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Heterotaxy syndrome and interrupted inferior vena cava (IVC) with azygos continuation

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Abstract

Heterotaxy syndrome or situs ambiguous is a rare congenital disease in which the pattern of anatomical organization of the thoraco-abdominal visceral and vascular structures is not arranged in normal position. Patients with heterotaxy syndrome represent a wide range of anatomical variations including thoraco-abdominal structures. Here we report a rare case of asymptomatic heterotaxy syndrome in an elderly female with multiple accessory spleens, stomach on right side of the abdomen, midline liver, azygos continuation of Inferior Vena Cava (IVC) and intestinal malrotation.

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Introduction

Visceral situs is a complete reversal of the spatial location of body organs relative to the midline. Visceral situs is classified into four types: situs solitus, situs inversus, heterotaxy with thoracic right isomerism, and heterotaxy with thoracic left isomerism (1). Situs solitus is normal position of thoracic and abdominal organs. In this type, aorta, cardiac apex, spleen, and stomach are located on the left side, and liver and inferior vena cava are on the right side. In situs inversus, body organs are mirror location of the situs solitus. In situs inversus, cardiac apex position may be in the form of dextrocardia or levocardia. Situs ambiguous or heterotaxy syndrome is a less common condition considered as an intermediate level of visceral malposition, dismorphism, and atrial disposition which is not consistent with situs solitus or inversus definition(2, 3).

Heterotaxy syndrome or situs ambiguous is a rare multiple congenital anomaly in which the thoraco-abdominal visceral and vascular structures are abnormally arranged within the thorax and abdomen (4). It is often associated with multiple congenital anomalies (5). The incidence of heterotaxy syndrome is 1 in 10,000 people worldwide (6). For reasons yet unknown, the condition appears to be more common in Asian

populations than in North American and European ones (7). Anomalies happen when the process of normal left-right axis specification during embryogenesis is disturbed (8-10). Patients with situs ambiguous can be stratified into the subdivisions of situs ambiguous with polysplenia, and situs ambiguous with asplenia. Polysplenia is generally associated with the situs ambiguous anomaly (11). This case study reports a rare case of incidentally found polysplenia syndrome in a 26-year-old female patient who also had an interrupted inferior vena cava (IVC) with azygos continuation, midline liver, and Intestinal malrotation. There are few published reports regarding the polysplenia with azygos continuation (Figure 3) (12), and midline liver.

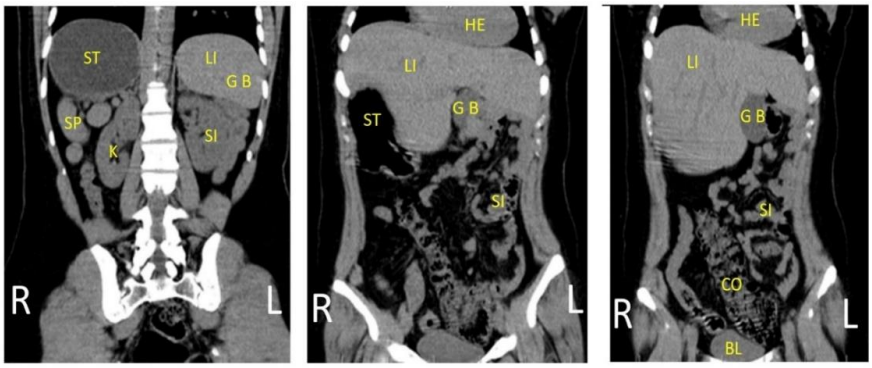

Figure 1. Coronal without contrast-enhanced computed tomography (CT) image showing a Heterotaxy syndrome. GB, gallbladder; IVC, inferior vena cava; SVC, superior vena cava; AZ, azygos; HE ,heart; LI, liver; ST, stomach; SP, spleen; CO, colon; K

Case report

A 26-year-old female with Intermittent Abdominal Pain referred to our imaging center for further evaluation. Past medical history and family history were not contributory. Her arterial blood pressure was 210/100 mm Hg and heart rate was 78/min. Other vital signs were within normal limits. Scanning was done from xiphoid process to the level of pubic symphysis. At that exam, congenital anomalies involving thoraco-abdominal viscero- vascular structures were seen indicating the presence of heterotaxy polysplenia syndrome (Figure 2 and 3). The infrarenal segment of the IVC was positioned at the normal location and received the right renal vein; however, the suprarenal segment of the IVC was absent. An inferior vena cavagram demonstrated the inferior vena cava to continue with the azygos vein, passing into the retrocrural space till joining superior vena cava (SVC) at the normal location in the right paratracheal space(Figure 2 and 3). The fundus of the stomach was located in the right upper quadrant of abdomen with multiple splenic masses (polysplenia) located along the greater curvature (Figure 2 and 3). The liver was located in the midline, but it was left-dominant liver (Figure 2 and 3). The small bowel was located on the left side in the upper abdomen and the ileocecal junction situated in the left iliac fossa to the left of midline with the Superior mesenteric artery directed downwards and to the left. Ascending colon was located on the left side and the descending colon on the right side with the inferior mesenteric artery directed downwards and to the right (Figure 2 and 3). The situation of the bowel loops and the reversal of status of superior mesenteric vessels were indicative of malrotation of gut. Renal microlithiasis was seen in both kidneys (Figure 2 and 3).

