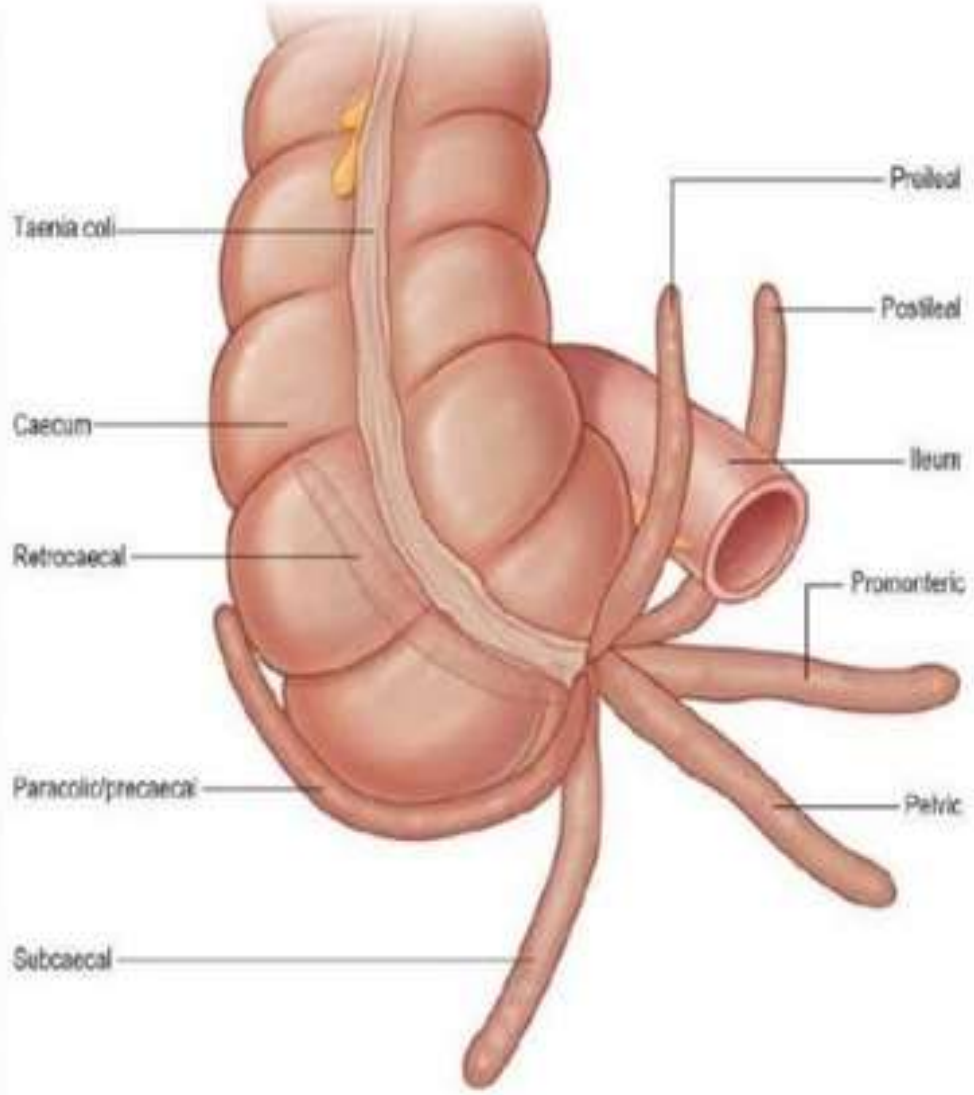
Diseases of the appendix

- **Anatomy: the vermiform appendix is present only in humans, certain anthropoid apes and wombat. It is blind muscular tube with mucosal, submucosal , muscular and serosal layers. Morphologically , it is underdeveloped distal end of the large cecum found in many lower animals.**

- **At birth, the appendix is short and broad at its junction with the cecum, but differential growth of the cecum produces the typical tubular structure by about the age of two years.**

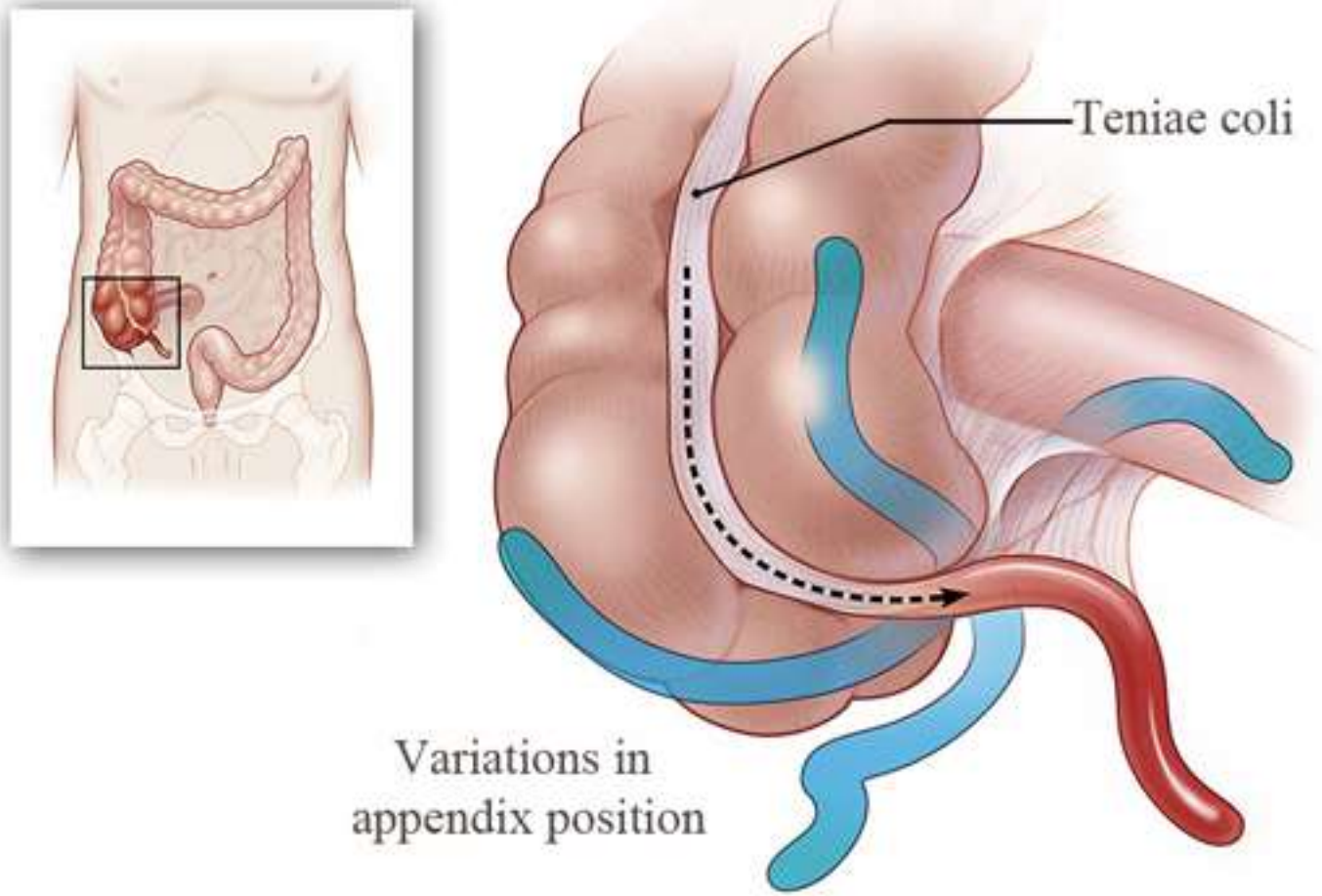
- **During childhood , continued growth of the cecum commonly rotates the appendix into a retrocecal but intraperitonial position, in approximately one quarter of cases rotation of the appendix does not occur resulting in pelvic, subcecal, or paracecal position. Occasionally the or tip of the appendix becomes extraperitoneal lying behind the cecum or ascending colon . rarely the cecum does not migrate during development to its normal position in the right lower quadrant of the abdomen.**



Variasi anatomi posisi appendix:

