

PRESENTACIÓN DE CASO

Pentalogy of Cantrell: report of a case with consanguineous parents

Harry Pachajoa^{1,2}, Arelis Barragán³, Ángela Potes³, Javier Torres³, Carolina Isaza¹

¹ Departamento de Morfología, Facultad de Salud, Universidad del Valle, Cali, Colombia

² Facultad de Ciencias de la Salud, Universidad Icesi, Cali, Colombia

³ Departamento de Pediatría, Facultad de Medicina, Universidad del Valle, Cali, Colombia

Pentalogy of Cantrell is a syndrome evidencing five anomalies: a midline, upper abdominal wall abnormality; lower sternal defect; anterior diaphragmatic defect; diaphragmatic pericardial defect, and congenital abnormalities of the heart. Its prevalence is one in every 65,000 live births and a survival rate that is low if the fall the five defects are present or the gravity of the cardiac anomalies. It may be diagnosed during the first trimester obstetric ultrasound. For postnatal care, emission-computed tomography and magnetic resonance imaging is recommended for a clear definition of the extent of the defect and to design a course of corrective surgery. Herein, a case of pentalogy of Cantrell is reported for a child offspring of consanguineous parents.

Key words: *ectopia cordis*, congenital abnormalities, inheritance patterns; hernia, diaphragmatic; tomography, emission-computed; magnetic resonance imaging, pericardium.

Pentalogía de Cantrell: reporte de un caso de padres consanguíneos

La pentalogía de Cantrell es un síndrome que se caracteriza por cinco anomalías: un defecto de la pared abdominal en la línea media, un defecto esternal inferior, un defecto en el diafragma anterior, un defecto pericárdico diafragmático y anomalías congénitas del corazón.

Se presenta con una prevalencia de 1 en 65.000 nacidos vivos y con una baja tasa de supervivencia, la cual depende de la presencia de todos los defectos inherentes a este síndrome o la gravedad de las anomalías cardíacas.

El diagnóstico puede hacerse por ecografía obstétrica en el primer trimestre. Para la atención posnatal, las imágenes por tomografía computadorizada y la resonancia magnética se recomiendan para definir claramente la extensión del defecto y para la corrección quirúrgica. Se reporta un caso producto de padres consanguíneos.

Palabras clave: *ectopia cordis*, anomalías congénitas, patrón de herencia, tomografía computadorizada de emisión, imagen por resonancia magnética, hernia diafragmática, pericardio.

Pentalogy of Cantrell (OMIM 313850) was described in 1958 by Cantrell, naming it because of the presence of five major malformations, which include a midline, upper abdominal wall abnormality; lower sternal defect; anterior diaphragmatic defect; diaphragmatic pericardial defect; and congenital abnormalities of the heart (1,2). In the first description it was designated as a syndrome, with the assumption of a common etiological factor. In 1972, Toyama suggested a further classification of the syndrome: Class 1, definite diagnosis with all 5 defects present; Class 2, probable diagnosis with 4 defects noted (including intracardiac and ventral abdominal wall abnormalities); and Class 3, incomplete expression (3).

Mailing address:

Harry Pachajoa, Laboratorio de Citogenética, Universidad del Valle, Calle 4B N° 36-00, edificio 116, Cali, Colombia.

Telefax: (572) 518 5624

harrympl@yahoo.com

Recibido: 25/11/09; aceptado:10/06/10

As of 1990, the search for etiological factors suggested an alteration in the migration of the primordial mesodermic structures of the medial line (4). In 1993, a possible association was described in familial cases of a gene linked to the X chromosome in the Xq25-26.1 region (5).

Currently, the etiology of this syndrome is not clear and the syndrome is considered of heterogeneous origin. Reports of some familial cases have suggested inheritance linked to the X chromosome; however, other cases suggested a field defect of the embryo development; or a vascular disruption defect (6,7).

Herein, a male patient is presented with incomplete expression of pentalogy of Cantrell (Class 3), and who is the offspring of consanguineous parents. At the time of this submission, he has survived 40 days.

Case report

Newborn with pentalogy of Cantrell, offspring of second degree consanguineous parents without

familial antecedents of the condition (Figure 1); the birth is the product of a pregnancy of a 42-year-old mother, 4 pregnancies, 4 childbirths, who entered Hospital Universitario del Valle (Cali, Colombia) at 37 weeks of gestational age with diagnosis of omphalocele through second-trimester obstetric ultrasound. No history exists of acute or chronic disease, or of exposure to teratogens or of congenital malformations in family members.

The karyotype with G bands (700 bands) in fetal blood taken during the 16th week was reported as 46, XY, without apparent structural alterations. On the 37th week, a cesarean section was conducted, and

a born-alive male infant was obtained, measuring 50 cm, cephalic perimeter of 35 cm, weight: 3,290 g, and APGAR of 8 on the 1st minute and 9 on the 5th minute.

