

Peer Reviewed **Article of Interest****WHAT IS THE CHILAITITI SIGN AND SYNDROME? AN OVERVIEW AND PICTORIAL PRESENTATION**

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Abstract

An overview of Chilaiditi's sign and syndrome is presented. A range of radiographs and computed tomography images are included to underscore relevant imaging; it is important to recognise a pseudopneumoperitoneum to prevent unnecessary surgical interventions.

Keywords: colonic interposition, liver, diaphragm, haustral folds, pseudopneumoperitoneum

INTRODUCTION

The most common cause of air under the diaphragm is rupture of a hollow viscus.^[1] In most cases an erect chest radiograph is taken to check for free air under the diaphragm. Figure 1 shows free air under the diaphragm.

There are other causes of free air under the diaphragm. The focus of this presentation is Chilaiditi sign which is the interposition of colon between the diaphragm and liver simulating the presence of air under the diaphragm.

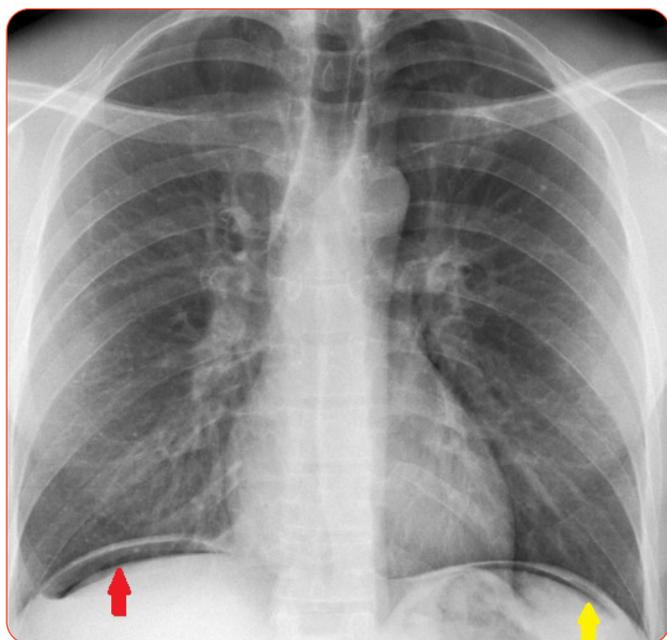


Figure 1. Erect chest showing air under the right diaphragm (red arrow) and under the left diaphragm (yellow arrow) (courtesy Dr P Mercouris, Durban).

CHILAITITI'S SIGN

In 1910 a Greek radiologist, Demetrius Chilaiditi, was the first to report on the x-ray findings of three cases of interposition of the colon between the liver and diaphragm.^[2] This pathology is known as the Chilaiditi sign. It is a radiology sign that pertains to asymptomatic air under the diaphragm due to colon being interposed between the liver and diaphragm. It is a benign acquired condition and is extremely rare; less than 1% of the population, with a male to female ratio of 4:1 have the condition.^[3] It is more common in the elderly^[4,5] and rare in the paediatric population.^[6] Usually the hepatic flexure and proximal transverse colon are involved. Figure 2a and b show colon anatomy and proximal transverse colon dipping towards the pelvis. Figure 3a to d show normal CT axial views and Chilaiditi sign. Usually an erect chest radiograph (Figure 4) is done to check for a pneumoperitoneum.^[1]

There are two recent reports of failed optical colonoscopy (OC) due to underlying Chilaiditi sign. Kumar et al.^[7] reported on a case that was related to an OC. Their patient presented with non-specific abdominal pain and generalised weakness. Two expert colonoscopists failed to pass the colonoscope beyond the hepatic flexure. Gas with haustral folds in the right and left subphrenic space was noted on a chest X-ray (CXR) and abdominal radiograph. A CT abdomen showed interposition of colon between the liver and right and left diaphragms.^[7] The patient in the other case developed severe abdominal pain and dyspnoea after an OC.^[8] The patient did not have abdominal guarding or rebound tenderness. The diagnosis was an abdominal perforation. However, a CXR and CT abdomen scan showed elevated right diaphragm with loops of bowel in the right hemitho-