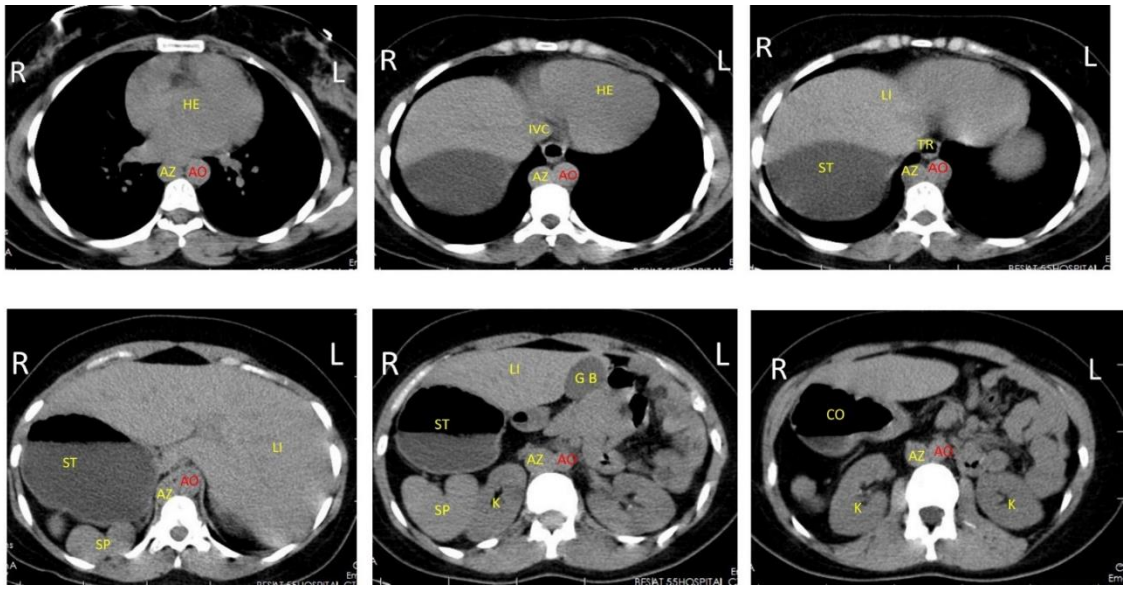

Figure 2. Axial without contrast computed tomography (CT) image exposing a Heterotaxy syndrome. GB, gallbladder; IVC, inferior vena cava; SVC, superior vena cava; AZ, azygos; HE, heart; LI, liver; ST, stomach; SP, spleen; CO, colon; K, kidney.

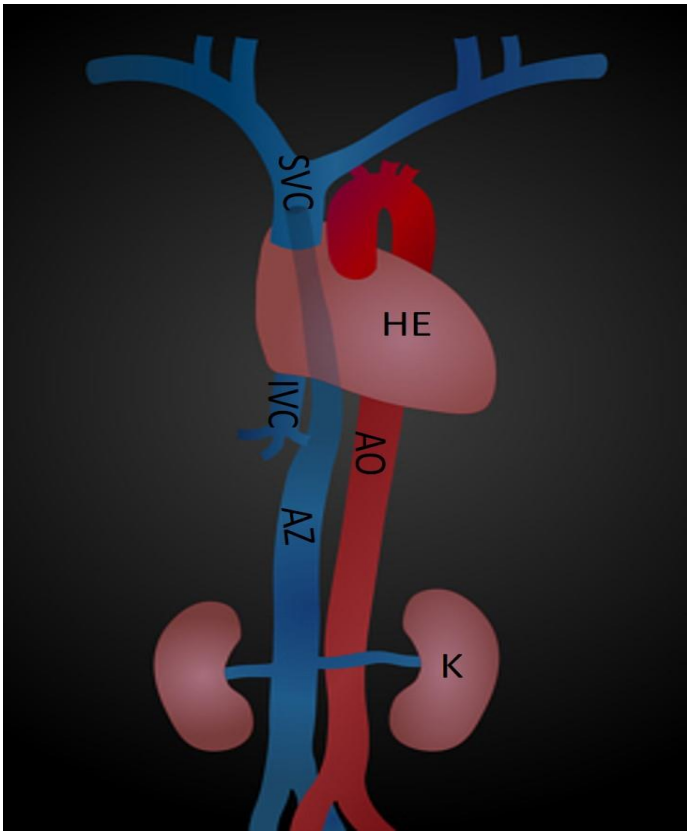

Figure 3. Schematic illustration of Azygos continuation of the inferior vena cava. IVC, inferior vena cava; SVC, superior vena cava; AZ, azygos; HE, heart; LI, liver; K, kidney.

