

Scimitar syndrome with late presentation

El síndrome de la cimitarra con presentación tardía

Laura María García-Henao^{1,2*}, Santiago A. Sánchez-Duque² y Héctor M. Erazo-Criollo^{1,2}

¹Facultad de Ciencias para la Salud, Universidad de Caldas; ²Hospital Universitario de Caldas SES. Manizales, Colombia

Abstract

Introduction: Scimitar syndrome is a congenital malformation with an incidence of 1-3 per 100,000 live births, consisting of abnormal drainage of the right pulmonary veins. The age of diagnosis varies according to the severity of the pathology, which depends on the degree of cardiac and pulmonary malformation. The case of a patient with a late diagnosis of the syndrome due to a silent course is reported despite severe anatomical alterations. **Clinical Case:** A 76-year-old female was admitted due to a 6-month clinical picture of progressive dyspnea to minimal efforts. A transthoracic echocardiogram was performed showing severe pulmonary hypertension of 96 mmHg with abnormal communication between the right pulmonary veins and the inferior vena cava, confirmed by CT angiography. **Discussion:** The late clinical course in relation to severe anatomical malformations has not been described in the scientific literature due to its high mortality in childhood.

Keywords: Scimitar syndrome. Pulmonary hypertension. Heart septal defects. Atrial. Heart diseases. Lung diseases.

Resumen

Introducción: El síndrome de la cimitarra es una malformación congénita con una incidencia de 1 a 3 por cada 100,000 nacidos vivos, que consiste en un drenaje anormal de las venas pulmonares derechas. La edad en el momento del diagnóstico varía según la severidad de la patología, la cual depende del grado de malformación cardíaca y pulmonar. Se reporta el caso de una paciente con diagnóstico tardío del síndrome dado por un curso silencioso a pesar de tener alteraciones anatómicas severas. **Caso clínico:** mujer de 76 años de edad quien se hospitaliza por un cuadro clínico de seis meses de evolución consistente en disnea progresiva de mínimos esfuerzos. Se le practica un ecocardiograma transtorácico evidenciando hipertensión pulmonar severa de 96 mmHG con una comunicación anormal entre las venas pulmonares derechas y la vena cava inferior, confirmada por angiografía por TC. **Discusión:** El curso clínico tardío con relación a las malformaciones anatómicas severas no se ha descrito en la literatura científica dada su alta mortalidad en la infancia.

Palabras clave: Síndrome de la cimitarra. Hipertensión Pulmonar. Defectos Septales Cardíacos, Atrial. Enfermedades Cardíacas.

Correspondence:

*Laura María García-Henao

E-mail: lauragarciah20@gmail.com

Date of reception: 24-11-2020

Date of acceptance: 09-06-2021

DOI: 10.24875/RCCAR.M22000148

Available online: 19-05-2022

Rev Colomb Cardiol. 2022;29(2):209-214

www.rccardiologia.com

0120-5633 / © 2021 Sociedad Colombiana de Cardiología y Cirugía Cardiovascular. Published by Permanyer. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Scimitar syndrome (SS) or venolobar syndrome is a congenital malformation consisting of total or partial anomalous drainage of the right pulmonary veins, more frequently to the inferior vena cava and to a lesser extent to the right atrium, left atrium, azygos vein, or suprahepatic veins^{1,2}; regularly associated with hypoplasia of the right lung and the right bronchial arterial tree^{3,4}. Some authors only consider the syndrome when the abnormal drainage occurs to the inferior vena cava, otherwise, they classify it as a variant of SS⁵. It was described by Cooper for the 1st time in 1836 after the autopsy of an infant⁶ and then named by Neill in 1960⁷. SS constitutes 0.5-2% of congenital heart disease (CHD), 3-5% of cases of abnormal return of pulmonary veins and it has been described in 3-6% of the patients with partial abnormal venous connections⁸⁻¹¹. There is an estimated incidence of 1-3 per 100,000 live births, with a female/male ratio of 2-1^{8,12}.

The age of diagnosis varies according to the severity of the symptoms, which is proportional to the degree of cardiac and pulmonary formation. To date, the highest reporting age has been associated with mild structural alterations¹³. The case of a patient with a late diagnosis of the syndrome is reported, despite severe pulmonary and cardiac alterations.