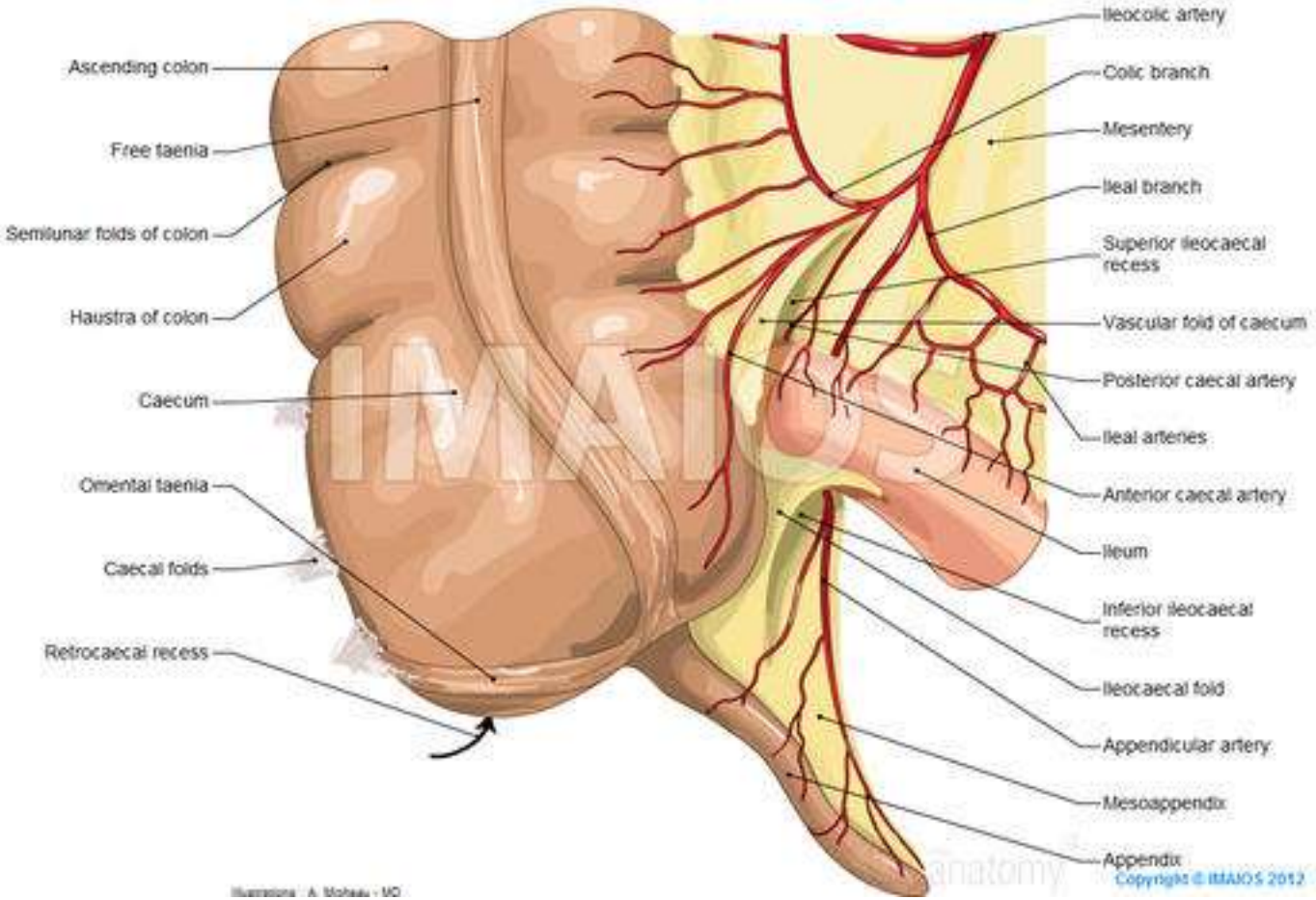
(1) Preilieal
(2) Postilieal
(3) Promontoric
(4) Pelvic
(5) Subcecal
(6) Paracolic or Prececal
(7) Retrocaecal or Retrocolic (paling sering)

Gray's anatomy ed 40th


Teniae coli
Variations in
appendix position

- **In these circumstances the appendix can be found near the gall bladder (subhepatic) or in the case of intestinal rotation , in the left iliac fossa, causing diagnostic difficulty if appendicitis develops. the position of the base of the appendix is constant, being found at the confluence of the three taeniae coli of the cecum, which fuse to form the outer longitudinal muscle coat of the appendix. at operation, use can be made of this to find an elusive appendix, as gentle traction on the taeniae coli, particularly the anterior taenia, will lead the operator to the base of the appendix.**

- **The mesentery of the appendix or mesoappendix arise from the lower surface of the mesentery or the terminal ileum and is itself subject to great variation. Sometimes as much as the distal one third ofb the appendix is bereft of mesoappendix. Especially in the childhood, the mesoappendix is so transparent that the contained blood vessels can be seen . in many adults, it becomes laden with fat, which obscures these vessels.**


Ileocolic artery
Ascending colon
Colic branch
Free taenia
Mesentery
Ileal branch
Semilunar folds of colon
Superior ileocaecal recess
Haustra of colon
Vascular fold of caecum
Posterior caecal artery
Caecum
Ileal arteries
Omental taenia
Anterior caecal artery
Ileum
Caecal folds
Inferior ileocaecal recess
Retrocaecal recess
Ileocaecal fold
Appendicular artery
Mesoappendix
Appendix
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- **The appendicular artery , a branch of the lower division of the ileocolic artery , passes behind the terminal ileum to enter the mesoappendix a short distance from the base of the appendix. It then comes to lie in the free border of the mesoappendix. An accessory appendicular artery may be present but in most people the appendicular artery is an end artery, thrombosis of which results in necrosis of the appendix as in gangreneous appendicitis. Four, six of more lymphatic channels traverse the mesoappendix to empty into the ileocecal lymph nodes.**

- **Microscopic anatomy: the length of appendix vary between average 7.5 cm and 10 cm. the lumen is irregular folded of mucus membrane lined by columnar cell intestinal mucosa of colonic type. Crypts are present but are not numerous. In the base of the crypts lies argentaffin cells (kulchitsky cells), which may give rise to carcinoid tumor. The submucosa contains numerous lymphatic aggregation or follicle but of no change in immune system following appendicectomy, and it explain the frequency of acute appendicitis in young adults.**

- **Acute appendicitis: it is the most common surgical emergency in the world, and its incidence is increased in the first half of this century specially in Europe , America and Australia with up to 16% of the population undergoing appendicectomy. It is relatively rare in infants and becomes increasingly common in childhood and early adult life reaching peak incidence in the teens and early 20s.**

- **after middle age the risk of developing the disease is quite small. The incidence is equal in male and female before puberty. In teenagers and young adults the ratio male to female is increase to 3:2 at age of 25, thereafter the incidence in male declines.**