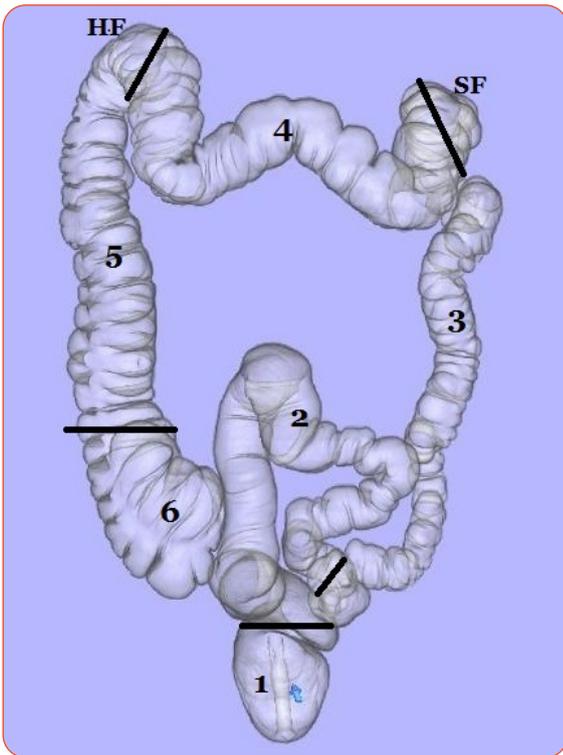


Figure 2a. Colon-map showing: rectum (1), sigmoid colon (2), descending colon (3), transverse colon (4), ascending colon (5) and caecum (6). HF = hepatic flexure. SF = splenic flexure.

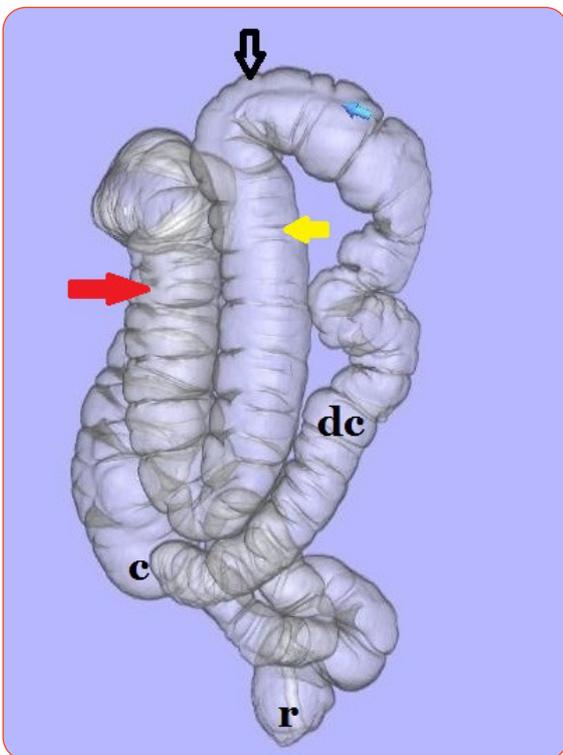


Figure 2b. Colon-map showing transverse colon (red arrow) dipping steeply. Yellow arrow = transverse colon near the splenic flexure (open black arrow). Rectum (r), descending colon (dc), caecum (c).



Figure 3a. Axial CT scan showing normal liver, spleen, stomach (s) and haustral folds in the colon (white arrows).

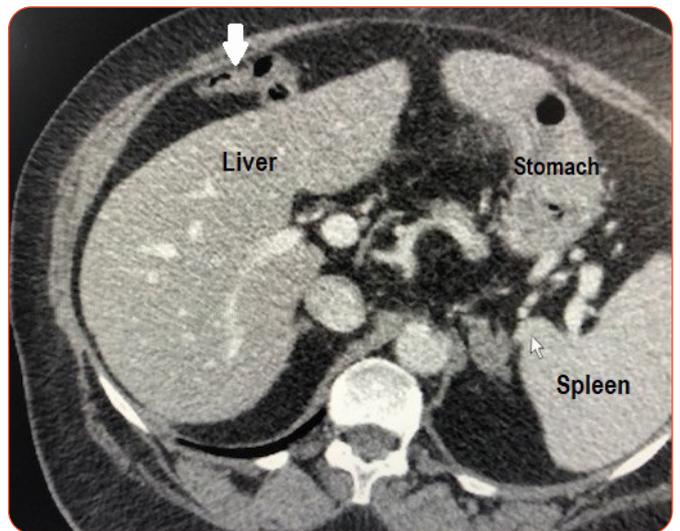


Figure 3b. Axial CT showing large bowel (white arrow) above the liver: Chilaiditi sign.