Clinical case

A 76-year-old woman from Manizales with a history of dextroposition diagnosed at age 30, at age 74, she was diagnosed with hypothyroidism and hypertension. She was admitted to the institution with a 6 months history of dyspnea with progressive worsening until minimal effort, concomitantly cough with hyaline expectoration and subjective fever; extension paraclinical tests with transesophageal echocardiography that reported severe pulmonary hypertension (PHT) 96 mmHg secondary to congenital shunt type atrial septal defect, dextroposition, and abnormal communication between the right pulmonary veins and the inferior vena cava, compatible with SS, confirmed by CT angiography (Figs. 1-2), which reported concomitant lung infection.

The patient consults 2 months later due to persistent dyspnea, despite the prescribed treatment, reporting symptoms compatible with pulmonary superinfection; outpatient spirometry report with a restrictive pattern that does not improve with a bronchodilator. Piperacillin tazobactam is administered and to optimize

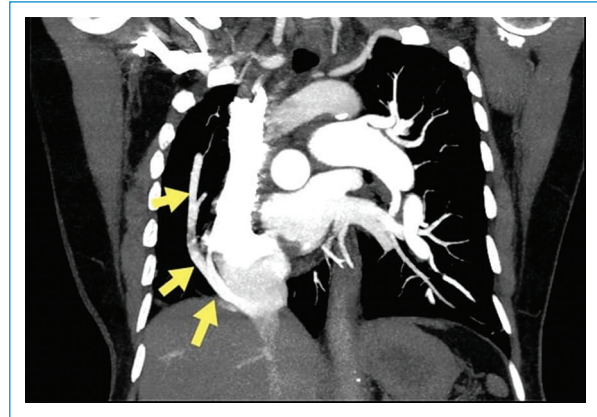


Figure 1. Yellow arrows point to scimitar vein in coronal section in chest CT angiography.

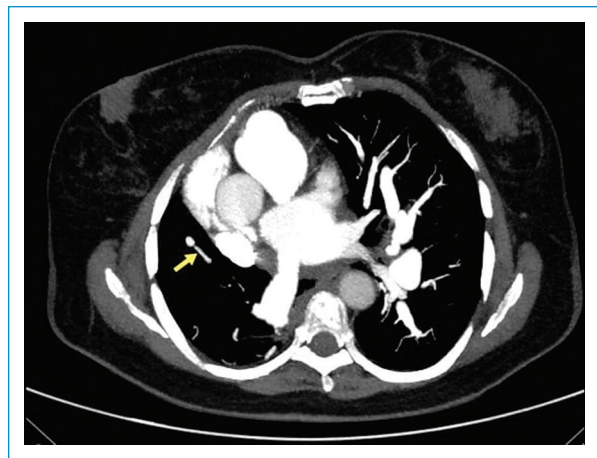


Figure 2. Yellow arrows point to scimitar vein in cross-section in chest CT angiography.

management. For severe PHT, a right catheterization was requested, which reported pulmonary arterial pressure 61/27, mean arterial pressure 40 mmHg, pulmonary vascular resistance 6.8 Wood units, pre-capillary PHT with a transpulmonary gradient of 30, pulmonary diastolic gradient of 17, RVP/SVR ratio 0.25, wedge pressure 10, and no secondary LV dysfunction; plethysmography was performed in which increased total pulmonary resistance was documented with an expiratory reserve volume of 0.76 OL (148%), total lung capacity 5.75 OL (128%), residual volume 3.85 (187%), RV/TLC ratio 66.9 (148%), and specific airway resistance 14.5. Once antibiotic management was completed, a poor response to management with bosentan was considered, so ambulatory management was changed to riociguat, with a better clinical response, to date without new consultations.

Discussion and review of the literature

The SS; also known as Halasz syndrome, mirror image lung syndrome, hypogenetic lung syndrome, right peribronchial pulmonary artery syndrome, and bronchovascular vena cava syndrome¹²; takes its name from the eastern saber with a long curved blade that resembles the shape of the drainage visible on the chest X-ray, known as the scimitar sign^{6,14}. Cardiovascular diseases, pulmonary hypoplasia, and dextrocardia or dextroposition have been reported as the most prevalent concomitants, which are more severe at a younger age of diagnosis so that only mild forms of the disease have been described in adults³.

The exact process that contributes to the development of SS is not currently known. However, it is estimated to be due to an embryological error in lung development in early embryogenesis⁹. To date, it has not been established as a hereditary syndrome and specific genes have not been implicated, however, in a recent article, a family case was described in which genetic analysis revealed a deletion of chromosome 15q 15.3 that has been associated with the syndrome of deafness-infertility secondary to alterations in the STRC and CATSPER2 gene, raising for the 1st time the possibility of finding autosomal dominant inheritance; however, complete sequencing is pending¹⁵.