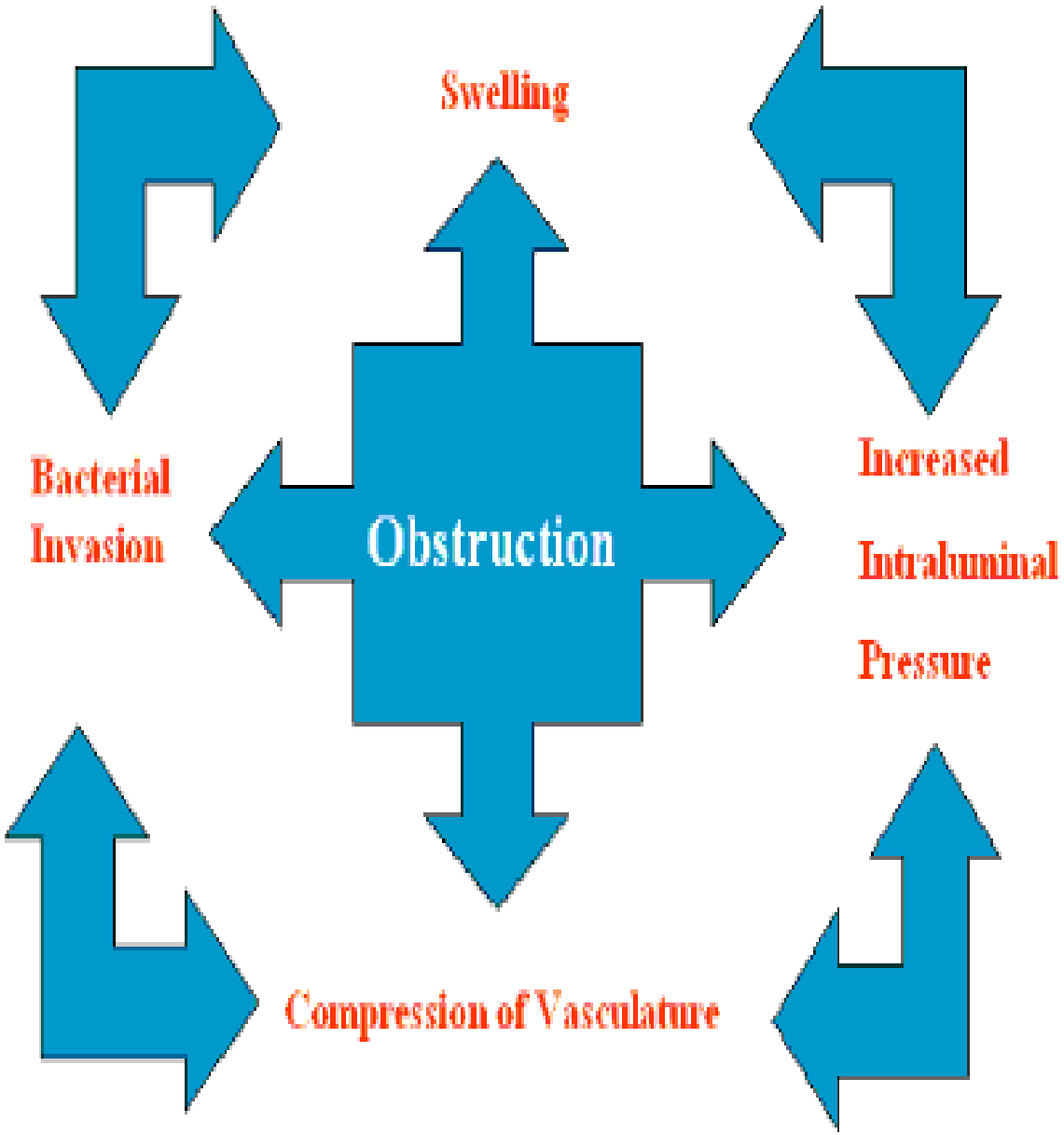
- **Aetiology: no specific cause for acute appendicitis but there are a lot of factors are responsible, as low fiber diet and high refined carbohydrates may share in etiology. The incidence is decreased in western countries due to good hygiene and change in the pattern of gastrointestinal infection in childhood related to increase in use of antibiotics may be responsible.**

- **Appendicitis is usually associated with bacterial proliferation with in the appendix , no single organism is responsible , mixed growth of aerobic and anaerobic organisms is usual.**

- **The initiating point for proliferation of bacteria is controversial. Obstruction of the appendix lumen has been widely held to be important, and some form of luminal obstruction either by fecolith or stricture is found in majority of cases. A fecolith is composed of inspissated fecal material , calcium phosphate, bacteria and epithelial debris, rarely foreign body is incorporated into the mass. A presence of a fecolith is a relative indication for prophylactic appendicectomy**


Fecalith
obstructing lumen
Inflammation

Cyclic Changes Cause Appendicitis



- **. A fibrotic stricture of the appendix is usually indicate previous appendicitis that resolved without surgical intervention. Obstruction of appendicular orifice by tumors particularly carcinoma of cecum is an occasional cause of appendicitis in middle age or elderly patients. Intestinal parasites particularly Oxyuris vermicularis pin worm can proliferate in the appendix and occlude the lumen**


ATLAS
ATLAS

- **Pathology: obstruction of the lumen seems to be essential for development of appendicecal gangrene and perforation . yet, in many cases of early appendicitis, the appendix lumen is patent despite the presence of mucosal inflammation and lymphoid hyperplasia. Viral infection can occurs in children with seasonal variation more cases between May and August in north Europe than other times of the year.**

- **Lymphoid hyperplasia narrows the lumen of the appendix leading to luminal obstruction , once obstruction occurs continued mucus secretion and inflammatory exudate increase intraluminal pressure obstructing lymphatic drainage . edema and mucosal ulceration develop with bacteria translocation to submucosa. Resolution at this point may occur either spontaneously or in response to antibiotics therapy.**

- **. If the condition progresses further distension of the appendix may cause venous obstruction and ischemia of the appendicular wall. With ischemia, bacterial invasion occurs through the muscularis properia and submucosa producing acute appendicitis, with free contamination to peritoneal cavity..**

- **Alternatively, the greater omentum and loops of small bowels becomes adherent to the inflamed appendix , walling off the spread of peritoneal contamination and resulting in a phlegmonous mass or paracecal abscess. Rarely appendicecal inflammation resolves , leaving a distended mucus-filled organ termed a mucocele of the appendix**

- **Peritonitis is a bad complication of acute appendicitis and to be as result of free migration of bacteria through an ischemic appendicular wall or from frank perforation or gangrenous appendix or from delayed perforation of appendicular abscess.**

- **Factors that may play a role in perforation and peritonitis are extremes of age, immunosuppression, diabetes and fecolith obstruction of the appendix lumen, a free-lying pelvic appendix and previous abdominal surgery that limits the ability of the greater omentum to wall off the spread of peritoneal contamination. At this case a rapid deteriorating clinical course is accompanied by signs of diffuse peritonitis and systemic sepsis syndrome called septic shock.**

- **clinical diagnosis:**
- **history: the classic features of acute appendicitis begin with poorly localized colicky abdominal pain. This is due to mid gut visceral discomfort in response to appendicecal inflammation and obstruction. The pain is frequently first noticed in the periumbilical region and is similar to, but less intense than, the colic of small intestine obstruction.**

- **Central abdominal pain is associated with anorexia, nausea and usually one or two episodes of vomiting that follow the onset of pain. Anorexia is a useful a d constant clinical feature , particularly in children. The patient often gives a history of similar discomfort that settled spontaneously.**

- **A family history is also useful as up to one third of children with appendicitis have a first degree relative with a similar history. With the progressive inflammation of the appendix , the parietal peritoneum in the right iliac fossa becomes irritated, producing more intense , constant and localized somatic pain that begins to predominate. Patients often report this as an abdominal pain that has shifted and changed in character.**

- **Typically, coughing or sudden movement exacerbates the right iliac fossa pain. The classic visceral-somatic sequence of pain is present in only about half of those patients subsequently proven to have acute appendicitis**

- **Atypical presentations include pain that is predominately somatic or visceral and poorly localized. Atypical pain is more common in the elderly , in whom localization to the right iliac fossa is unusual. An inflamed appendix in the pelvis may never produce somatic pain involving the anterior abdominal wall , but may instead cause suprapubic discomfort and tenesmus.**

- **In this circumstances, tenderness may be elicited only on rectal examination and is the basis for the recommendation that a rectal examination should be performed on every patient who presents with acute lower abdominal pain.**

- **During the first 6 hours , there is rarely any alteration in temperature or pulse rate. After that time, slight pyrexia (37.2-37.7) with a corresponding increase in the pulse rate to 80 or 90 is usual. However, in 20% of patients, there is no pyrexia or tachycardia in the early stages.**

- **In children, a temperature greater than 38.5c suggests other causes, e.g. mesenteric adenitis. Typically, two clinical syndromes of acute appendicitis can be discerned, acute catarrhal (non obstructive) appendicitis and acute obstructive appendicitis.**