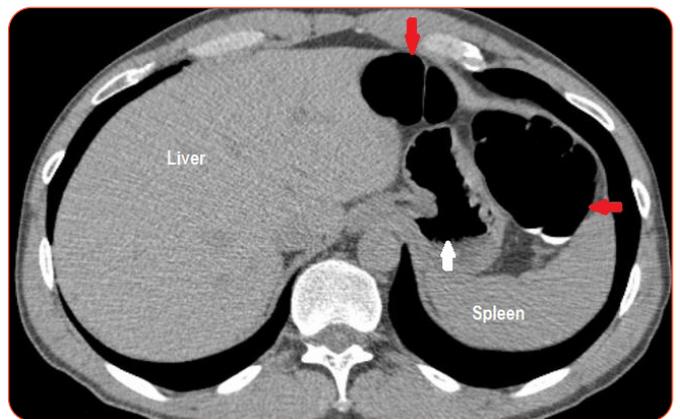


Figure 3c. Axial view showing normal liver, spleen, air in stomach (white arrow) and loop of large bowel (red arrows).

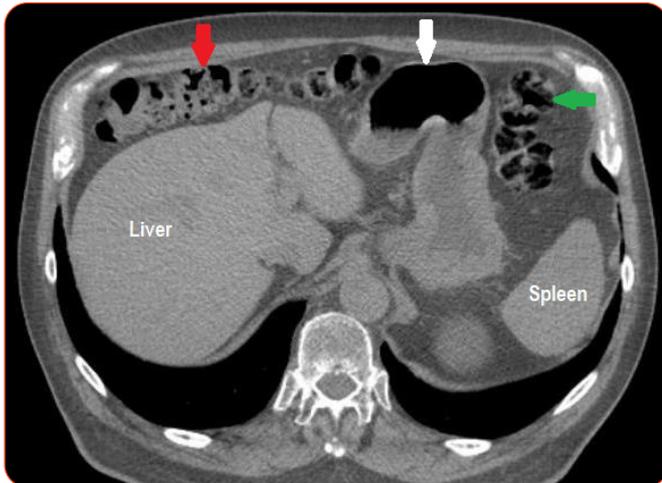


Figure 3d. Axial view showing unenhanced loop of transverse colon (red arrow) above the liver and beneath the diaphragm: Chilaiditi sign. Transverse colon (green arrow). Air in stomach (white arrow).

rax. No leakage of contrast or free air was seen in the abdomen therefore the patient was treated conservatively.^[8] In order to prevent the risk of perforation, due to OC, it is important to recognise the features of Chilaiditi sign.^[7]

To illustrate Chilaiditi's sign versus a pneumoperitoneum a range of images are presented.

CHILAITITI'S SYNDROME

When a patient with a Chilaiditi sign has gastric and/or respiratory symptoms this is known as Chilaiditi syndrome. Gastric symptoms may vary depending whether a child or adult is affected. These symptoms are often mild in children and adults. In children the most common symptom is abdominal distension.^[6] Usually there is no distension in the early morning. As the day wears on the distention becomes more prominent and increasing pain. Its cause has been attributed to aerophagia (swallowing of air).^[9] This may also cause marked gastric distension.^[6] The distension usually subsides at night with no evidence of intestinal obstruction. In these patients an air-fluid level is observed beneath the right hemi-diaphragm (RHD) where there is colonic distension and interposition of the colon between the diaphragm above and the liver below (aka hepatodiaphragmatic interposition of the colon).^[10] The liver is usually displaced inferiorly or posteriorly. This is an acquired and not a congenital finding. It usually manifests in the 7th decade. It may however occur very early in life. Chilaiditi's syndrome may be bilateral.^[11]

The air fluid level beneath the RHD may simulate a perforation causing a pneumoperitoneum, or an appearance of a sub-phrenic abscess.^[12] However, patients with such radiological signs do not appear ill and they do not have rigid abdomens. A chest X-ray or CT scan differentiates between a normal finding and pathology.^[12]