Discussion

Heterotaxy is a rare condition in which the normal arrangements of the thoracic and abdominal organs disrupt in the normal left-right axis during early embryonic development (13). Heterotaxy or Situs ambiguous describes an anomaly in which there are portions of both situs solitus (normal asymmetrical arrangement) and situs inversus (mirror-image of normal arrangement) in the same patient (14). In general, situs ambiguous can be present when the thoraco-abdominal organs are not clearly lateralized. Heterotaxy generally is classified into polysplenia (left isomerism) and asplenia (right isomerism) syndromes (15). Polysplenia is classically defined as left isomerism or bilateral left-handedness referring to left-sided organs duplication via bilateral bilobed lungs, bilateral hyparterial bronchi and bilateral pulmonary atria as well as to the presence of several spleens (16). In nearly 50 % - 90 % cases, polysplenia is associated with the cardiac defect and only about 10% of patients may reach adulthood without any complications (17). The exact cause of heterotaxia polysplenia syndrome remains unclear. Disorders of the left-right asymmetry during early embryonic development result in a broad range of cardiac and extracardiac malformations that specify the human heterotaxy syndrome. Recent studies have reported that more than 100 genes are needed for normal left-right organ patterning during development but only a few are likely candidates for the left-right asymmetry defects in humans. The genes which are implicated in left-right laterality determination and heterotaxy syndrome include ZIC 3, NODAL, LEFTY 2, ACVR2B, CRYPTIC, CRELD-1, NKX2.5 and SHROOM 3 (13, 18). Microdeletions of Xq26 and mutations in some of these genes have been reported in patients with heterotaxy (8). Left to right patterning is one of the most significant embryological events for asymmetrical organs like heart, lungs and digestive system. Exact sequential delivery and expression of accurate genetic signals along the left-right axis are responsible for appropriate morphogenesis and normal positioning of the internal component. Failure of normal coordination in different organ systems may have resulted in a set of anomalies such as situs anomalies of abdominal organs associated with the normally positioned heart. (19). Rose et al have reported that situs ambiguous has an incidence of 1 per 40,000 live births (20). Polysplenia is a rare form of the heterotaxy syndrome which is more common in females (21) and has a reported incidence of about 1 per 250,000 live births (19). Numerous studies reported that the situs ambiguous is more common in a highly inbred community of Asian Muslims (1 in 2700) comparing to the English population (1 in 24000) (22).

It is difficult to estimate the exact occurrence of polysplenia in adults because of the absence of drastic congenital heart defect and usually this anomaly is identified incidentally in adults during imaging evaluation for unrelated conditions.

Congenital interruption of the inferior vena cava (IVC) with azygos continuation is the most common anomaly associated with polysplenia syndrome (23). The suprarenal portion of the IVC is absent resulting to the failure of development of anastomosis between the right subcardinal vein and the hepatocardiac channel (derived from the right vitelline vein) but the suprahepatic portion is usually present draining the hepatic veins and opening directly into the right atrium. In the present case, the renal portion of the normally located IVC after receiving the right renal vein entered the retrocrural space and continued as the azygos vein while the left renal vein continued as hemiazygos vein.

In the present case, both stomach and eight splenules were placed in the right upper quadrant. Normal clockwise rotation during development brings the stomach to the left side, and counterclockwise rotation brings it to the right side. Because spleen develops in the dorsal mesogastrium, a discordant location of spleen and stomach is not expected. In this case, the small bowel loops were all placed on the left side and the ileocecal junction was situated in the left iliac fossa to the left of midline. Ascending colon was present on the left side and descending colon on the right side. Moreover, the third part of duodenum was not seen horizontally in its normal position. In this patient also, the common hepatic artery was originating from the superior mesenteric artery. No anomaly could be detected in the urogenital organs. Management of adult cases of polysplenia (left isomerism) is mainly palliative and symptom-specific.