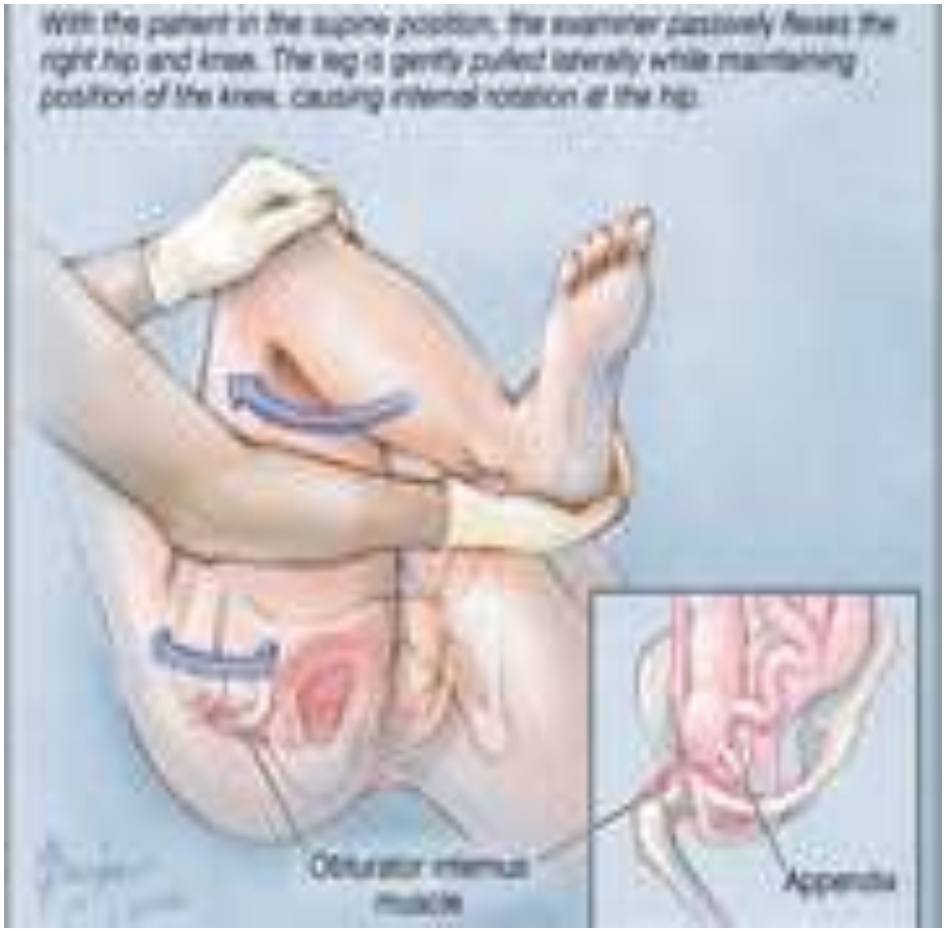
- **The latter is characterized by a much more acute course. The onset of symptoms is abrupt, and there may be generalized abdominal pain from the start. The temperature may be normal and vomiting is common, so that the clinical picture may mimic acute intestinal obstruction. Once recognized, urgent surgical intervention is required because of the more rapid progression to perforation.**

- **Signs: the diagnosis of appendicitis rests more on thorough clinical examination of the abdomen than on any aspect of the history or laboratory investigations, the cardinal features are those of an unwell patient with low grade pyrexia, localized abdominal tenderness, muscle guarding and rebound tenderness.**

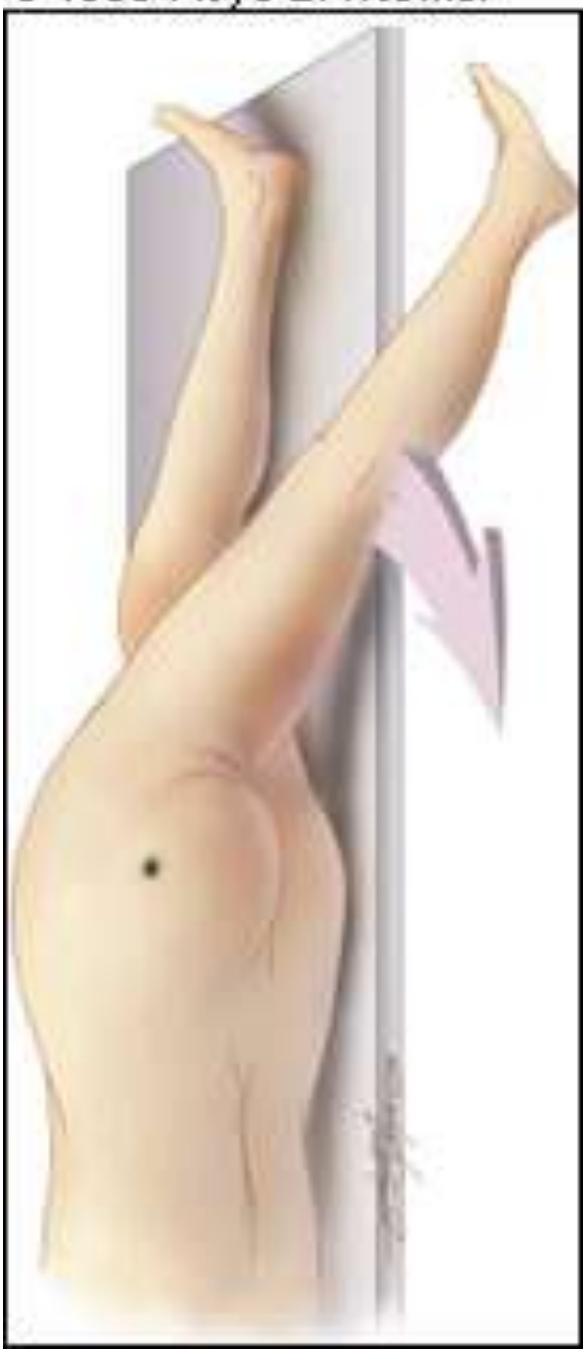
- **Inspection of the abdomen may show limitation of respiratory movement in the lower abdomen. The patient is then asked to where the pain began and where it moved (pointing sign). Gentle superficial palpation of the abdomen , beginning in the left iliac fossa moving anticlockwise to right iliac fossa will detect muscle guarding over the point of maximum tenderness, classically Mc Burney's point. Asking the patient to cough or gentle percussion over the site of maximum tenderness will elicit rebound tenderness.**

- **Deep palpation in the left iliac fossa may cause pain in the right iliac fossa called Rovsing's sign which helpful in supporting a clinical diagnosis of appendicitis. Occasionally, an inflamed appendix lies on the psoas muscle, and the patient, often a young adult will lie with the right hip flexed for pain relief called psoas sign.**

- **Spasm of the obturator internus is sometimes demonstrable when the hip is flexed and internally rotated. If an inflamed appendix is in contact with obturator internus , the manoveoure will cause pain in the hypogastrium called obturator sign or Zachary Cope. Cutaneous hyperesthesia may be demonstrable in the right iliac fossa, but is rarely of diagnostic value.**
- Straight leg raising sign (digital pressure over tender spot , elevation of right leg may cause increase in pain)


With the patient in the supine position, the examiner passively flexes the right hip and knee. The leg is gently pulled laterally while maintaining position of the knee, causing internal rotation at the hip.
Obturator internus muscle
Appendix


Left lateral
decubitus position
Psoas muscle
Examiner extends the patient's
right leg at the hip.
Appendix