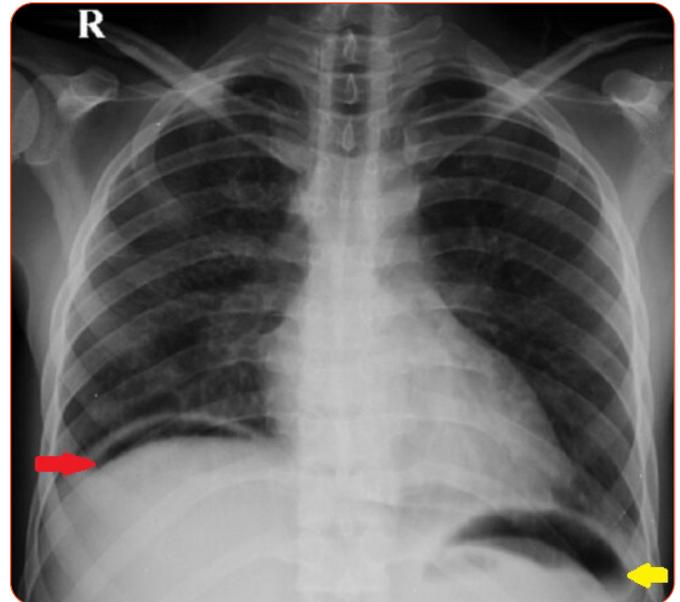


Figure 4. Erect chest x-ray showing free air, under the right diaphragm (red arrow) and under the left diaphragm (yellow arrow), due to perforation of hollow viscus. The free air is part of the pneumoperitoneum (courtesy Dr P Mercouris, Durban).

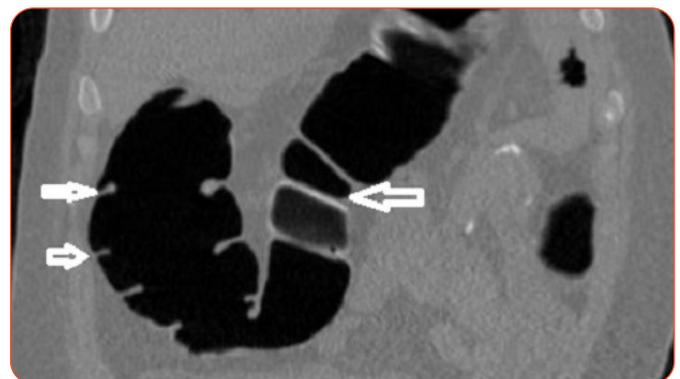


Figure 5a. Coronal view showing haustral folds in the colon (open white arrows).

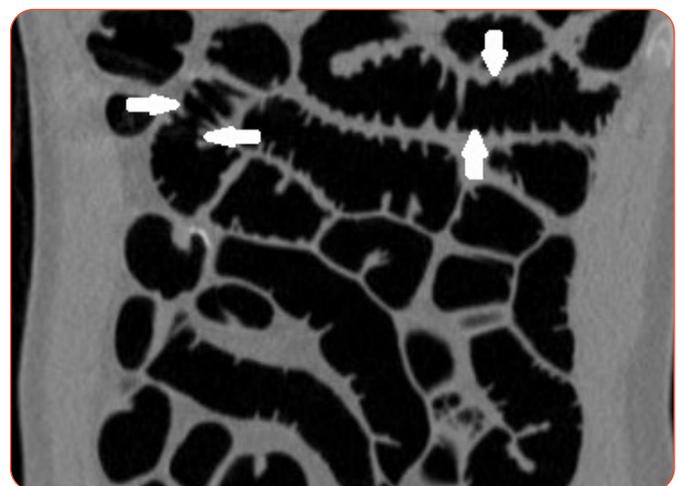


Figure 5b. Coronal view showing small bowel valvulae conniventes (white arrows). Note the difference between valvulae conniventes and haustral folds in Figure 5a.

PNEUMOPERITONEUM VS PSEUDOPNEUMOPERITONEUM

The main differentiating features between a pneumoperitoneum, due to perforation of a hollow viscus, and a pseudopneumoperitoneum, is the presence of haustral folds within the dilated bowel underneath the diaphragm. Figure 5 a and b shows folds normal colon and small bowel.