Some authors made a hypothesis pathogenetic, consisting of a developmental alteration in Streeter's stage XIV (28-30 days of embryonic development), when the common pulmonary vein of the left atrium connects with the pulmonary venous sinus, at which time involution of the primary venous connections. However, the primitive canal of the primary pulmonary venous connection that empties into the suprahepatic portion of the inferior vena cava remains patent¹⁶.

The right pulmonary artery hypoplasia is thought to lead to ipsilateral pulmonary hypoplasia, due to decreased blood flow¹⁷. However, in another article, a hypothesis was raised based on the processes of lung development, which are inducing epithelium-mesenchymal interactions, growth, cell differentiation, movement, and apoptosis¹⁸. The first is responsible for the construction and differentiation of the bronchial tree and the establishment of the respiratory epithelium; it is believed that when this process is altered, it causes dysplasia and hypoplasia of the organ in the SS¹⁶. In addition, there is a case report in which the right pulmonary hypoplasia precedes the hypoplasia of the

pulmonary artery, for which the mechanism is considered to be bidirectional¹⁷.

Some anatomical variants of the syndrome have been described; the first is called "left variant," characterized by aortopulmonary collateral circulation to the left lung, with various degrees of hypoplasia of both the left lung and the pulmonary artery and at least one anomalous vein that drains to the inferior vena cava⁵. The second consists solely of the presence of an anomalous right pulmonary vein that drains to the inferior vena cava, without hypoplasia of the right lung or pulmonary artery. The third variant is given by the three characteristics mentioned in the first, together with a pulmonary venous drainage that can be normal or abnormal, and that goes to a different site from the inferior vena cava, the least frequent being the azygos vein^{5,19}. Concomitantly associated heart defects have been described, the most common being atrial septal defect (80%), patent ductus arteriosus (75%), ventricular septal defect (30%), and pulmonary vein stenosis (20%); however, tetralogy of Fallot, hypoplasia or coarctation of the aortic arch, and hypoplastic left heart syndrome can also be found⁹.

It is classified into three groups according to age and severity of symptoms⁴. Group I, called "isolated adult," constitutes the form in adults, they are typically acyanotic, asymptomatic; the diagnosis is generally made as an incidental finding or by the development of symptoms years or decades after birth in association with heart failure or cirrhosis²⁰; they may present with a small atrial septal defect and do not develop pulmonary arterial hypertension^{12,14,21}. Group II is characterized by its association with complex CHD, within which atrial septal defect and patent ductus arteriosus are excluded, it is known as "childhood CHD"; it is diagnosed in the neonatal period and presents with respiratory failure; it is commonly associated with PHT and due to its severity it frequently requires surgical treatment^{22,23}. Group III is the "isolated infantile" form, most frequently diagnosed in childhood, it begins with recurrent respiratory infections that generally affect the right lower lobe, the severity and frequency of infections are related to the degree of hypoplasia and PHT; it has a poor prognosis as it is commonly characterized by severe PHT^{12,14,21,24}.

Some authors have suggested that the partial anomalous pulmonary venous connection becomes clinically significant only when 50% or more of the pulmonary blood flow returns abnormally^{14,25}. In the bibliographic search carried out, few cases described in adulthood were found, all with mild cardiac anomalies, among

which a 57-year-old woman and two 68- and 84-year-old men stand out for being the longest-lived identified^{13,26,27}. No case was found with significant cardiac abnormalities in adulthood (dextroposition, atrial septal defect, or severe PHT), such as the patient reported in this case. It should be noted that in pregnant women with a de novo diagnosis, it forces the end of the pregnancy early²⁸.

The reasons for consultation in adulthood have been identified as dyspnea on exertion and recurrent respiratory infections; with a finding on physical examination of a precordial murmur^{12,29}. In infants, the condition usually appears with tachypnea, cyanosis, growth failure, and PHT³⁰.

PHT and the degree of pulmonary hypoplasia are recognized as the causes of the severe symptoms and poor prognosis of the syndrome, which can lead to premature death^{14,23,31-33}. A retrospective study with an average follow-up of 4.2 years with 80 patients found that the only independent risk factor associated with mortality is PHT³⁴. The major contributor to this is the large left-to-right shunt through the anomalous pulmonary vein or from the systemic arterial supply to the right lung³⁵. The shunt from left to right in adults is <50% in 82% of patients, in those who present it, more than 50% develop dyspnea, chest infections, and PHT³⁶. If the shunt is large enough, the right heart failure can occur³⁷.