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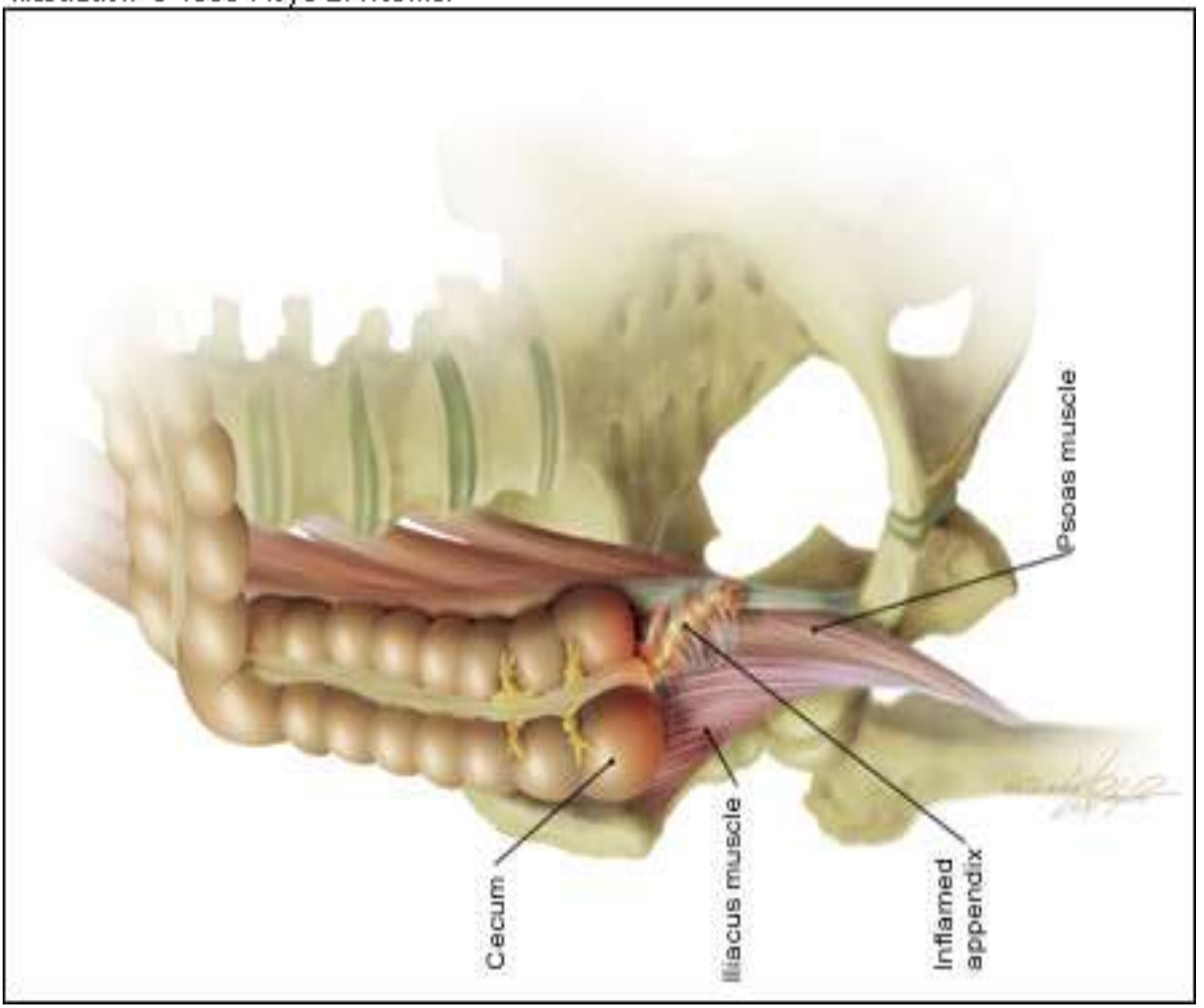
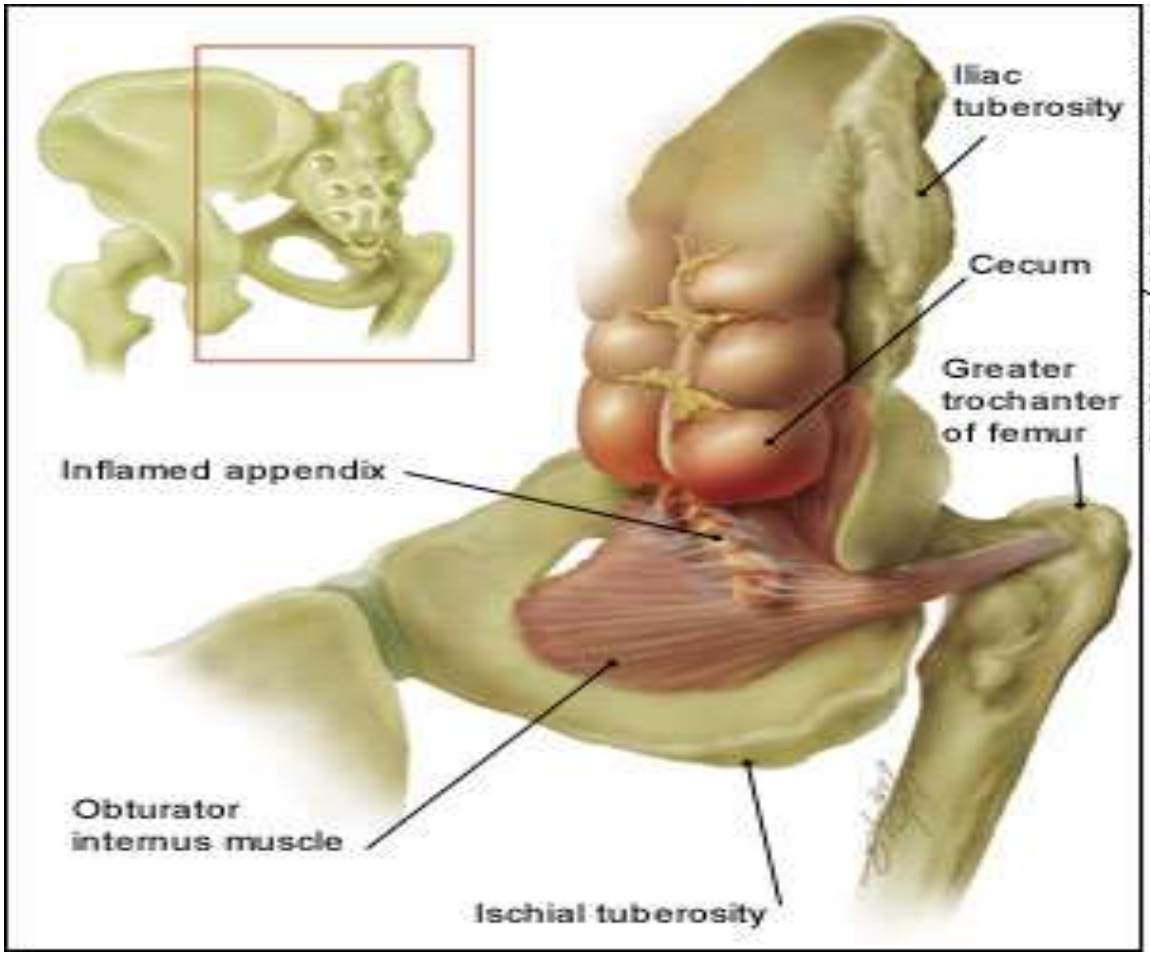





A
B
C
D

- **Special features according to position of the appendix**
- **Retrocecal: called silent appendicitis , rigidity is often absent and even application of deep pressure may fail to elicit tenderness, the reason being that the cecum ,distended with gas, prevents the pressure exerted by the hand from reaching the inflamed structure. psoas sign is positive.**

- **Pelvic: diarrhea can be result when the inflamed appendix be in contact with the rectum, when the appendix is entirely within the pelvis there is complete absence of abdominal rigidity and also absence of tenderness over Mc Burney's point. In some cases there is tenderness above and to the right of pubic symphysis.**

- **Rectal examination should be done reveals tenderness at rectovesical pouch in male or pouch of Douglas (rectouterine pouch) . psoas and obturator signs are positive. If the inflamed appendix is present in contact with bladder, patient may has frequency of micturition due to irritation of the bladder.**

- **Postilial: when the inflamed appendix lies behind the terminal ileum, pain may not shift and patient develop diarrhea.**
- **Special features according to age: in infant acute appendicitis is rarely before 36 months of age so it is difficult to diagnose and will be delayed so perforation might occurs and diffuse peritonitis will soon be present because of the underdeveloped greater omentum which is unable to give much assistance in localizing the infection.**

- **The elderly: gangrene and perforation occur more frequently in elderly patients. Elderly patients with lax abdominal wall or obesity may harbor a gangrenous appendix with little evidence of it and the picture may simulate sub acute intestinal obstruction. These features coupled with coincident medical conditions produce a much higher mortality for acute appendicitis in the elderly.**

- **The obese: obesity can obscure and diminish all the local signs of acute appendicitis. Delay in diagnosis coupled with technical difficulties of operating in obese makes it wiser to operate through a midline abdominal incision. Laparoscopy is particularly useful in the obese as it may obviate the need for a large abdominal incision.**

- **Pregnancy: appendicitis is the commonest extra uterine acute abdominal condition in pregnancy with a frequency of 1:1500-2000 pregnancies. Diagnosis is complicated by delay in presentation as early non specific symptoms are often attributed to the pregnancy. Usually the cecum and appendix are progressively pushed to the right upper quadrants the pregnancy develops during the second or third trimesters.**

