Treatment

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Non-operative management There are two scenarios in which patients with acute appendi citis may be considered for non-operative treatment. Uncomplicated appendicitis While surgery remains the standard teaching, there is evidence to support a trial of conservative management in patients Alfredo Alvarado , contemporary , surgeon, Plantation, FL, USA. Preoperative investigations in appendicitis /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF - /uni25CF /uni25CF /uni25CF -). A - , par - diag - - - - -

Routine Full blood count Urinalysis Selective Pregnancy test Urea and electrolytes C-reactive protein Supine abdominal radiograph Ultrasound of the abdomen/pelvis Contrast-enhanced abdomen and pelvic CT scan (consider low-dose protocol in young adults) TABLE 76.2 The Alvarado (MANTRELS) score. Score Symptoms M igratory

RIF pain 1 A norexia 1 N ausea and vomiting 1 Signs T enderness (RIF) 2 R ebound tenderness 1 E levated temperature 1 Laboratory L eukocytosis 2 S hift to left 1 Total 10 RIF , right iliac fossa. Figure 76.8 Ultrasound image of the right iliac fossa (RIF) demonstrat

ing a mildly enlarged appendix, measuring 8 mm in diameter, consis

tent with acute appendicitis in a 40-year-old man. Arrow indicates a small pocket of free /f_l uid more inferiorly in the RIF (courtesy of Dr D Byrne, Dublin, Ireland).

with uncomplicated (absence of appendicolith, perforation or abscess) appendicitis. Treatment is bowel rest and intra venous antibiotics, often metronidazole and a third-generation cephalosporin. The available data indicate initial successful outcomes in approximately 85% of pa tients; however, between one-quarter and one-third of patients initially treated conservatively will require surgery within 1 year for recurrent symptoms. Subsequent surgery , if needed, tends to be uncomplicated and the overall postoperative complication rate is similar when patients treated conservatively and later needing surgery are compared with those undergoing surgery at the outset. Overall hospital length of stay is also similar when comparing patients in each group. Thus, antibiotic treatment of acute uncomplicated appendicitis appears to be safe and it allows a large number of patients to

avoid invasive treatment; however, this information must be balanced by the high treatment failure rate and need for interval intervention. Conservative treatment may be considered in the well patient with limited signs or those with high operative risk (multiple comorbidities); the patients must be aware of the high failure rate. As with conservative treatment of an appendix Albert John Ochsner , 1858–1925, Professor of Clinical Surgery , The University of Illinois College of Medicine, Chicago, IL, USA. James Sherren , 1876–1945, surgeon, The London Hospital, London, UK. ensure that there is no underlying malignancy (see Neoplasms of the appendix and pseudomyxoma peritonei). In children, conservative treatment of uncomplicated appendicitis also appears to be safe in the short term with r es - olution of acute symptoms in approximately 90% of patients. Re-presentation with complicated appendicitis appears to be ver y rare; however, recurrent symptoms requiring sur gery have been reported in up to 46% of patients. Notably , histological features of acute appendicitis may be present in only one-fifth of patients needing interval surgery . Appendix mass If an appendix mass is present and the condition of the patient is satisfactory , the standard treatment is the conserva - tive Ochsner–Sherren regime. This strategy is based on the premise that the inflammatory process is already localised and that inadvertent surgery is di ffi cult and may be dangerous. It may be impossible to find the appendix and, occasionally , a faecal fistula may form. For these reasons, it is wise to observe a non-operative programme but to be prepared to operate should clinical deterioration occur. Summary box 76.6 Criteria for stopping conservative treatment of an appen - dix mass /uni25CF /uni25CF /uni25CF Careful recording of the patient’s condition and the extent of the mass should be made and the abdomen regularly re - examined. It is helpful to mark the limits of the mass on the abdominal wall using a skin pencil. A contrast-enhanced CT - examination of the abdomen should be performed and anti - biotic therapy instigated. An abscess, if pr esent, should be drained radiologically . Temperature and pulse rate should be recorded 4-hourly and a fluid balance record maintained. Clinical deterioration or evidence of peritonitis is an indication for early laparotom y . Clinical improvement is usually evident within 24–48 hours. Failure of the mass to resolve should raise suspicion of a carcinoma or Crohn’s disease. Using this regime, approximately 90% of cases resolve without incident. The need for interval appendicectomy in this cohort is much debated. The majority of patients will not develop recur - rent appendicitis; however, recently published studies have identified higher than expected rates of underlying appen - diceal neoplasm in those patients who do go on to interval appendicectomy , particularly those patients over the age of 40. A recent randomised clinical trial was termina ted early owing to the unexpected finding of appendiceal tumour during follow-up in 29% (12/41) of pa tients aged more than 40 /uni00A0 years who initially presented with periappendicular abscess. Low-grade appendiceal mucinous neoplasms (LAMNs)