Diagnosis

Clinical suspicion in adulthood arises in the presence of exertional dyspnea, exercise intolerance, or a chest murmur. A routine chest X-ray should be performed, where the scimitar sign may raise diagnostic suspicion. However, this occurs in 70% of cases in adolescence or adulthood and is usually absent in infants³⁸; it has also been reported in other vascular collaterals, so this sign is considered insufficient for its diagnosis^{11,38}. Other findings may include dextrocardia and volume loss in the hemithorax with compensatory hyperinflation of the abnormal lung¹².

Early diagnosis and appropriate treatment can improve the prognosis of patients³¹. Echocardiography is the technique of choice for the diagnosis of CHD, but it has several limitations in the detection and evaluation of pulmonary venous connections^{14,39}. Tomography, for its part, offers the possibility of non-invasive and rapid acquisition with high resolution, its main disadvantage being the use of ionizing radiation^{14,38-40}.

Cardiac catheterization and angiography are the most useful diagnostic studies to confirm SS, but they are not always necessary. They provide pulmonary vascular resistance, degree of left-to-right shunting, anomalous vein anatomy, grade of PHT, pulmonary artery anatomy, associated heart defects, and may demonstrate additional collateral systemic arteries from the thoracoabdominal aorta to the lung^{6,12,29,41}. However, it may not reveal the anatomical details of small accessory or anomalous vessels³⁶. Images with three-dimensional reconstruction clearly depict abnormal pulmonary venous structures, with detection rates approaching 100%³⁹.

Treatment

Treatment is carried out according to the age of diagnosis, the number, and the location of the anomalous veins. The infantile form tends to show signs of heart failure, so medical therapy should be started immediately; according to the persistence of the symptoms, angiography and obliteration of the abnormal systemic arteries can be performed using a catheter. This allows for clinical improvement by reducing abnormal flow and pulmonary artery pressure. However, if the patient has associated cardiac defects and is symptomatic or the pulmonary-to-systemic flow ratio is greater than 1.5 in asymptomatic patients, they benefit from surgical correction^{23,32,34}.

A relationship between a lower age at diagnosis with severe symptoms as an indicator of a very poor prognosis and an older age at diagnosis with a lower incidence of complications in surgical management and better survival is reported^{29,38}.

Surgical treatment can be achieved either by resecting the lung with abnormal venous drainage or by performing a surgical correction for flow redistribution⁹. Cardiopulmonary bypass methods that have been used include direct or indirect anastomosis of the scimitar vein in the posterior part of the left atrium when the atrial septum is intact, or division and reimplantation of the abnormal pulmonary vein in the right atrium, sometimes requiring the use of grafts. If the stenosis presents as a complication, dilation can be performed with a percutaneous balloon, with good hemodynamic and symptomatic improvement⁴².

A multicenter study of the demonstrated that corrective surgery can be performed safely with low mortality and morbidity, regardless of the type of surgical technique used, especially if it is performed before the

development of PHT⁴², thus the optimal moment to the intervention is preschool age^{12,14,42}.

In other studies, it has been reported that patients who have developed mild-to-moderate PHT, surgical repair is generally safe and effective, although medical and catheter-guided therapies may be safer. Finally, in patients who have already progressed to severe PHT, a lung transplant may be necessary^{12,32,42}.

Lobectomy or pneumonectomy is only indicated if there are recurrent infections, diffuse bronchiectasis, persistent hemoptysis, or marked hypoplasia of the right lung^{21,21,40,43}.

Conclusion

SS is a rare entity with a poor prognosis for life when it develops in conjunction with dextrocardia or dextroposition and PHT, the latter can be considered as the main cause of complication and predisposition to recurrent chronic and acute inflammatory lung diseases and its progression should be studied as a multicausal phenomenon.

The unusual presentation of the reported clinical case is highlighted given the age of the patient, mild symptoms during most of her life, associated with structural alterations of poor prognosis such as left to right flow, severe PHT, dextroposition, with restriction and decrease of lung capacity documented in paraclinical patients, a course not described to date in the scientific literature which highlights the importance of early diagnostic suspicion even in atypical presentations, and optimal medical management to control symptoms and PHT.

Funding

This manuscript was funded by the same authors.

