In the presence of an appendicular mass, surgery is generally limited to the drainage of abscess. Scientific literature is sparse and controversial as to how the ongoing sepsis despite the drainage of appendicular abscess should be managed. Deliberate appendicectomy in the presence of mass formation is often not recommended as it may cause collateral damage to the adherent bowel loops. The authors describe a useful technique of doing appendicectomy by stripping the mucosa alone, leaving behind the adherent muscular cuff undisturbed. This technique is given an acronym “mucosa-coring salvage (MU-CO-SAL) appendicectomy.” This article is intended to draw the attention of pediatric surgeons to this useful technique, which remains underutilized despite being described almost a decade ago.

Keywords: Appendicectomy, appendicular mass, mucosa-coring salvage appendicectomy

Case Reports

Case 1
A 4-year-old male child presented with a history of pain in the right iliac fossa for 15 days. He had been treated by a general physician with oral antibiotics. Fever and vomiting which were present initially subsided after taking antibiotics. Limping gait due to right loin pain had been noticed for 10 days of admission. On examination, he was alert and afebrile. His abdomen was soft with normal bowel sounds. Appendicular mass could not be appreciated due to local guarding and tenderness in the right iliac fossa. Cope’s psoas sign was positive.

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Rectal examination did not reveal any para-rectal mass. Clinically, retrocecal appendicitis was suspected.

Ultrasonography confirmed an inflamed appendix complicated by heterogeneous mass formation and a retrocecal abscess of size 5 cm × 4 cm. On mini-laparotomy, thick, foul-smelling pus was drained. As the cecum and small bowel were densely adherent, inflamed, and friable, the appendicular mass was left undisturbed, and no attempt was made to visualize or excise the inflamed appendix. A corrugated flank drain was kept in the abscess cavity for continuous drainage. He was treated with intravenous antibiotics (cefotaxime, gentamicin, and metronidazole). However, he continued to suffer febrile spikes, recurrent episodes of vomiting, and prolonged paralytic ileus. Considering the possibilities of the ongoing inflammation of the appendix or adhesive obstruction, on the 5th postoperative day, a re-laparotomy was done through a wider incision.

Intraoperatively, the appendix was found to be perforated at 5 cm from the ceco-appendicular junction, while its distal portion had completely sloughed off. The perforated stump of the appendix was leaking fecal matter into the abscess cavity, thereby contributing to the ongoing sepsis. The stump was inseparably adherent to the friable edematous cecal wall [Figure 1]. It was realized that the ongoing sepsis cannot be controlled unless the leaking stump is fixed, and dissecting the appendicular stump would also be equally dangerous. In this scenario, drawing analogy from Lilly’s operation of choledochal cyst and Soave operation of Hirschsprung disease, we conceived mucosal appendicectomy on table and executed the same [Figure 2]. Following this, the boy recovered uneventfully.

**The technique**

Seromuscular layer of the visible portion of the adherent appendix is incised longitudinally using diathermy [Figure 1]. Once submucosal plane is reached, the mucosal tube is stripped off the muscular cuff by blunt dissection. Dissections are carried up to the cecum. The dissected mucosal tube is resected by ligating its base. The bivalved seromuscular cuff adherent to the cecal wall is left undisturbed. A drain is kept in situ before closing the abdominal wound.

**Case 2**

A 7-year-old female child presented with a history of fever for 15 days and abdomen pain for 3 days. She did not experience vomiting or nausea. She had been diagnosed with enteric fever and treated accordingly by a pediatrician. On examination, she was alert and afebrile. Right lower quadrant of the abdomen was tender, and a vague mass was palpable in the suprapubic area. Digital rectal examination revealed a cricket ball-sized mass in the right adnexa. Blood Widal test was negative. Ultrasonography revealed a pelvic abscess of size 7 cm × 4 cm with the tip of appendix embedded in it. Approaching the abscess through a Pfannenstiel incision was difficult due to dense adhesions of the overlying bowel loops. Meticulous release of the adherent bowel loops was necessary to reach the abscess cavity. About 100 ml of foul-smelling pus was drained. The cecum and appendix could be seen as a result of adhesiolysis. The distal half of the appendix had sloughed out, with the proximal half inseparably adherent to the cecal wall. Our experience with the previous case prompted us to do mucosal appendicectomy. Her postoperative recovery was uneventful.

**DISCUSSION**

Appendicitis is essentially a mucosal disease. Inflammation of muscular layer and serosa are secondary
to microbial invasion of the mucosa. Therefore, in adverse pathological anatomy, excision of the mucosal tube rather than the entire appendix is sufficient to contain the inflammation. Pediatric surgeons are familiar with the technique of mucosal stripping when complete excision is either impossible or inadvisable. For example, when an infected choledochal cyst is adherent to the portal vein, Lilly advised only mucosal stripping. High frequency of operative injury to adjacent pelvic structures during Swenson’s operation prompted Soave to strip rectal mucosa before doing endorectal pull through in Hirschsprung disease. Mucosal appendicectomy can be considered analogous to these operations.

Obviously, we are not the first to perform this operation, and the idea has also occurred independently to others. The technique was first mentioned in a case report by Rangarajan et al. in 2006. Subsequently, Nasher et al. and Zhu et al. reported additional cases. Large series were reported by Sebastian (49 patients in 2007) and Hannan (19 patients in 2012). Although these publications, many surgeons are not aware of this useful technique and hence, it remains underutilized.

Patients of Hannan and Nasher were of pediatric age group, whereas those of others were adults. Although the principle of operation was essentially the same, various authors differed in minor technical details and in the preferred nomenclature of the procedure. The operation had been done either by laparoscopy or by open surgery. Antegrade or retrograde stripping of the mucosa was another technical variation of the theme. Nasher et al. did mucosal stripping for half of the length of the appendix combining it with extra-serosal full-thickness excision for the remaining length of it. The procedure has been named variously as “subserosal,” “submucosal,” and “trans-mesoappendicular appendicectomy” by various authors. To avoid confusion, we propose an acronym MU-CO-SAL appendicectomy which stands for “mucosa-coring salvage appendicectomy.”

In adverse pathological anatomy, MU-CO-SAL appendicectomy appears to have several advantages as follows: (1) adherent appendix need not be separated from the friable cecum, thereby the risk of cecal perforation is averted; (2) the trouble of identifying appendicular artery, which is buried within adhesions, is circumvented by dissections in submucosal plane. Contrary to expectations, there was no undue bleeding during mucosal stripping. We hypothesize that this could be due to small-sized intramural vessels being occluded by inflammatory thrombosis or edema; (3) mucosal stripping is made technically easy by the inflammatory edema; (4) it avoids prolonged medical management of appendicular mass and the diagnostic uncertainties associated with it; and (5) it is versatile to be used either by laparoscopic or open approach. However, we would like to caution that this method should be used as a salvage technique rather than as a routine choice. Further experience is required before the safety and effectiveness of MU-CO-SAL appendicectomy is established.

Informed consent
Appropriate written informed consent was obtained from all patients.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for 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 identity, but anonymity cannot be guaranteed.

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Conflicts of interest
There are no conflicts of interest.

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