Figure 76.9 Sagittal reformat of a computed tomography scan of the abdomen obtained with oral and

intravenous contrast, demonstrating an enlarged (10 mm), enhancing retrocaecal appendix with periappen diceal fat stranding. There is no evidence of necrosis, perforation or collection. No radiopaque appendicolith can be seen. Figure 76.6 refers to the same patient (courtesy of Professor P MacMahon, FRCR, Dublin, Ireland). A rising pulse rate Increasing or spreading abdominal pain

Increasing size of the mass

incidental appendix tumour in patients presenting with abscess appears to be much higher than in the general population undergoing appendicectomy , suggesting a di ff erent patho genesis in the former group. Careful consideration should be given to interval appendicectomy in this cohort of patients. At the very least, follow-up CT or magnetic r esonance imaging (MRI) should be performed to ensure complete resolution of findings and patients should undergo colonoscopy . Operative management General principles The traditional treatment for acute appendicitis is appendicec

tomy . While there should be no unnecessary delay , all patients, particularly those most at risk of serious morbidity , benefit by a short period of intensive preoperative preparation. Intravenous fluids, su ffi cient to establish adequa te urine output (catheterisa tion is needed only in the very ill), and appropriate antibiotics should be given. Risk factors for venous thromboembolism should be considered and appropriate prophylaxis (mechanical and/or phar macological) initiated. There is evidence that, in the absence of purulent peritonitis, a single perioperative dose of antibiotics reduces the incidence of postoperative wound infection. When peritonitis is suspected, therapeutic intravenous antibiotics to cover Gram-negative bacilli as well as anaerobic cocci should be given. Hyperpyrexia in children should be treated with salicylates in addition to antibiotics and intravenous fluids. With appropriate use of intravenous fluids and parenteral antibiotics, a policy of deferring appendicec tomy after midnight to the first case on the following morning does not increase morbidity . However, when acute obstructive appendicitis is recognised, operation should not be deferred longer than it takes to optimise the patient’s condition. Gridiron , a frame of crossbeams to support a ship during repairs. Lewis Linn McArthur , 1858–1934, surgeon, St. Luke’s Hospital, Chicago, IL, USA. James Rutherford Morison , 1853–1939, Professor of Surgery , Durham University , Durham, UK. Otto Lanz , 1865–1935, surgeon, Amsterdam, The Netherlands. anaesthetic with the patient supine on the operating table and may be undertaken using either an open or laparoscopic - approach. When the appropriate equipment and expertise are available and cost allows, the laparoscopic appr oach is advantageous. The initial laparoscopy allows the diagnosis to be established and may reduce the negative appendicectomy rate. Furthermore, the patient may benefit from the quicker recovery a ff orded by a minimally invasive approach, the rate of wound infection is lower (when compared with open sur - gery) and, contrary to initial concerns, the incidence of post - operative pelvic collection does not appear to be increased. When a laparoscopic technique is used, the bladder must - be empty (ensure that the patient has voided before leaving the ward). Prior to preparing the entire abdomen with an appropri - ate antise ptic solution, the right iliac fossa should be palpated for a mass. If a mass is felt, it may , on occasion, be preferable - to adopt a conservative approach. Draping of the abdomen is in accordance with the planned operative technique , taking account of any requirement to extend the incision or convert a laparoscopic technique to an open operation. Surgical technique: conventional appendicectomy When the preoperative diagnosis is considered reasonably certain, the incision that is widely used for appendicectomy is the so-called gridiron incision. The gridiron incision (described first by McArthur) is made at right angles to a line joining the anterior superior iliac spine to the umbilicus, its centre being along the line at McBurney’s point (Figure 76.10). If better - access is required, it is possible to convert the gridiron to a Rutherford Morison incision (see below) by cutting the internal oblique and transversus muscles in the line of the incision. In recent years, a transverse skin crease (Lanz) incision has become more popular, as the exposure is better and extension,

2 / 3 1 / 3 Figure 76.10 Gridiron incision for appendicitis, at right angles to a line joining the anterior superior iliac spine and umbilicus, centred on McBurney’s point (courtesy of Professor M Earley, FRCSI, Dublin, Ireland). Figure 76.11 Transverse or skin crease (Lanz) incision for appendicitis, 2 cm below the umbilicus, centred on the midclavicular–midinguinal line (courtesy of Professor M Earley, FRSCI, Dublin, Ireland).