- **However pain at right lower quadrant of abdomen remains the cardinal feature of appendicitis in pregnancy. Fetal loss occurs in 3-5% of cases, increasing to 20% if perforation Is found at operation.**

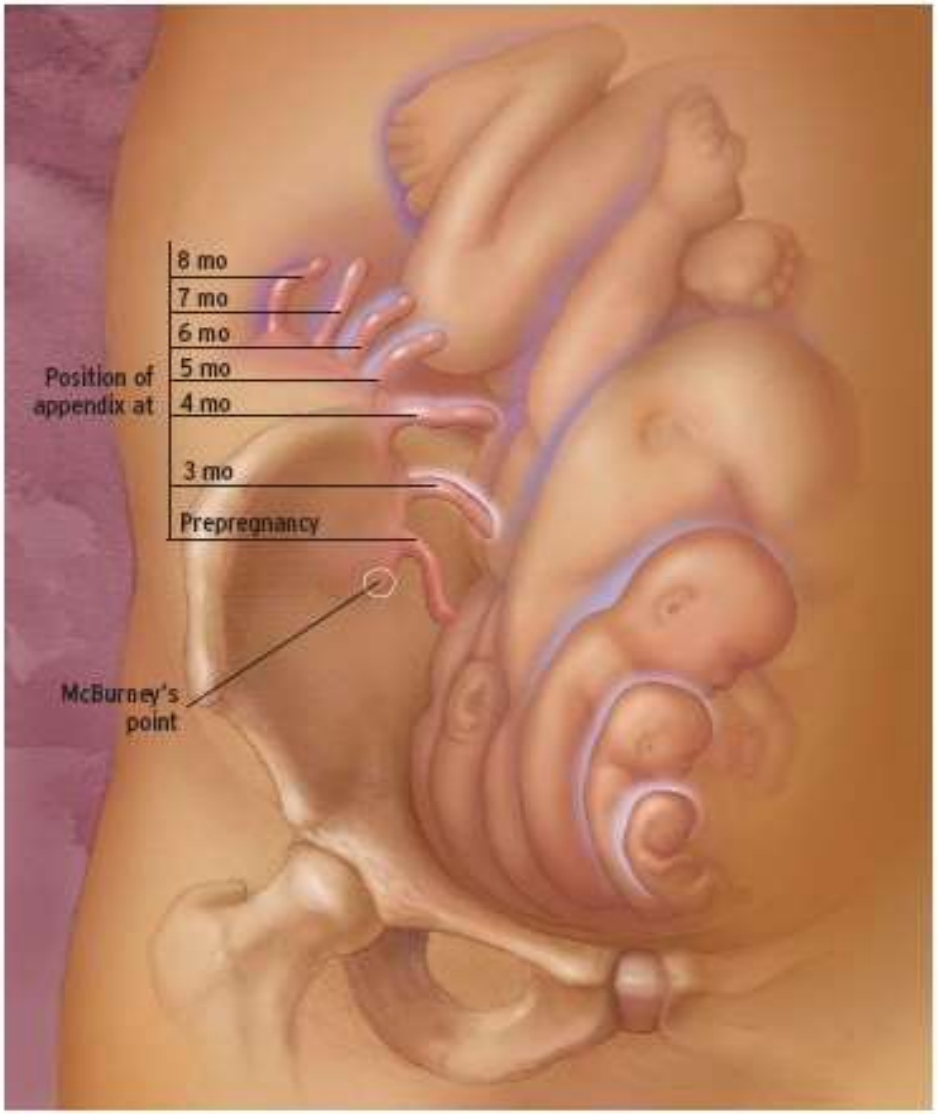


FIGURE The growing uterus progressively displaces the appendix in a counterclockwise rotation out of the pelvis into the right upper quadrant.

- **Differential diagnosis:**
- **In children: gastroenteritis, mesenteric adenitis, Meckle's diverticulitis, intussusception, Henoch-Scholen purpura, lobar pneumonia.**
- **In adult: regional enteritis, ureteric colic, perforated peptic ulcer, torsion of the testis, pancreatitis, rectus sheath hematoma.**
- **Adult female: Mittelsschmerz, pelvic inflammatory disease, pyelonephritis, ectopic pregnancy, torsion or rupture of ovarian cyst, endometeritis.**
- **Elderly: diverticulitis, intestinal obstruction, colonic carcinoma, torsion appendix epiploicae, mesenteric infarction, leaking aortic aneurysm.**

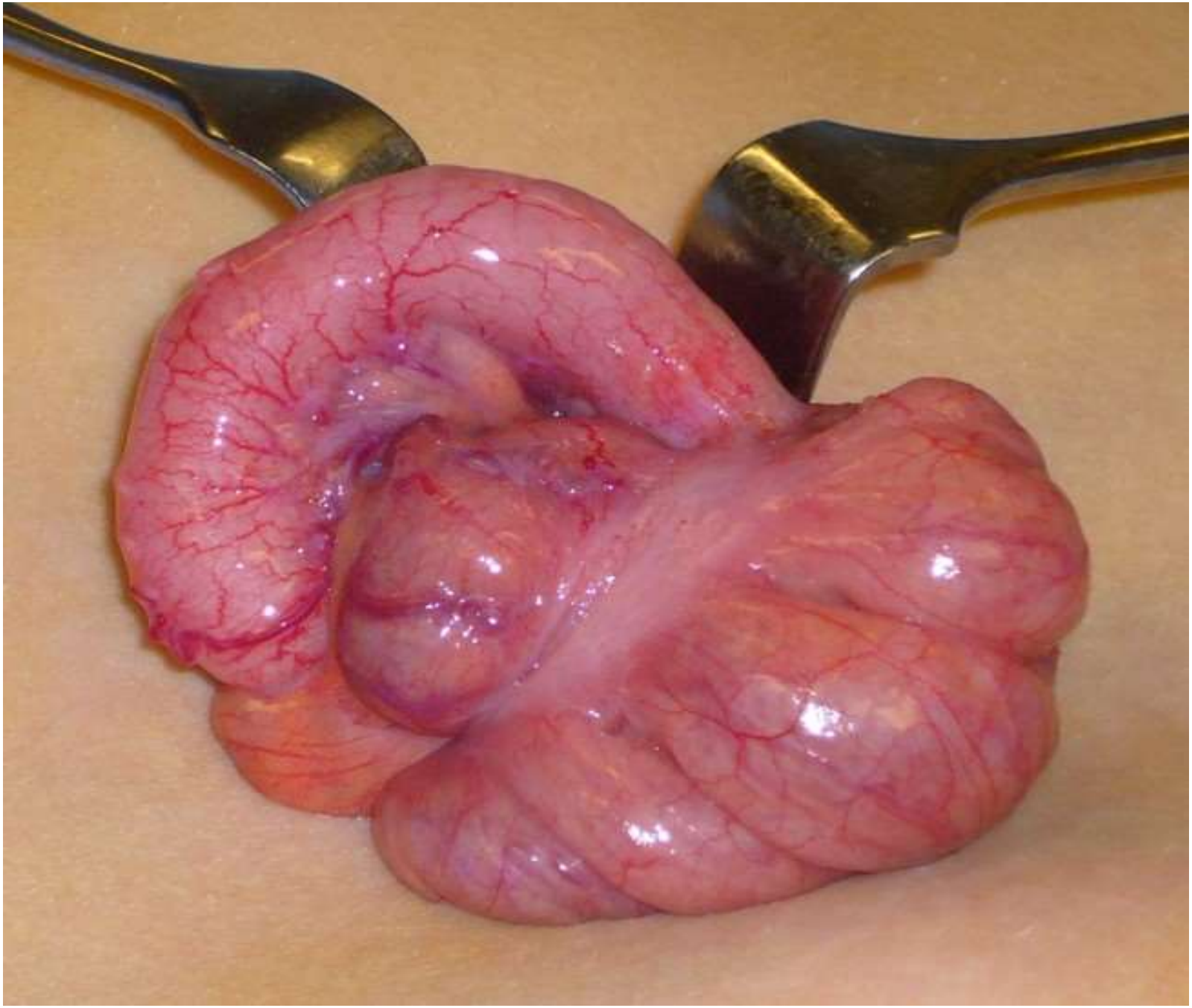
- **Investigations: the diagnosis of acute appendicitis is essentially clinical. However a decision to operate based on clinical suspicion alone can lead to the removal of a normal appendix in 15-30% of cases. To say it is better to remove a normal appendix than to delay diagnosis is not always fit specially in elderly patient. A number of clinical and laboratory based scoring systems have been devised to assist diagnosis. The most widely used is the Alvarado score . a score of 7 or more is strongly predictive of acute appendicitis.**