Conflicts of interest

The author declare have no conflicts of interests.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the

patients or subjects mentioned in the article. The corresponding author is in possession of this document.

References

- Dupuis C, Charaf LA, Breviere GM, Abou P. "Infantile" form of the scimitar syndrome with pulmonary hypertension. *Am J Cardiol.* 1993;71:1326-30.
- Holt PD, Berdon WE, Marans Z, Griffiths S, Hsu D. Scimitar vein draining to the left atrium and a historical review of the scimitar syndrome. *Pediatr Radiol.* 2004;34:409-13.
- Dupuis C, Charaf LA, Breviere GM, Abou P, Rémy-Jardin M, Helmius G. The "adult" form of the scimitar syndrome. *Am J Cardiol.* 1992;70:502-7.
- Gao YA, Madrigueras PE, Benson LN, Rabinovitch M, Freedom RM. Scimitar syndrome in infancy. *J Am Coll Cardiol.* 1993;22:873-82.
- Bo I, Carvalho JS, Cheasty E, Rubens M, Rigby ML. Variants of the scimitar syndrome. *Cardiol Young.* 2016;26:941-7.
- Çiçek S, Arslan AH, Ugurlucan M, Yildiz Y, Ay S. Scimitar syndrome: the curved Turkish saber. *Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu.* 2014;17:56-61.
- Tirado FP, Faconi NPF, Corso RB, Silva IA. A very rare combination: two scimitar veins and a myocardial bridge. *Braz J Cardiovasc Surg.* 2020;35:229-31.
- González CJ, Bechara JK, Gómez JS, Olivares AS, Balderas LJ. Scimitar syndrome: case series. *Bol Méd Hosp Infant México.* 2014;71:367-72.
- Diaz J, Frias JW. Scimitar Syndrome. Treasure Island, FL: StatPearls; 2020, 1-12pp. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK546602/?report=classic>.
- Vida VL. The Complete Reference for Scimitar Syndrome. 1st ed. Padua: Universidad de Padua; 2018.
- Vida VL, Guariento A. A sword threatening the heart: the scimitar syndrome. *JTCVS Tech.* 2020;1:75-80.
- Kahrom M. Síndrome de Kahrom H. Scimitar y evolución de los manejos. *Pan Afr Med J.* 2009;3:20-20.
- Lacoma E, Sánchez L, Barlés PJ. Síndrome de la cimitarra de diagnóstico en la edad adulta. *Imagen Diagn.* 2017;8:30-1.
- Magalhães SP, Moreno N, Loureiro M, França M, Reis F, Alvares S, et al. Anomalous pulmonary venous connection: an underestimated entity. *Rev Port Cardiol.* 2016;35:697.e1-6.
- Mahendran A, Saidi A, Maegawa G, Peek G, Traub E, Bleiweis M, et al. Scimitar syndrome: a family matter. *J Am Coll Cardiol.* 2020;75 11 Suppl 1:2409.
- Muñoz L, Kuri M. Síndrome de la cimitarra. Correlación anatómo-embriológica. *Arch Cardiol México.* 2016;86:103-9.
- Hoshino Y, Arai J. Unusual course of scimitar syndrome preceded by lung hypoplasia. *Case Rep Pediatr.* 2019;2019:8927243.
- Carlson BM. Embriología Humana y Biología del Desarrollo. 6th ed. Madrid: Elsevier España; 2005.
- Bratincsák A, Rao RP, El-Said HG. Unusual variant of a rare constellation: a left-sided scimitar syndrome with connection to the azygos vein. *Congenit Heart Dis.* 2010;5:174-7.
- Pivato E, Arbune A, Rovner A, Murad K. Scimitar syndrome: an unexpected etiology of right-sided heart failure and cardiac cirrhosis in an elderly patient. *J Am Coll Cardiol.* 2018;71 Suppl 11:A2502.
- Wang H, Kalfa D, Rosenbaum MS, Ginns JN, Lewis MJ, Glickstein JS, et al. Scimitar syndrome in children and adults: natural history, outcomes, and risk analysis. *Ann Thorac Surg.* 2018;105:592-8.
- González JL, Fontoba JE, Garrido TC, San Roman CG, Concepción PM, Moreno JL, et al. Síndrome de la cimitarra: serie de 12 casos. *Cir Pediatr.* 1995;8:2-6.
- Schramel FM, Westermann CJ, Knaepen PJ, van den Bosch JM. The scimitar syndrome: clinical spectrum and surgical treatment. *Eur Respir J.* 1995;8:196-201.
- Kuiper-Oosterwal CH, Moolaert A. The scimitar syndrome in infancy and childhood. *Eur J Cardiol.* 1973;1:55-61.
- Haramati LB, Moche IE, Rivera VT, Patel PV, Heyneman L, McAdams HP, et al. Computed tomography of partial anomalous pulmonary venous connection in adults. *J Comput Assist Tomogr.* 2003;27:743-9.
- Jarroumi-Sellak I, Arenas-Gordillo M, García-Sánchez MÁ, Luque-Romeiro LG. Síndrome de la cimitarra en la edad adulta. *Aten Prim.* 2020;52:789-91.
- Alegre-Boschetti S, Babilonia JR, Valle I, Rivera EA. Atypical presentation of a rare congenital disease: scimitar syndrome in the elderly. *J Am Coll Cardiol.* 2019;73 9 Suppl 1:2293.
- Ashraf F, Bayoumi JC, Garg N. Scimitar syndrome diagnosed in advanced pregnancy: what to do. *JACC J.* 2018;71 Suppl 11:A2505.
- Gudjonsson U, Brown JW. Scimitar syndrome. *Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu.* 2006;9:56-62.