the size and obesity of the patient, is made approximately 2 /uni00A0 cm below the umbilicus centred on the midclavicular–midinguinal line (Figure 76.11). When necessary , the incision may

be extended medially , with retraction or suitable division of the rectus abdominis muscle. When the diagnosis is in doubt, particularly in the presence of intestinal obstruction, a lower midline abdominal incision is to be preferred over a right lower paramedian incision. The lat ter, although widely practised in the past, is di ffi cult to extend, more di ffi cult to close and provides poorer access to the pelvis and peritoneal cavity . Rutherf ord Morison's incision is useful if the appendix is para- or retrocaecal and fixed. It is essentially an oblique muscle-cutting incision with its lower end over McBurney's point and extending obliquely upwards and laterally as neces sary . All layers are divided in the line of the incision. The caecum is identified by the presence of taeniae coli and, using a finger or a swab, the caecum is withdrawn. A turgid appendix may be felt at the base of the caecum. Inflammatory adhesions must be gently broken with a finger, which is then hooked around the appendix to deliver it into the wound. T William Wayne Babcock , 1876–1963, surgeon, Philadelphia, PA, USA. Sir William Arbuthnot Lane , 1856–1943, surgeon, Guy's Hospital, London, UK forceps applied in such a way as to encircle the appendix and yet not damage it. The base of the mesoappendix is clamped in artery forceps, divided and liga ted (Figure 76.12a). When the mesoappendix is broad, the procedure must be repeated with a second or, rarely , a third artery forceps. The appendix, now completely freed, is clamped with an artery forceps near its base and then ligated close to the junction with the caecum using an - absorbable 2/0 ligature. The appendix is amputated between the artery forceps and the ligature (Figure 76.12b). When the appendix is retrocaecal and adherent, it may be an advantage to divide the base first. The appendiceal vessels are then ligated and gentle traction on the caecum will enable the surgeon to deliver the body of the appendix, which is then removed from base to tip. Occasionally , this manoeuvre requires division of - the lateral peritoneal attachments of the caecum. An absorbable 2/0 or 3/0 purse-string or 'Z' suture may then be inserted into the caecum about 1.25 /uni00A0 cm from the base (Figure 76.12c). The stitch should pass thr ough the muscle coat, picking up the taeniae coli. The stump of the appendix is invaginated (Figure 76.12d) while the purse-string or 'Z' he suture is tied, thus burying the appendix stump.

(a) (c) Figure 76.12 Appendicectomy. (a) The mesoappendix divided between artery forceps and ligated. about to be divided. (c) 'Z' suture inserted prior to inversion of the appendiceal stump. been tied. (b) (d) (b) The appendix is ligated at its base and (d) The appendiceal stump inverted, the 'Z' suture having

suture is in danger of cutting out. If the oedema is of lim ited extent, this can be overcome by inserting the purse-string suture into more healthy caecal wall at a greater distance from the base of the appendix. Occasions may arise when, because of the extensive oedema of the caecal wall, it is better not to attempt invagination. Many surgeons believe invagination of the appendiceal stump is unnecessary . Should the base of the appendix be gangrenous, ligation should not be attempted. Two stitches are placed through the caecal wall close to the base of the gangrenous appendix, which is amputated flush with the caecal wall, after which these stitches are tied. Further closure is e ff ected by means of a sec ond layer of interrupted seromuscular sutures. An alternative but more costly option when the appendix base is compro mised is to resect the appendix with a cu ff of healthy caecum using a sing le firing of a linear stapling device. Surgical technique: laparoscopic appendicectomy The most valuable aspect of laparoscopy in the management of suspected appendicitis is as a diagnostic tool, particularly in women of childbearing age. The placement of operating ports may vary according to operator preference and previous abdominal scars. Typically , a pneumoperitoneum is established using an open infraumbilical approach. This umbilical port