During the physical exam at birth, a defect of the thoraco-abdominal wall was detected that involved the inferior sternal portion and the midline of the abdominal wall to the infra-umbilical zone. Due to the defect and the opening provided by the umbilical cord, the heart (*ectopia cordis*), the liver, and the intestinal loops were protruding (figure 2).

The echocardiogram and the renal echography carried out during the first week of life were reported normal. At one and a half months of life, a thoraco-abdominal nuclear magnetic resonance was conducted with magneto superconductor at 1.5 Tesla and synchronization of respiratory frequency. Images were obtained in the TSE T2 sequence on the three planes and on the T1 axial plane without gadolinium. A 16-row multi-slice tomography for cardiac evaluation was also taken with intravenous contrast and EKG synchronization. It revealed a: closure defect of the anterior midline of the thorax, distal third of the abdomen, omphalocele containing the left ventricle of the heart, liver, small and large intestinal loops with a volume of 179 mm³; right diaphragmatic defect with herniated kidney and pulmonary hypoplasia on the same side. The heart was observed located on the medial line without intracardial or pericardial alterations and without

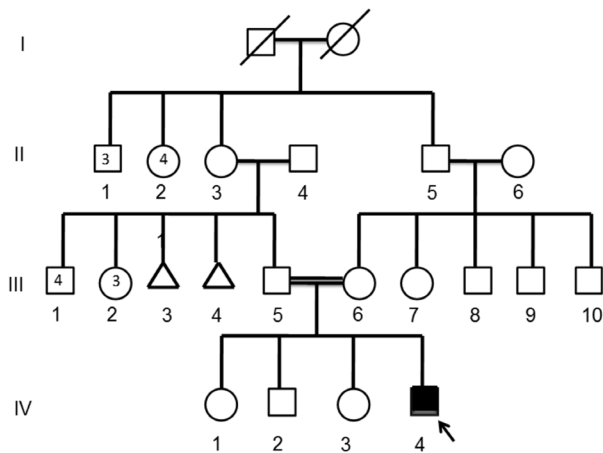


Figure 1. Genealogy of the patient with pentalogy of Cantrell, an offspring of consanguineous parents.



Figure 2. Patient at one day of birth, noting the amniotic membranes covering the liver, the intestinal loops, and the *ectopia cordis*.

enlarged vessels (figures 3 to 5). The mother has authorized the photography and the case publication in academic journals.

Discussion

The prevalence of pentalogy of Cantrell has been estimated to be one in 65,000 to 5.5 in a million

live births (8,9). Approximately 250 cases have been reported. Of these, 180 occurred in Europe and the United States; 50 to 60 in Japan; and 5 in Latin America (10). Herein, a patient is reported with diagnosis of class 3 pentalogy of Cantrell with a midline defect, upper abdominal wall abnormality, lower sternal defect, anterior diaphragmatic defect. The absence of diaphragmatic pericardial defect classified this case as a pentalogy of Cantrell of incomplete expression.

The pathogenesis of pentalogy of Cantrell is unclear. The defect is a consequence of the lack of fusion in the medial line of the mesoderm responsible for the formation of the thoraco-abdominal wall. The heart protrudes through a sternal defect, which can be from a cleft sternum or absence of the lower third of the sternum, producing *ectopia cordis*. The intestinal loops and liver protrude through the abdominal defect (involving the umbilical cord) and, creates the spectrum of abnormalities found in the pentalogy of Cantrell (2). Recently, a case was published of pentalogy of Cantrell associated with administration of the labor-inducing drug, misoprostol, where the authors proposed that the

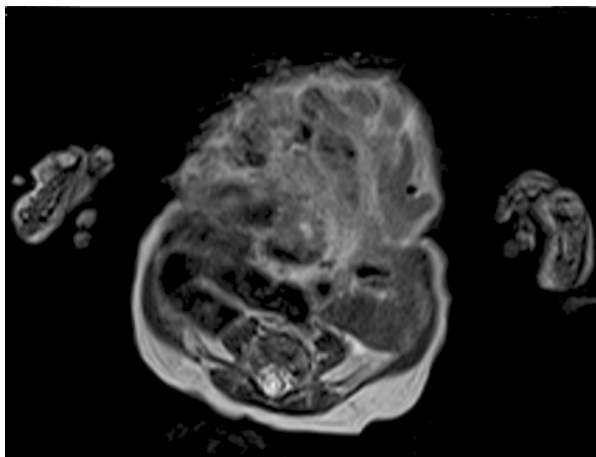


Figure 3. Powered magnetic resonance sequence at transverse relaxation time. Axial slice showing the defect on the abdominal wall where the intestinal loops are largely external to the cavity relative to the omphalocele.