Air in the colon should not change in position in a lateral decubitus view, whereas free air does change in position.^[13] It is important to recognise these signs to prevent patients undergoing unnecessary surgery for suspected bowel perforation.^[2,14] Air due to perforation has a crescentic shape under the RHD. The amount of free air may vary considerably. Haustral folds are not visible. Other abdominal features may be abdominal pain with varying severity, nausea, vomiting, constipation, and the abdomen may be rigid.

MANAGEMENT OF CHILAITIDI SYNDROME

Management often is conservative with fasting, nasogastric tube decompression and pain control. The symptoms usually clear within a day or two.^[9,14]

PREDISPOSING CAUSE OF CHILAITIDI SIGN/SYMPATOM

Possible eventration of the diaphragm, diaphragmatic hernia, and diaphragmatic paralysis. Other causes responsible for the appearance may be hepatic in nature: cirrhosis of the liver or hepatic atrophy; or relaxation/elongation of sus-

pensory ligaments. Chronic obstructive pulmonary disease (COPD), abdominal obesity, ascites, multiple pregnancies and intestinal adhesions, may also be causes.^[15]

PICTORIAL EXAMPLES OF CHILAITIDI SIGN/SYMPATOM

A range of CT images (Figures 6 a to l) are presented to illustrate the main radiologic features of Chilaiditi sign. As stated above it is important to recognise these features to prevent unnecessary surgical interventions.

Key points

- Chilaiditi is a radiological sign and not a clinical diagnosis.
- It is recognised on chest X-ray, plain abdominal radiographs, and CT scans.
- Hepatic flexure and proximal transverse colon are often the cause; small bowel may also be observed radiologically.
- The difference between the sign and syndrome is merely the presence of symptoms, which may be gastric and/or respiratory in nature.
- Pneumoperitoneum occurs from perforation of a hollow viscus.
- Pseudopneumoperitoneum occurs when dilated bowel is seen beneath the RHD. This air is contained within the large bowel hence haustral folds of the colon are evident.



Figure 6a. Sagittal view showing barium in ascending colon. Distended hepatic flexure seen anteriorly containing barium (white arrow) and displacing the liver inferiorly and posteriorly. RK = right kidney.



Figure 6b. Coronal view showing distended hepatic flexure (white arrow) under the RHD



Figure 6c. Axial view showing distended hepatic flexure (red arrow) and proximal TC with inferior displacement of liver. Aorta (A). Proximal descending colon (green arrow).

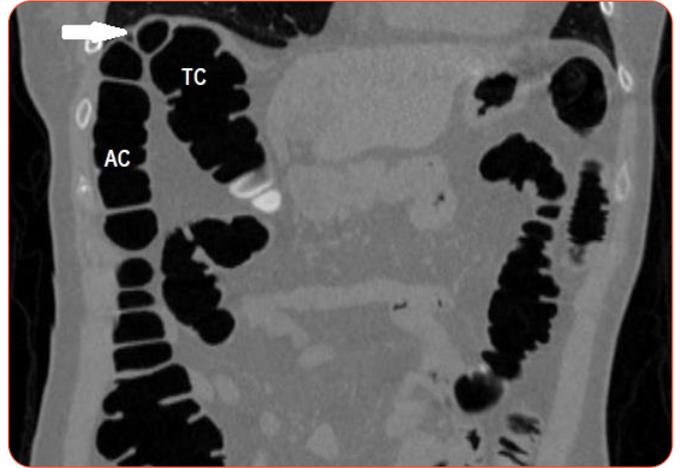


Figure 6f. Coronal view showing AC with hepatic flexure (white arrow) and proximal transverse colon (TC) under RHD.