serves as the camera port with two working ports inserted under direct vision, the first suprapubically and the second in the left lower quadrant. A moderate Trendelenburg tilt with elevation of the right side of the operating table improves exposure and assists delivery of loops of small bowel from the pelvis. The appendix is found in the conventional manner by identification of the caecal taeniae and is controlled using a laparoscopic tissue-holding forceps. Occasionally , it is necessary to divide the peritoneal attachments and mobilise the caecum in order to adequately expose the appendix. By elevating the appendix, the mesoappendix is then displayed. A dissecting forceps, hook or scissors diathermy is used to dissect the mesoappendix (Figure 76.13a) and expose the appendicular vessels, which may be coagulated or ligated using a clip applicator (Figure 76.13b). The appendix, free of its mesentery , can be ligated at its base with an absorbable loop ligature (Figure 76.13c linear stapling device, divided (Figure 76.13d) and removed in a specimen bag through one of the operating ports. It is not usual to invert the stump of the appendix. Absorbable sutures are used to close the fascia at the umbilicus and at any port sites greater than 5 /uni00A0 mm, and the small skin incisions may be closed with subcuticular sutures. Problems encountered during appendicectomy The finding of a normal appendix demands careful exclusion of other possible diagnoses, particularly terminal ileitis, Meck el’s diverticulitis and tubal or ovarian causes in women. It is usual to remove the appendix to avoid future diagnostic di ffi culties, even though the appendix is macroscopically normal, particularly if a skin crease or gridiron incision has been /uni00A0 Friedrich Trendelenburg , 1844–1924, Professor of Surgery successively at Rostock (1875–1882), Bonn (1882–1895), Leipzig (1895–1911), Germany . The Tren delenburg position was first described in 1885. - appendix seen at diagnostic laparoscopy , although approxi - mately one-quarter of seemingly normal appendices show microscopic evidence of inflammation. If the appendix cannot be found, the caecum should be mobilised and the taeniae coli should be traced to their conflu - ence on the caecum before the diagnosis of ‘absent appendix’ is made. If an appendix mass is found at operation, particularly at laparoscopy , it may be safer to abandon the procedure rather than risk bowel injury during attempted mobilisation. Any abscess should be drained, intra venous antibiotics administered - and the patient carefully monitored during the postoperative period. V ery rarely in the face of a frankly necrotic appendix, - a caecectomy or partial right hemicolectomy is required. Occasionally , a patient undergoing surgery for acute appendicitis is found to have concomitant Crohn’s disease of the ileocaecal region. Providing that the caecal wall is healthy at the base of the appendix, appendicectomy can be per - formed without increasing the risk of an enterocutaneous fis - tula. Rarely , the appendix is involved with the Crohn’s disease. In this situation, a conservative approach may be warranted; a trial of intravenous corticosteroids and systemic antibiotics can be used to resolve the acute inflammatory process . Treatment

Patients with PMP should be referred to a specialist centre with multidisciplinary expertise in the assessment and management of patients with peritoneal malignancy . The accepted treatment is CRS combined with HIPEC (Sugarbaker). This approach combines multiple peritonectomy procedures with multivisceral resections as required to achieve a complete surgical clearance of the tumour (complete cytoreduction), which is augmented by HIPEC (typically mitomycin C or oxaliplatin) to eradicate presumed residual microscopic disease (Figure 76.19). The combined operation can take in excess of 10 hours and may require total abdominopelvic peritonectomy , greater and lesser Paul H Sugarbaker , contemporary , surgeon, Washington DC, USA. Brendan J Moran , contemporary , surgeon, Basingstoke, UK. cholecystectomy , splenectomy , partial gastrectomy , colectomy and anterior resection of the rectum. The largest re ported CRS/HIPEC for

PMP comes from Basingstoke, UK series of (Moran). In their experience involving more than 1000 patients, a complete cytoreduction was achieved in approximately 75% of patients, with the remainder undergoing maximal tumour debulking. Although a potentially morbid procedure, in experienced centres the operative mortality rate following CRS/HIPEC is less than 2% with major postoperative morbidity in 15% of patients. Appropriate patient selection is critical and patients must have a su ffi cient performance status and be without major comorbidity in order to withstand the surgery . Preoperative evaluation, including nutritional assessment and optimisation, is paramount. Following a complete cytoreduction 5- and 10-year survival rates of 87% and 70%, respectively , can be achieved. Poorer outcomes are seen in males, patients with elevated tumour marker s and following resection of tumour showing high- grade or invasive features. Follow-up typically comprises at least annual clinical evaluation, monitoring of tumour markers and CT scan. Surveillance should be continued for at least 10 years as late recurrence is documented. Systemic chemotherapy may be considered as first-line treatment in patients with high-grade or invasive unresectable disease or in the adjuvant setting following CRS/HIPEC, ag ain in patients with high-grade tumour. Chemotherapy is not typically considered in patients with low-grade PMP .

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