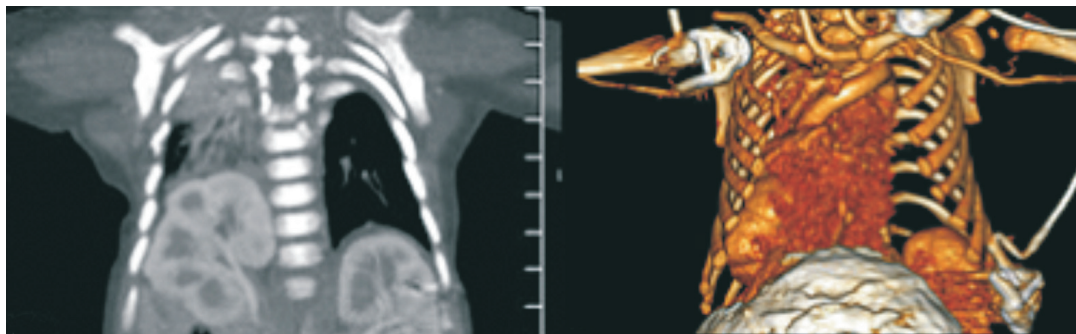


Figure 4. Powered magnetic resonance on T12 and 16-row multi-slice computed tomography. PMI reconstruction of the thorax. The right kidney is noted in the right thoracic cavity due to defect of the diaphragm. Atelectasis of the pulmonary apex is also present.



Figure 5. Sixteen-row multi-slice computed tomography. Reconstruction of the thorax is by volume rendering. Note the closure defect of the medial line with agenesis of the distal third of the sternum distal third. Much of the heart is outside the thoracic cavity (*ectopia cordis*) and fused to the upper part of the abdominal content.

failure of fusion may be secondary to vascular disruption.

The main abdominal wall malformation associated with this syndrome is omphalocele found in 74.5% of patients followed by deformed regions in the lower sternum (59.4%), diaphragm (56.8%), and pericardium (41.8%). Cardiac anomalies occur in 83% of cases; interventricular communication is the most common malformation (11).

Familial cases have been described, suggesting probable inheritance linked to recessive X (12). Because the parents are consanguineous in the current case, an autosomal recessive inheritance pattern was suggested.

Currently, the pentalogy of Cantrell is considered a high-mortality syndrome. In a 1996 study by Hornberger, mortality occurred at a rate of 50% in patients with *ectopia cordis* associated to a thoraco-abdominal defect (13). The long-term prognosis for children with this anomaly depends to a great extent on the complexity of the associated congenital heart defect (14,15).

The treatment of the pentalogy of Cantrell consists of corrective or palliative cardiovascular surgery, correction of ventral hernia and diaphragmatic defects and correction of associated anomalies. The best treatment strategy depends on the size of the abdominal wall defect, the associated heart anomalies, and the presence of *ectopia cordis* (16).

Few reports describe the methods for reconstruction of the thoraco-abdominal wall and sternum anomalies which accompany the syndrome of Cantrell, in spite of its association with cardiac anomalies where the rate of survival is low. However, cases have been reported of patients with excellent results of surgical correction of the defect of the thoracic wall and of the *ectopia cordis* (16).

Diagnosis via ultra-sonogram may be done during the first trimester, when malformations such as *ectopia cordis* and ventral abdominal defects are visible (16-18). Cases are difficult to diagnose where small defects occur in the pericardium or diaphragm, or if they occur in the inferior segment of the sternum without evident herniation of the heart (19).

Three-dimensional imaging of cardiac, thoracic, and abdominal malformations by MRI and helical computed tomography angiography is useful for diagnosis and for guiding surgical decisions in patients with pentalogy of Cantrell (20).

The differential diagnosis of this congenital defect is important and includes isolated *ectopia cordis* and the syndrome of amniotic bands. The key point for an adequate diagnosis is the position of the abdominal defect in relation to the insertion of the umbilical cord, the evisceration of the organs, the presence or absence of membranes or bands and associated anomalies (21-22). The defect of abdominal wall in pentalogy of Cantrell is characterized by being periumbilical, in the syndrome of amniotic bands defects or deformities are present in extremities with adhering bands. In pentalogy of Cantrell, the heart has a normal location in the thorax, which is different from what occurs with *ectopia cordis*, where the heart is located ectopically. The latter may not include pericardial, diaphragmatic, or abdominal wall defect, constituting the "true *ectopia cordis*," which is accompanied by a "complete sternal fissure" where the heart appears outside the thoracic cavity (23).

Conflict of interests

The authors state that they have no conflict of interests.

Financing

Universidad del Valle.

