilical right transverse incision, keeping the proximal limb towards the lateral side and the distal limb towards the medial side [Figure 5]. Ileostomy closure procedure in these patients was done after 6 weeks.

All patients without ileostomy were kept nil orally for 5 days, following which gradual enteral nutrition was started. Patients on ileostomy were started orally as soon as the stoma started functioning. Daily dressings were done for patients who developed wound infections.

Results

Seventy-seven patients with complicated appendicitis were operated using this approach with ages varying from

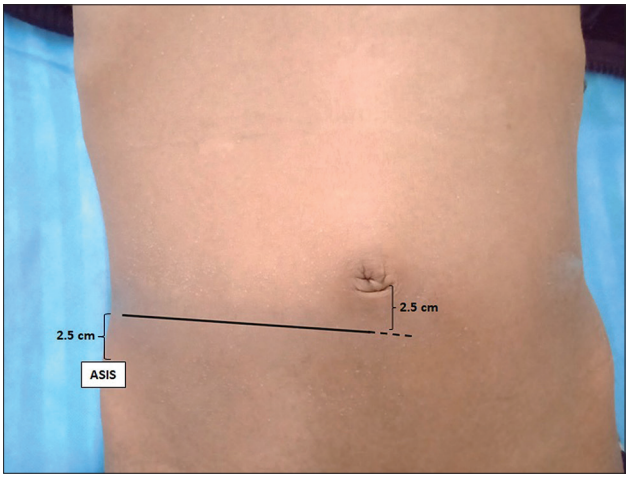


Figure 1: The subumbilical transverse incision begins 2.5 cm below the umbilicus in the midline and extends transversely to the right, to end about 2.5 cm above the ASIS. The incision can also be extended across the midline (dotted line) as required to access the entire peritoneal cavity. ASIS: Anterior superior iliac spine

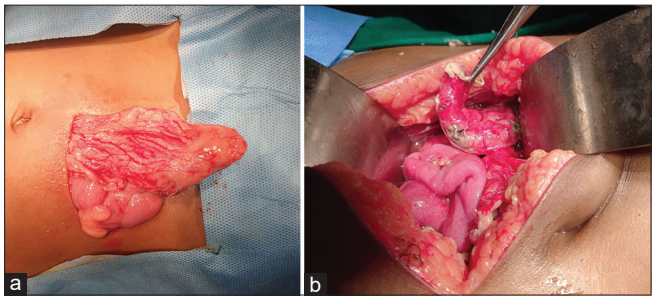


Figure 2: (a and b) These figures demonstrate how easily with minimal retraction the appendicular pathology can be exposed with right subumbilical transverse incision

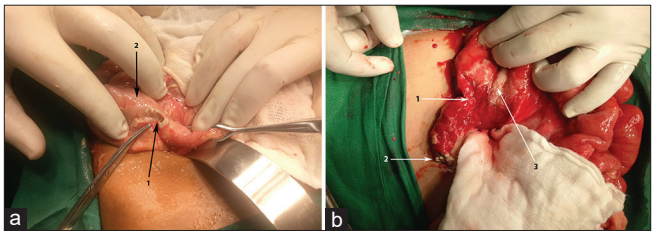


Figure 4: (a) Perforation at the base of the appendix with relatively healthy caecal wall. 1. Site of perforation at the base of the appendix. 2. Relatively healthy caecal wall. (b) Perforation at the base of the appendix with friable and edematous caecal wall. 1. Appendicular perforation at the base with unhealthy base. 2. Associated appendicular perforation at the tip also. 3. Edematous, inflamed and friable caecal wall

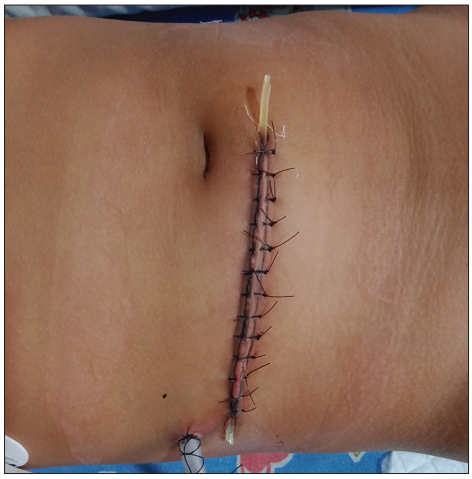


Figure 6: Skin closed with corrugated rubber drain in the subcutaneous plane in cases with frankly purulent intra-abdominal collection as well as cases with thick subcutaneous fat