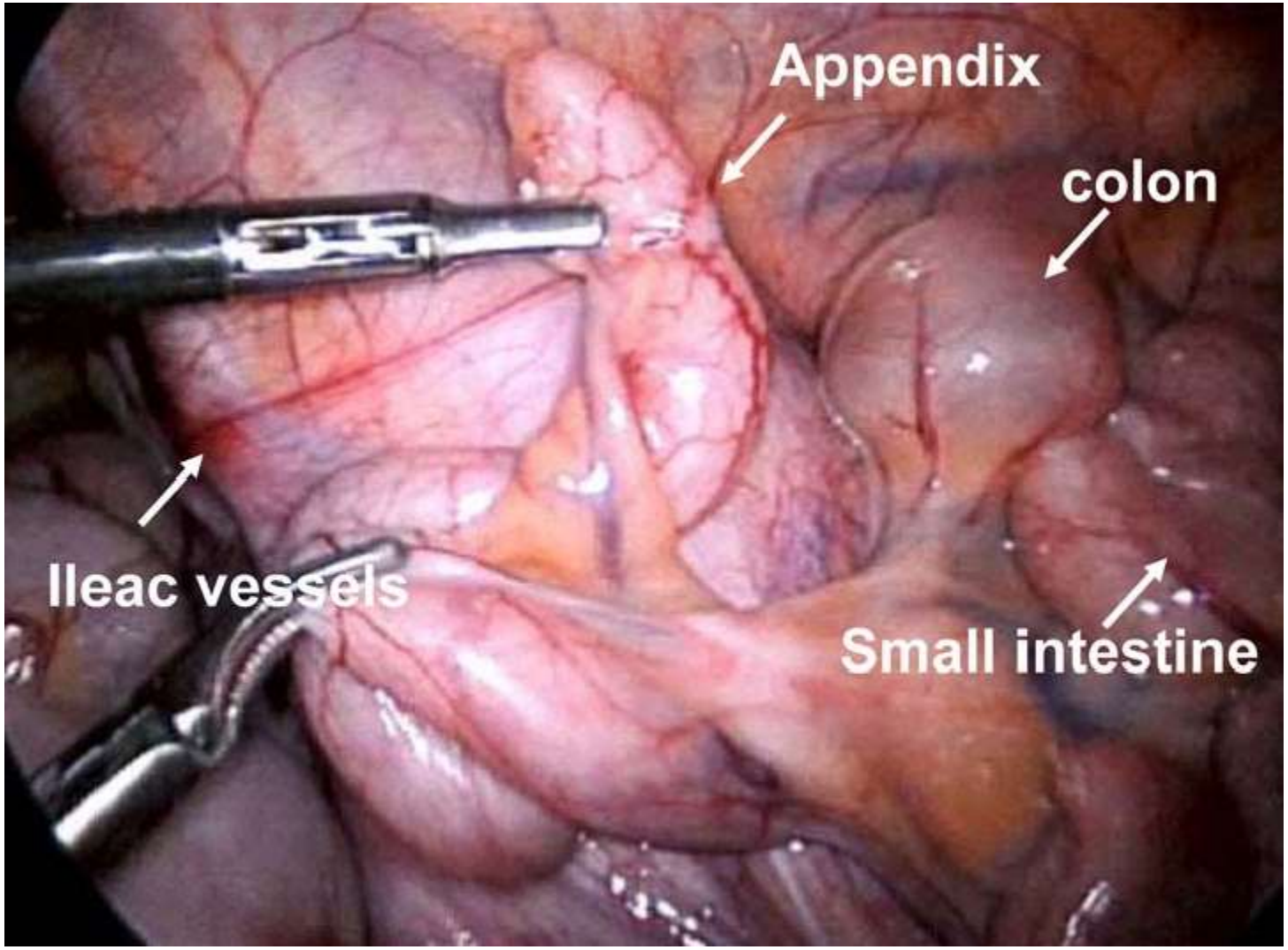
Symptoms	score
Migratory right iliac fossa	1
Anorexia	1
Nausea and vomiting	1
Signs	
Tenderness	2
Rebound tenderness	1
Elevated temperature	1
Laboratory	
Leukocytosis	2
Shift to left	1
Total	10

- **In patients with an equivocal score (5-6), abdominal ultrasound or CT scan further reduce the rate of –ve appendicectomy. Ultrasound is useful in cases of gynecological problems, and CT scan useful in elderly as has diverticulitis ,neoplasm, or intestinal obstruction.**
- **So full blood count, general urine examination, ultrasound, CT scan, urea, electrolyte all might be needed.**

- **Treatment: the treatment of acute appendicitis is appendicectomy. Urgent operation is essential to prevent the increased morbidity and mortality of peritonitis. It should no delay to operation and I.V fluids should be given and I.V antibiotics. Single injection of antibiotics reduce postoperative wound infection. The operation is done under general anesthesia by conventional (open) or laparoscopic.**

- **The patient should be examined for any presence of mass at right iliac fossa and operation may postponed for conservative treatment. The incision called grid-iron incision which is perpendicular on Mc Burney point which is in line joining between lateral one third with medial two third from umbilicus and anterior superior iliac spine.**




Appendix
colon
Ileac vessels
Small intestine

- **PROBLEMS ENCONTERED DURING APPENDICECTOMY**
- **-If normal appendix is found, this needs careful exclusion of other causes, ex terminal ileitis, Mickel's diverticulitis, tubo-ovarian diseases in women. It's usual to remove appendix to avoid future diagnostic difficulties even although the appendix is macroscopically normal, particularly if a skin crease or gridiron incision has been made.**

- **-If appendix can't be found, caecum should be mobilized & taenia coli should be traced to their confluence before the DX of "absent appendix" is made.**
- **-If appendix tumor is found, small tumor less than 2 cm can be removed by appendicectomy. Larger tumor should be treated by Right hemicoloectomy.**
- **-If appendix abscess is found& appendix can't be removed easily, local peritoneal toilet, drainage of abscess & IV antibiotic. Rarely caecectomy or Right hemicoloectomy is required.**