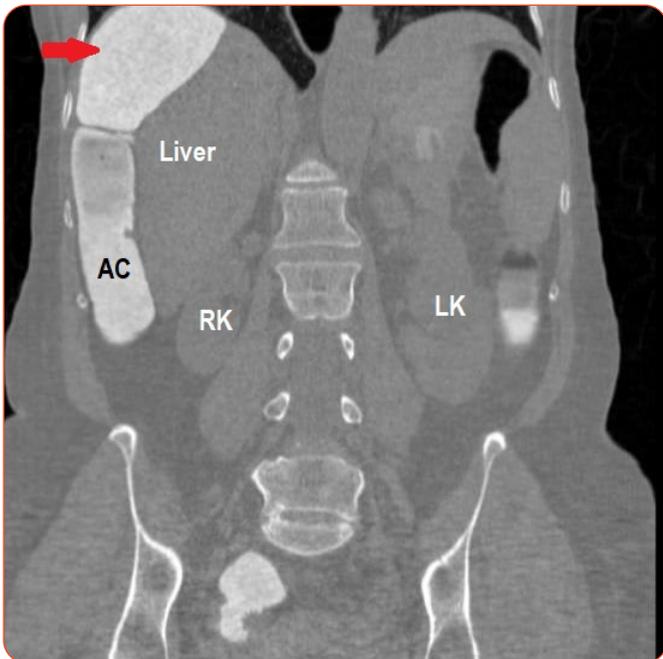


Figure 6d. Coronal view showing barium in the ascending colon (AC) and hepatic flexure under diaphragm (red arrow) displacing the liver to midline. RK (right kidney), LK (left kidney).

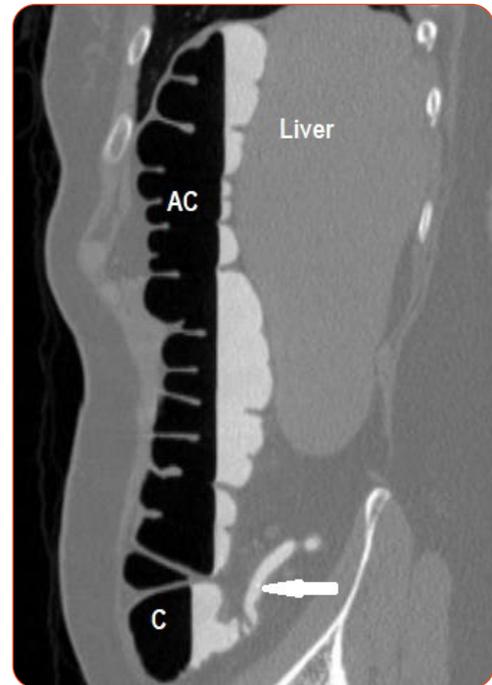


Figure 6g. Sagittal view showing caecum (C), appendix (white arrow), AC with barium causing posterior displacement of the liver.



Figure 6e. Axial view showing hepatic flexure (red arrow) and proximal TC (green arrow) above liver and below the diaphragm. Barium noted in colon.



Figure 6h. Axial view showing large bowel (white arrow) between the liver and diaphragm. Bilateral large renal cysts (red arrows). RK (right kidney), LK (left kidney).



Figure 6i. Sagittal view showing large bowel anteriorly (white arrow) with posterior displacement of the liver.



Figure 6l. Coronal view showing hepatic flexure (white arrow) and proximal TC beneath the RHD.

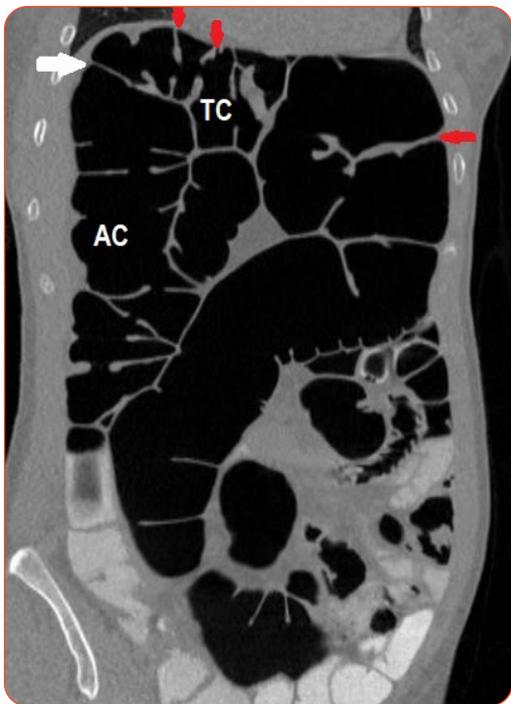


Figure 6j. Coronal view showing distended large bowel (AC) with hepatic flexure (white arrow) and proximal transverse colon (TC) underneath the diaphragm. Haustral folds (red arrows) indicate normal large bowel and not a pneumoperitoneum.