4 years to 15 years. Sixty-five patients were males (84.4%) and rest 12 patients (15.6%) were females. The various intra-operative clinical scenarios encountered during surgery are summarised in Table 1. In 59 patients (76.6%), the appendix was freed completely and had healthy bases so that a routine appendicectomy was performed. Out of these 59 patients, 6 had retrocaecal appendix, so retrograde appendicectomy was performed. In five patients (6.5%), the appendix was found to be perforated at the base with the surrounding caecal wall healthy, in these patients after removing the appendix, a primary repair of

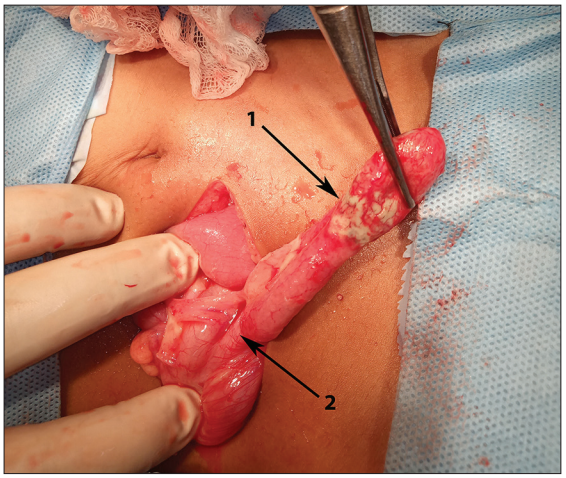


Figure 3: The site of perforation away from the base. 1 Site of perforation near the tip of the appendix. 2. Base of the appendix is healthy



Figure 5: Ileostomy done at the lateral end of the right subumbilical transverse incision with mild peristomal excoriation



Figure 7: Large appendicolith found lying outside the appendicular lumen in the substance of the appendicular lump

the caecal wall is done. In eight patients (10.3%), the appendix was found to be perforated at the base with the surrounding

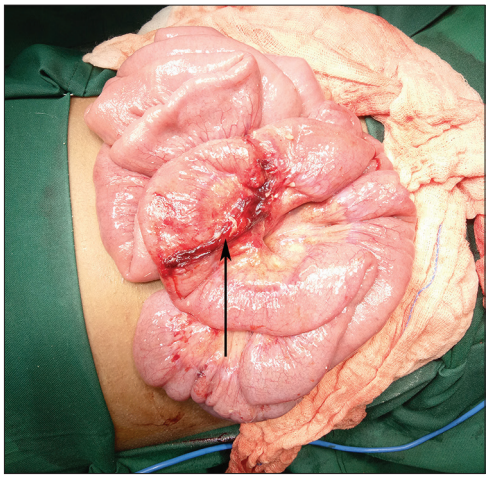


Figure 8: Dense adhesive band causing acute small intestinal obstruction (indicated by arrow)

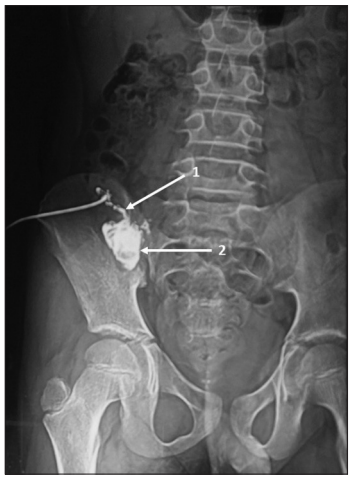


Figure 9: Fistulogram showing the fistulous tract of faecal fistula in a case of complicated appendicitis operated elsewhere using a McBurney's incision in an 8 years old boy. The fistula had been present for 2 years at the time of presentation at our center. Complete excision of the fistulous tract with repair of caecal wall was done with omental patching. 1. Fistulous tract extending from skin to the caecum. 2. Collection of contrast seen in the caecum

caecal wall unhealthy and edematous, in these patients after removing the appendix, and repairing the caecal wall, a loop ileostomy was also made. In one case (1.3%), the appendix was retrocaecal subserosal and very densely adherent to the wall of caecum and ascending colon with no plane of separation. In this case, no further attempts were made to separate the structures, peritoneal lavage was given, drain placed and the abdomen was closed. The child improved uneventfully. In two patients (2.6%), the appendicular lump was found too dense to be released, so no further dissection was made, peritoneal lavage was given, drain placed and the abdomen closed. Both the patients improved uneventfully and interval appendicectomy was then done in both these patients after 6 weeks through the same incision. We had two patients (2.6%), where, initially the appendicular lump appeared separable, but subsequently was found to be too dense to proceed safely. In one of these patients, we were sure that no structures had been injured, so the procedure was aborted, lavage given and drain placed. This patient went on to have interval appendicectomy after 6 weeks. However in the second patient, the anatomy was not very clear and a caecal wall injury was suspected so additionally a loop ileostomy was made after loosely repairing the doubtful injury. After 6 weeks, a distal loopogram was done which did not show any contrast leakage so subsequently ileostomy closure along with appendicectomy was done.