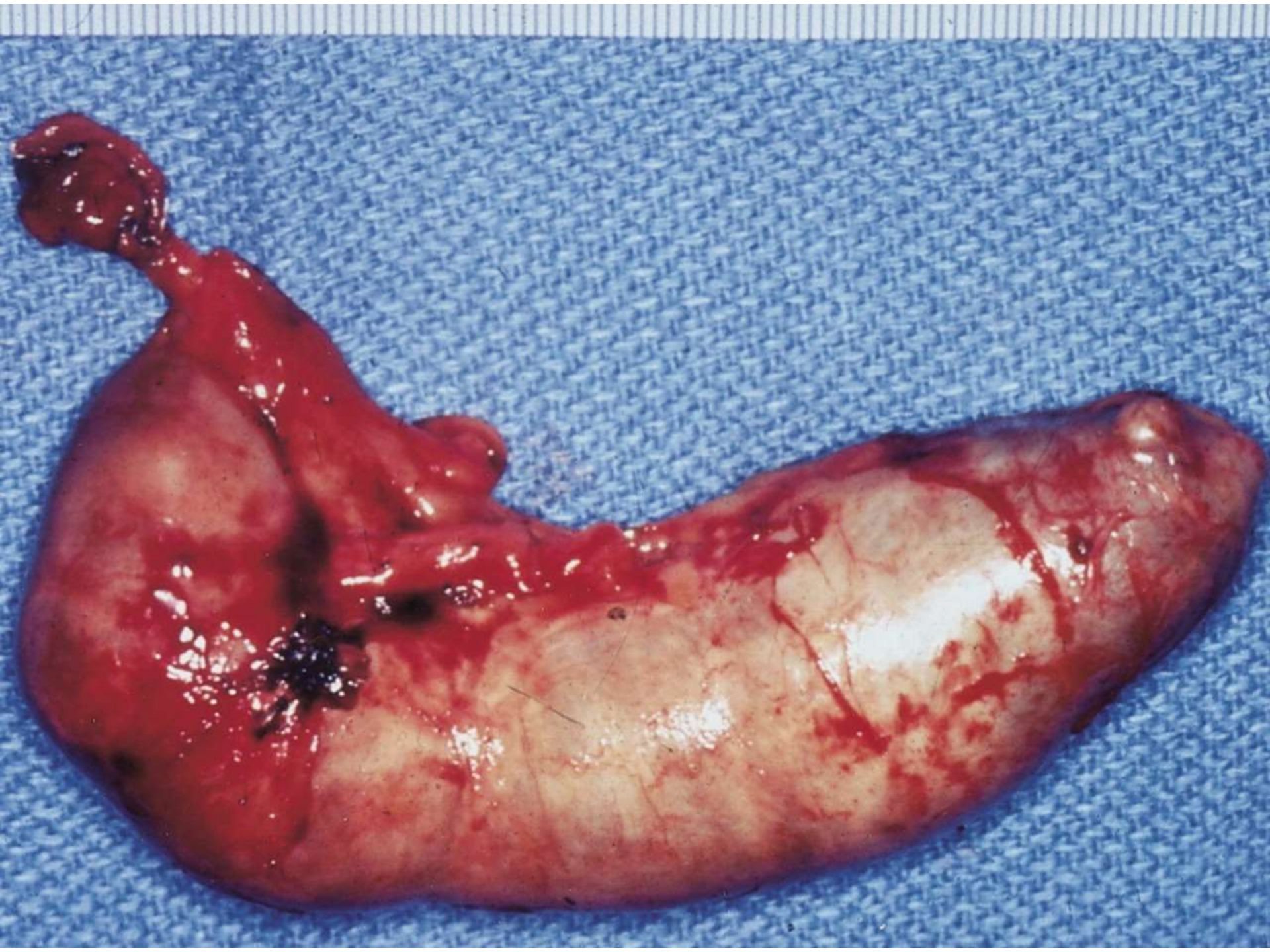
- **Appendicular mass: if the operation is not done, at fifth day appendicular mass may appear, and can be felt in right iliac fossa which compose of inflamed appendix. Cecum, coils of loops bowel and greater omentum, the standard treatment is the conservative Ochsner-Sherren regimen. The strategy is based on premise that the inflammatory process is already localized and that inadvertent surgery is difficult and may be dangerous.**

- **It may be impossible to find appendix and occasionally a fecal fistula may form. For these reasons it is wise to observe a non-operative programme but to be prepared to operate when clinical deterioration occurs. This regimen include recording the patient condition carefully .**

- **it is helpful to mark the limits of the mass on the abdomen using a skin pencil. CT scan abdomen is done and I.V antibiotics by metronidazole and third generation cephalosporin. If abscess is present should be drained radiologically. Chart 4 hourly of pulse ,blood pressure, respiratory rate, temperature fluid input and amount of urine output all should be recorded. Clinical deterioration and evidence of peritonitis is an indication of laparotomy.**

- **Clinical improvement is usually evident within 24-48 hours. Failure of the mass to resolve rise suspicion of carcinoma or Crohn's disease. Using of this regimen 90% of the cases resolve without incident. The great majority of the patients will not develop recurrence and it is no longer considered advisable to remove the appendix after an interval of 6-8 weeks.**

- Conservative management includes:
- Admission of the patient to the hospital
- Nothing by mouth
- I.V. fluid therapy, daily requirement according to the weight of patient
- Antibiotics therapy against aerobic and anaerobic organisms
- Regular measurements of temperature and pulse rate every 4 h.
- It’s helpful to mark the mass on the abdominal wall using skin pencil
- A contrast-enhanced CT examination of the abdomen should be performed



Criteria for improvement:

- **Improvement of general condition of the patient**
- **Improvement of appetite**
- **Decrease in the abdominal pain**
- **Decrease in temp. and pulse rate**
- **The mass decreased in its size and tenderness.**

It’s advisable to remove the appendix after an interval of 6-8 weeks

- **Criteria for stopping conservative treatment**
- **1- a rising pulse 2- vomiting or copious gastric aspirate 3- increasing or spreading of abdominal pain 4- increasing the size of abscess. So these factors indicates developing of appendicular abscess needing urgent operation for drainage.**
- **Contraindications to delayed conservative treatment**
- **1- diagnosis is uncertain that it can not be differentiating between acute appendicitis and other abdominal condition that requiring immediate operation as perforated peptic ulcer.**

- **2- the signs indicates that inflammation is still confined to the appendix.**
- **3- patient is less than 10 years of age as early perforation of appendix may occur due to poor development of greater omentum to localize the inflammation.**
- **4- patient is above 60 years of age because may has peritonitis with minimum clinical signs due laxity of abdominal wall musculature so he will not develop rigidity or guarding of abdominal wall that indicate peritonitis and early operation.**

- **Recurrent appendicitis: usually the patient gives a history of previous abdominal pain treated conservatively so he develops mild recurrent attacks of mild abdominal pain and dyspepsia and mild tenderness on right iliac fossa, usually diagnosed as recurrent appendicitis and operation reveals that the removed appendix has signs of chronicity as fibrosis, short and kinking .**
- **Chronic appendicitis: it does not exist. Some authors used this term, it usually example of recurrent appendicitis.**

- **Post-operative complications:**
- **Early complications**
- **1- Wound infection 2- intra-abdominal abscess, residual abscess (local, pelvic, paracolic, subphrenic) 3- paralytic ileus 4- respiratory atalactaxis (lung collapse), pneumonitis 5-venous thrombosis and embolism 6- portal pyemia (pyleophlebitis) 7- fecal fistula 8- adhesive intestinal obstruction.**

- **Late complications**
- **1- intestinal obstruction from fibrous adhesion 2- incisional hernia 3- right inguinal hernia following grid-iron incision especially if the drain brought through the wound 4- sterility in the female from frozen pelvis.**

- **Neoplasms of appendix**
- **Carcinoid tumor (argentaffinoma): it arise from argentaffin tissue(Kulchitsky cells of the crypts of Lieberkuhn)and most common in appendix . it seen once in 300-400 appendices sent to histopathological examination and it is 10 times more common than any other neoplasm present in appendix. It usually present as acute appendicitis , it felt hard and yellow in color that it contain lipoid.**

- **it rarely metastases , and needs only appendicectomy if it less than 2 cm , if it is larger or has lymph nodes metastases or involvement of cecal wall, a right hemicoloctomy should be performed. The cell of this tumor has special stain for chromogranin. It usually occurs in female, can appear at any age from 10-60 years. It usually presents at distal third of the appendix. Their metastases does not secrete hormone to cause carcinoid syndrome as flushness ,cyanosis and diarrhea.**

- **Primary adenocarcinoma: usually rare and of colonic type and treated by right hemicoloectomy. A mucus secreting adenocarcinoma of the appendix may rupture into peritoneal cavity, seeding it inside , presentation is often delayed until the patient develop a gross abdominal distension as a result of pseudomyxoma peritoneii, which may mimic ascites. Treatment consists of radical resections of all involved parietal peritoneal surfaces and aggressive intraperitoneal chemotherapy.**

- **Less common conditions of the appendix:**
- **Mucocele of the appendix: may occur when e proximal end of the lumen slowly becomes completely occluded, usually by fibrous stricture, and the secretions inside the lumen remains sterile. The appendix is greatly enlarged and contains mucin. When the mucin becomes infected it changed to pyocele called empyema by appendicectomy. One should be aware that mucocele is not a mucus secreting adenocarcinoma as the treatment will be right hemicoloectomy.**

- **Diverticulosis of the appendix: treatment is appendicectomy.**
- **Endometriosis of the appendix: intensively rare and bleeding per rectum occurs monthly with the menstrual cycle as due to presence of endometrial tissue in the appendix.**
- **Crohn's disease: fistula has been reported following appendicectomy , usually there is Crohn's disease of the cecum reaching to the base of the appendix , at this situation appendicectomy should not be performed.**
- **Intussusception of the appendix: usually in childhood , as appendiculo-colic intussusception or part of ileo-cecal intussusception , treatment by release of intussusception with appendicectomy.**