30. Perera I, Kumanan T, Guruparan M, Ragunathan I. Scimitar Syndrome: a Rare Cause of Right Sided Palpitations in an Adult. *Stings, Bites and Poisoning*; 2018. p. 71-4.
31. Yang J, Ding WW, Wang R, Li XF, Fan XM, Jin M. Clinical analysis of scimitar syndrome in 6 pediatric patients. *Zhonghua Er Ke Za Zhi Chin J Pediatr*. 2019;5:705-9.
32. Najm HK, Williams WG, Coles JG, Rebeyka IM, Freedom RM. Scimitar syndrome: twenty years' experience and results of repair. *J Thorac Cardiovasc Surg*. 1996;112:1161-8; discussion 1168-9.
33. Salas LA, Fiesco LS, Fernández JL. Percutaneous closure of the ductus arteriosus using an arteriovenous loop in a patient with scimitar syndrome. *Bol Méd Hosp Infant México*. 2017;74:55-9.
34. Dusenbery S, Geva T, Seale A, Valente AM, Zhou J, Sena L, et al. Outcome predictors in scimitar syndrome. *J Am Coll Cardiol* 2012;59 Suppl 13:E763.
35. Woody JN, Graham TP, Bradford WD, Sabiston DC, Canent RV. Hypoplastic right lung with systemic blood supply and anomalous pulmonary venous drainage: reversal of pulmonary hypertension with surgical management in infancy. *Soy Corazón J*. 1972;83:82-8.
36. Walles T, Lichtenberg A, Shiraga K, Klima U. Combined correction of an adult scimitar syndrome and coronary artery bypass grafting. *Ann Thorac Surg*. 2002;73:640-2.
37. Neal KA, Siegel MJ. The hypogenetic lung (scimitar) syndrome. *Radiology*. 2019;293:522.
38. Manso PE, de Melo V, Vera A. Scimitar sign in the absence of anomalous pulmonary venous drainage: a case report. *Eur Heart J*. 2019;3:1-4.
39. Dillman JR, Yarram SG, Hernandez RJ. Imaging of pulmonary venous developmental anomalies. *AJR Am J Roentgenol*. 2009;192:1272-85.
40. Vladimiro L, Guariento A, Milanese O, Gregori D, Stellin G. Natural history and surgical outcome of patients with scimitar syndrome: a multi-center European study. *Eur Heart J*. 2018;39:1002-11.
41. Masrani A, McWilliams S, Bhalla S, Woodard PK. Anatomical associations and radiological characteristics of Scimitar syndrome on CT and MR. *J Cardiovasc Comput Tomogr*. 2018;12:286-9.
42. Vida VL, Padalino MA, Boccuzzo G, Tarja E, Berggren H, Carrel T, et al. Scimitar syndrome: a European congenital heart surgeons association (ECHSA) multicentric study. *Circulation*. 2010;122:1159-66.
43. Vida VL, Padrini M, Boccuzzo G, Agnoletti G, Bondanza S, Butera G, et al. Natural history and clinical course of patients with "uncorrected" scimitar syndrome: a multicenter study from the Italian Society of Pediatric Cardiology. *Rev Esp Cardiol Engl*. 2013;66:556-60.