References

1. **Cantrell JR, Haller JA, Ravitsh MM.** A syndrome of congenital defects involving the abdominal wall, sternum, diaphragm, pericardium and heart. *Surg Gynecol Obstet.* 1958;107:602-14.
2. **Engum SA.** Embryology, sternal clefts, *ectopia cordis*, and Cantrell's pentalogy. *Semin Pediatr Surg.* 2008;17:154-60.
3. **Toyama WM.** Combined congenital defects of the anterior abdominal wall, sternum, diaphragm, pericardium and heart: a case report and review of the syndrome. *Pediatrics.* 1972;50:778-86.
4. **Carmi R, Meizner I, Katz M.** Familial congenital diaphragmatic defect and associated midline anomalies: Further evidence for an X-linked midline gene? *Am J Med Genet.* 1990;36:313-5.
5. **Carmi R, Parvari R, Weinstein J.** Mapping of an X-linked gene for ventral midline defects (the TAS gene). *Birth Defects Orig Artic Ser.* 1996;30:179-87.
6. **Parvari R, Carmi R, Weissenbach J, Pilia G, Mumm S, Weinstein Y.** Refined genetic mapping of X-linked thoracoabdominal syndrome. *Am J Med Genet.* 1996;61:401-2.
7. **Pachajoa H.** Pentalogía de Cantrell en un recién nacido expuesto en útero a misoprostol. *Rev Chil Obstet Ginecol.* 2010;75:47-9.
8. **van Allen MI, Curry C, Walden CE, Gallagher L, Patten RM.** Limb-body wall complex: II. Limb and spine defects. *Am J Med Genet.* 1987;28:549-65.

9. **Carmi R, Boughman JA.** Pentalogy of Cantrell and associated midline anomalies: A possible ventral midline developmental field. *Am J Med Genet.* 1992;42:90-5.
10. **Mitsukawa N, Yasunaga H, Tananari Y.** Chest wall reconstruction in a patient with Cantrell syndrome. *J Plast Reconstr Aesthet Surg.* 2007;62:814-8.
11. **Vázquez-Jiménez JF, Muhler EG, Daebritz S, Keutel J, Nishigaki K, Huegel W, et al.** Cantrell's syndrome: a challenger to the surgeon. *Ann Thorac Surg.* 1998;65:1178-85.
12. **Martin RA, Cunniff C, Erickson L, Jones KL.** Pentalogy of Cantrell and *ectopia cordis*, a familial developmental field complex. *Am J Med Genet.* 1992;42:839-41.
13. **Hornberger LK, Colan SD, Lock JE, Wessel DL, Mayer JE Jr.** Outcome of patients with *ectopia cordis* and significant intracardiac defects. *Circulation.* 1996;9(Suppl.9):II32-7.
14. **Wheeler DS, St Louis JD.** Pentalogy of Cantrell associated with hypoplastic left heart syndrome. *Pediatr Cardiol.* 2007;28:311-3.
15. **Pampoli A, Noccioli B, Pampaloni F.** *Ectopia cordis* and Cantrell's pentalogy: Personal experience and consideration of the surgical treatment. *Pediatr Med Chir.* 1997;19:59-64.
16. **van Hoorn JH, Moonen RM, Huysentruyt CJ, van Heurn LW, Offermans JP, Mulder AL.** Pentalogy of Cantrell: Two patients and a review to determine prognostic factors for optimal approach. *Eur J Pediatr.* 2008;167:29-35.
17. **Yao-Yuan H, Chien-Chung L, Chi-Chen C.** Prenatal sonographic diagnosis of Cantrell's pentalogy with cystic hygroma in the first trimester. *J Clin Ultrasound.* 1998;26:409-12.
18. **Bennett TL, Burlbaw J, Drake CK.** Diagnosis of ectopic cordis at 12 weeks gestation using transabdominal ultrasonography with color flow Doppler. *J Ultrasound Med.* 1991;10:695-6.
19. **Ghidini A, Sirtori M, Romero E.** Prenatal diagnosis of pentalogy of Cantrell. *J Ultrasound Med.* 1988;7:567-72.
20. **Cordoni G, Schlindwein S, Granero L, Gonçalves LF.** Pentalogy of Cantrell, early diagnosis at 9 weeks. En: Buyse ML, editor. *Birth Defects Encyclopedia.* Cambridge: Blackwell Scientific Publications; 1999.
21. **Oka T, Shiraishi I, Iwasaki N, Itoi T, Hamaoka K.** Usefulness of helical CT angiography and MRI in the diagnosis and treatment of Pentalogy of Cantrell. *J Pediatr.* 2003;142:83-4.
22. **Emanuel PG, García GI, Angtuaco TL.** Prenatal detection of anterior abdominal wall defects with US. *Radiographics.* 1995;15:517-30.
23. **Chopra S, Kalpdev A, Suri V, Aggarwal N, Rohilla M.** Complete *ectopia cordis* with anencephaly: A case report. *J Clin Ultrasound.* 2010;38:212-4.