Figure 6k. Prone axial view. Large bowel (red arrow) is anterior to the liver.

CONCLUSION

Chilaiditi sign/symptom is a rare occurrence and is a benign condition. It may simulate intestinal obstruction and/or perforation of the bowel. Clinical examination and CT scanning exclude this possibility. To prevent the risk of perforation due to optical colonoscopy it is important to recognise the features of Chilaiditi sign.

COMPETING INTERESTS

Nil to declare.

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ETHICAL CONSIDERATIONS

This article followed all ethical standards.

DISCLAIMER

The views and opinions expressed in the article are those of the author and do not necessarily reflect the views of the publisher and editorial board.

REFERENCES

1. Pinto A, Miele V, Schillirò ML, Nasuti M et al. Spectrum of signs of pneumoperitoneum. *Seminars in Ultrasound, CT and MRI*. 2016; 37 (1): 3-9.
2. Tzimas T, Baxevanos G, Akritidis N. Chilaiditi's sign. *Lancet*. 2009; 373: 836.
3. Yin AX, Park GH, Garnett GM, Balfour JF. Chilaiditi syndrome precipitated by colonoscopy: a case report and review of the literature. *Hawaii J Med Public Health*. 2012; 71(6): 158-162.
4. Walsh SD, Cruikshank JG. Chilaiditi syndrome. *Age Ageing*. 1977; 6(1): 51-7. doi:10.1093/ageing/6.1.51.
5. Kamel I, Yalcin Y, Ponder R, Elkhawas I, Solangi Z. Unveiling the Chilaiditi syndrome: a case report and management implications. *Cureus*. 2014; 16(4): e57483. doi:10.7759/cureus.57483.
6. Jackson ADM, Hodson CJ. Interposition of the colon and liver between the liver and diaphragm (Chilaiditi's syndrome) in children. *Archives of Diseases in Childhood*. 1956; 151-158.
7. Kumar R, Anand U, Priyadarshi RN. Chilaiditi syndrome: an unusual cause of failed colonoscopy. *J Dig Endosc*. 2019; 10: XX-XX.
8. Gökseven Y, Öztürk GZ, Borlu F, Tporak D. Chilaiditi syndrome after colonoscopy: a case report and review of the literature. *Türkiye Klinikleri J Case Rep*. 2020; 28(2): 110-3. doi:10.5336/caserep.2019-72576.
9. Garcia Expósito P, Ruales S, Montraveta-Querol M. Chilaiditi's syndrome in children: a case series of a rare cause of abdominal pain. *Annals of Clinical Case Studies*. 2023; 5: Article 1077.
10. Hsu HL, Liu KL. Hepatodiaphragmatic interposition of the colon. *CMAJ*. 2011 Feb 8; 183(2): E132. doi:10.1503/cmaj.092117.
11. Hamza A, Garba Nuhu A, Bashiru Adebayo M, Mustapha Mohammed A. Bilateral Chilaiditi syndrome in a Nigerian child with severe acute malnutrition: a case report. *Nigerian J of Paediatrics*. 2024; 51 (1): 33-36. <https://dx.doi.org/10.4314/njp.v51i1.06>.
12. Gad MM, Al-Husseini MJ, Salahia S, Saad AM, Amin R. Chilaiditi syndrome – a rare case of pneumoperitoneum in the emergency department: a case report. *J Med Case Reports*. 2018; 12, Article 263. <https://doi.org/10.1186/s13256-018-1804-y>.
13. Dsouza S, Mhaske Y, Kularni A, Baviskar A. Chilaiditi's syndrome – a clinical conundrum! *South Afr J of Anaesth Analg*. 2018; 24(6): 170-171. <https://doi.org/10.1080/22201181.2018.1523978>.
14. Chen SY, Chen N, Lu C. Chilaiditi syndrome. *QJM: Internat J of Med*. 2016; 109 (9): 625-626. <https://doi.org/10.1093/qjmed/hcw102>.
15. Jiménez OC, De Ávila MB, Montes EP, Códoba JD, Camacho R. Chilaiditi's sign and syndrome: rare conditions but diagnostically important in paediatrics. *Clinical case*. *Rev Chil Pediatr*. 2017; 88(5): 635-639. doi:10.4067/S0370-41062017000500010.