In two cases, we encountered large appendicoliths lying outside the appendicular lumen in the substance of the appendicular lump [Figure 7]. Both the patients recovered uneventfully and the presence of appendicolith in the peritoneal cavity did not contribute to any unfavourable outcome.

Four patients had presented very late with generalised peritonitis. One of them required ileostomy due to the involvement of caecum [intra-operative scenario no. 3– Table 1]. Two of them developed superficial wound infections.

Two patients had presented with features of intestinal obstruction. Intraoperatively, on releasing the adhesions, the appendicular base was found healthy [intra-operative scenario no. 2– Table 1] and their post-operative course was uneventful.

Most patients presenting with complicated appendicitis had onset of symptoms for more than 3 days before the time of

Table 1: Various intra-operative clinical scenarios encountered during surgery

Intra-operative clinical scenarios	Number of patients, *n* (%)
Appendix could be freed completely, the site of appendicular perforation was away from the base and the base was healthy	59 (76.6)
Appendix was perforated at the base and the surrounding caecal wall was healthy	5 (6.5)
Appendix was perforated at the base and the surrounding caecal wall was unhealthy	8 (10.3)
Appendix not separable from caecum	1 (1.3)
Appendicular lump too dense to release	2 (2.6)
Appendicular lump appearing separable but subsequently found too dense to release	2 (2.6)
Total	77

Table 2: Duration of symptoms at the time of presentation

Duration of symptoms	Number of patients, *n* (%)
<24 h	0
24 h-48 h	2 (2.6)
3-5 days	53 (68.8)
6-8 days	17 (22)
>8 days	5 (6.5)

presentation, but there were two patients who had symptoms just for about 24 h before presentation [Table 2].

There was no mortality. Average operative time was 1 h 48 min (ranging from 58 min to 3 h 12 min). Average length of hospital stay was 9 days (ranging from 5 days to 13 days). There was no incidence of faecal fistula. Seventeen (22%) patients developed superficial surgical site infection (Grade IV a– Southampton wound scoring system) which subsided with regular dressings. There was no incidence of wound dehiscence or burst abdomen. Five (6.5%) patients required the incision to be extended beyond the midline to the left side to deal with the pathology and to access the entire peritoneal cavity. Nine (11.6%) patients required loop ileostomies, which was fashioned on the lateral aspect of the transverse incision. All the procedures were conducted by the operating surgeon along with one assistant and one scrub nurse. Extra assistants were not required as there was no need for undue retraction because the incision exposed the pathology in the right iliac fossa (RIF) extremely well. Only one patient had a doubtful caecal injury which was repaired and loop ileostomy was done. Four patients developed features of intestinal obstruction during the hospital stay, three required re-exploration, which was done by opening the primary incision itself, dense adhesive bands were encountered causing the obstruction which were released and all the patients improved subsequently [Figure 8]. The fourth patient responded to conservative management and re-exploration was not required. Two patients presented late (one after 3 months and another after 7 months of discharge) with features of intestinal obstruction, but both responded to conservative management and no intervention was required. There was no incidence of incisional hernia in any of the patients. There was no incidence of any stoma-related complications apart from mild peristomal excoriation [Figure 5]. None of the patients with stoma developed wound infection.

Discussion

Complicated appendicitis in paediatric age group is a difficult clinical condition to manage. The factors that contribute to the early onset of complications and perforation in paediatric appendicitis are a thin-walled appendix, and inadequate omental barrier.[14]

Presentation of complicated appendicitis can have an entire spectrum varying from a simple appendicular lump without signs of localised peritonitis to a case of generalised peritonitis with gross abdominal distension with board-like rigidity of the abdomen. Studies have suggested operative management in complicated appendicitis with perforation, while nonoperative management is advised for complicated appendicitis with abscess or lump.[7] However, in our series of cases, these three situations were not at all found to be exclusive of one another, rather 82% (63 out of 77) of our cases of perforated appendicitis were found to have lumps in the right iliac region intraoperatively, though their denseness varied, and most of them had either frank purulent collection in the RIF or loculated collection within the substance of the lump.