Conclusion

Patients with heterotaxy polysplenia syndrome represent a wide spectrum of abnormalities including thoraco-abdominal viscera and vessels. The polysplenia syndrome is incidentally detected in many adult cases when the patients were being evaluated for other reasons. The exact diagnosis is also crucial for proper planning of surgical and interventional procedures and to avoid damages to vital structures. Appropriate imaging modalities like echocardiography, ultrasonography, CT, and MRI are essential to appreciate diverse visceral and vascular abnormalities of heterotaxy syndrome.

References

1. Stanger P, Rudolph AM, Edwards JE. Cardiac malpositions. An overview based on study of sixty-five necropsy specimens. Circulation. 1977;56(2):159-72.
2. Van Praagh R. Terminology of congenital heart disease. Glossary and commentary. Circulation. 1977;56(2):139-43.
3. Uemura H, Ho SY, Devine WA, Anderson RH. Analysis of visceral heterotaxy according to splenic status, appendage morphology, or both. The American journal of cardiology. 1995;76(11):846-9.
4. Mujo T, Finnegan T, Joshi J, Wilcoxen KA, Reed JC. Situs ambiguous, levocardia, right sided stomach, obstructing duodenal web, and intestinal nonrotation: a case report. Journal of radiology case reports. 2015;9(2):16.
5. Tortajada M, Moreno M, Gracia M, Sanchis A. Rare disease: Situs ambiguous in a schoolchild. BMJ case reports. 2010;2010.
6. Mortari EP, Baban A, Cantarutti N, Bocci C, Adorisio R, Carsetti R. Heterotaxy syndrome with and without spleen: Different infection risk and management. Journal of Allergy and Clinical Immunology. 2017;139(6):1981-4. e1.
7. Rameshbabu CS, Gupta KK, Qasim M, Gupta OP. Heterotaxy polysplenia syndrome in an adult with unique vascular anomalies: case report with review of literature. Journal of radiology case reports. 2015;9(7):22.
8. Ma L, Tierney ESS, Lee T, Lanzano P, Chung WK. Mutations in ZIC3 and ACVR2B are a common cause of heterotaxy and associated cardiovascular anomalies. Cardiology in the Young. 2012;22(2):194-201.

9. Farashah MSG, Shariati NH, Asghari R, Mohamadi S, Dolatkhah MA, Shariati MBH. Pulmonary Sequestration: A Case Report. Acta Medica Iranica. 2019;57(6):398-401.

10. Mohammadi S, Farashah MSG, Frounchi N, Shoorei H, Shariati MBH. Retro Aortic Left Renal Vein: A Case Report and Brief Literature of Review.

11. Yoneyama H, Kondo C, Yamasaki A, Nakanishi T, Sakai S. Comparison of situs ambiguous patterns between heterotaxy syndromes with polysplenia and asplenia. European journal of radiology. 2015;84(11):2301-6.

12. Radiopaedia. Radiopaedia. org. 2015.

13. Catana A, Apostu AP. The determination factors of left-right asymmetry disorders-a short review. Clujul Medical. 2017;90(2):139.

14. Kim S-J. Heterotaxy syndrome. Korean circulation journal. 2011;41(5):227-32.

15. Agarwal H, Mittal SK, Kulkarni CD, Verma AK, Srivastava SK. Right isomerism with complex cardiac anomalies presenting with dysphagia-A case report. Journal of radiology case reports. 2011;5(4):1.

16. Loomba RS, Anderson RH. Polysplenia or Left Isomerism? Internal Medicine. 2016;55(5):555-.

17. Kothari SS. Non-cardiac issues in patients with heterotaxy syndrome. Annals of pediatric cardiology. 2014;7(3):187.

18. Shiraishi I, Ichikawa H. Human heterotaxy syndrome. Circulation Journal. 2012;76(9):2066-75.

19. Low J, Williams D, Chaganti J. Polysplenia syndrome with agenesis of the dorsal pancreas and preduodenal portal vein presenting with obstructive jaundice—a case report and literature review. The British journal of radiology. 2011;84(1007):e219-e22.

20. Rose V, Izukawa T, Moes C. Syndromes of asplenia and polysplenia. A review of cardiac and non-cardiac malformations in 60 cases withspecial reference to diagnosis and prognosis. Heart. 1975;37(8):840-52.

21. Yılmaz G, Akpınar SH, Alıcıoğlu B. Polysplenia syndrome detected after chest symptoms in two adult patients: case report and review of literature. Polish journal of radiology. 2014;79:311-4.

22. Gatrad A, Read A, Watson G. Consanguinity and complex cardiac anomalies with situs ambiguus. Archives of disease in childhood. 1984;59(3):242-5.

23. Vijayvergiya R, Bhat MN, Kumar RM, Vivekanand SG, Grover A. Azygos continuation of interrupted inferior vena cava in association with sick sinus syndrome. Heart (British Cardiac Society). 2005;91(4):e26-e.