These cases of complicated appendicitis barring simple appendicular lumps, usually require surgical intervention for their management. Intervention can be done in form of laparoscopy or laparotomy. The role of laparoscopy in the clinical setting of complicated appendicitis in paediatric age group is controversial with few studies finding it to be superior[15,16] and some finding it to be inferior to the open approach.[13,17] Whenever open approach appears necessary in management of complicated appendicitis, it is usually done through a laparotomy. Classically, the approach for laparotomy in small children is by right supraumbilical transverse incision[18] and in older children is by midline incision. However, the appendix is a RIF organ and the basic pathology in complicated appendicitis also resides in the same region. Both the above-mentioned incisions do not expose the RIF region sufficiently to handle the situation without any undue retraction. This undue retraction and lack of proper exposure often lead to undue handling of the already friable and inflamed tissues in the right iliac region, leading to further post-operative complications like faecal fistula[19,20] [Figure 9]. Classical right iliac incisions such as McBurney's, Rutherford Morrison and Lanz are simply too small to provide adequate exposure to deal with cases of complicated appendicitis. Furthermore, a few cases invariable require a diversion ileostomy, and if a midline incision has been used for exploration, another incision is required in the right iliac region to fashion the ileostomy which increases the operating time both during the initial surgery and also at the time of ileostomy closure. Furthermore, there are two scar over the abdominal wall following the stoma closure surgery.

To overcome the above-mentioned problems we have been using a right subumbilical transverse incision to deal with cases of established complicated appendicitis for the past 3 years with excellent outcomes and minimal complications. While using this approach, the exposure of the pathology in the right iliac region is very good and most of the times no or minimal retraction is required. As the entire area is exposed no force is required to bring the pathological tissue to the incision site and any undue mishandling of the friable tissue is prevented. Rather very slow and blunt dissection is used to release the adhesions and expose the appendix from the appendicular lump. Depending on the condition of the appendix and the location of perforation, further steps are taken as described in the material and methods. As no extra pressure is applied to the caecum or the terminal ileum, none of the patients in our study developed faecal fistula. Cases where there was any element of doubt about the integrity of the caecal wall, a diverting loop ileostomy was also done over the lateral aspect of the same subumbilical transverse incision[21,22] hence decreasing the operative time that would have been required otherwise. There was also no wound infection in any of the patients with ileostomies. We always keep the proximal limb of the ileostomy towards the lateral side and the distal limb

of the ileostomy toward the medial side to minimise the contamination of rest of the incision and prevent infection.

Moreover, patients presenting with features of generalised peritonitis were also be managed with this approach. On extending the incision for a few centimetres beyond the midline to the left side, the entire peritoneal cavity can be accessed for peritoneal lavage.

The average operative time in our study was 1 h 48 min which appears to be slightly more than what has been reported by other studies,[17,23] which could be attributed to more time spent in wound closure as interrupted sutures were used. The time spent in actual dissection was less due to excellent exposure of the structures. The average time was also prolonged as nine of our patients needed ileostomies. Had midline approach been used in these cases, the operative times would have been further increased due to the requirement of another incision for the creation of ileostomy.

The average hospital stay in our study was 9 days which is also more than what has been reported in other studies.[23] This is because we follow a protocol of giving bowel rest of 4–5 days to all patients who had features of peritonitis at the time of surgery, to allow ileus and bowel oedema to resolve before starting enteral nutrition. We look forward to decrease this duration in our subsequent cases.

There were no intra-abdominal abscess or faecal fistula in our patients as reported by other authors,[16,20,23] which again could be attributed to excellent exposure of RIF, the pelvis, the paracolic gutter and the subhepatic regions, as a result, all loculated collections could be dealt with easily without much tissue handling.

The advantage of this incision is more pronounced from the surgeon's perspective as very less effort is required for retraction and all efforts can be targeted to deal with the actual pathology without any mishandling of the involved structures.

The possible disadvantage of the incision is the presence of multiple scars over the anterior abdominal wall, in case the child needs another intra-abdominal surgery at a later date requiring a midline incision. Another disadvantage is the requirement of more time for wound closure when compared to McBurney's or midline incisions, but is compensated well with the time saved in the actual dissection.

Conclusion

Complicated appendicitis is a condition which lacks standardisation of approach for management, and is inherently associated with complications. With the help of this study, we are trying to convey that with a more logical incision and intra-operative approach we can keep the complications to a minimum and improve outcomes to great extent in those patients requiring open surgical intervention. In our study, we have used the subumbilical transverse incision in all sizes of patients ranging from small children to adolescents with excellent results, and we believe that the same approach can be applied even in adult patients in similar clinical scenarios.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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