SYMPOSIUM FETAL SURGERY IN LATIN AMERICAN COUNTRIES

Perinatal management of twin pregnancy discordant for intrapericardial teratoma: A case report and literature review

Manejo perinatal del embarazo gemelar discordante para teratoma intrapericárdico: Comunicación de un caso y revisión de la literatura

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ABSTRACT

This publication aims to provide an overview of the clinical course, treatment and perinatal outcome of twin pregnancies discordant for intrapericardial teratoma. Following PRISMA and Cochrane guidelines for systematic reviews, we selected all publications that published on prenatally diagnosed twin pregnancies discordant for intrapericardial teratoma. Seven publications were found, all of which were case reports and were included in the final analysis, plus a recent case presented in this publication. To date, 8 cases of twin pregnancies discordant for intrapericardial teratoma have been reported. All (8/8) had severe pericardial effusion, 5 (62.5%) developed hydrops and 2/8 (25%) polyhydramnios. Five (62.5%) cases were treated with pericardiocentesis and 2 (25%) underwent concomitant amniodrainage because of polyhydramnios. All cases were delivered by cesarean section with a median gestational age of 34 weeks (RIC 32-35) and all were operated within the first three days of life. In 7/8 cases (87.5%), the tumors originated in the ascending aorta. Both twins survived in all cases. In conclusion, pericardiocentesis (+/- amniodrainage) of the affected twin is the only fetal therapy reported to date in twin pregnancy discordant for intrapericardial teratoma and the results are encouraging, although the evidence is scarce. Prenatal treatment of twin pregnancies presenting with this pathology should only be considered in the context of a highly trained multidisciplinary care team.

Key words: Pregnancy, twin, Teratoma, Heart defects, congenital, Fetal therapies, Prenatal diagnosis, Pericardiocentesis

RESUMEN

Esta publicación tiene como objetivo proporcionar una visión general de la evolución clínica, el tratamiento y el resultado perinatal de embarazos gemelares discordantes para teratoma intrapericárdico. Siguiendo las guías PRISMA y Cochrane para revisiones sistemáticas, se seleccionaron todas las publicaciones que publicaron sobre embarazos gemelares discordantes para teratoma intrapericárdico diagnosticados prenatalmente. Se encontraron 7 publicaciones, todas ellas correspondieron a reportes de casos y fueron incluidos en el análisis final, sumado un caso reciente presentado en esta publicación. Hasta la fecha, se han informado 8 casos de embarazos gemelares discordantes para teratoma intrapericárdico. Todos (8/8) presentaron derrame pericárdico severo, 5 (62,5%) desarrollaron *hidrops* y 2/8 (25%) polihidramnios. Cinco (62,5%) casos fueron tratados con pericardiocentesis y a 2 (25%) se les realizó amniodrenaje concomitante, por presentar polihidramnios. Todos los casos nacieron por cesárea con una mediana de edad gestacional de 34 semanas (RIC 32 a 35) y todos fueron operados dentro de los tres primeros días de vida. En 7/8 casos (87,5%), los tumores se originaron en la aorta ascendente. En todos los casos, ambos gemelos sobrevivieron. En conclusión, la pericardiocentesis (+/- amniodrenaje) del gemelo afectado es la única terapia fetal comunicada hasta la fecha en embarazo gemelar discordantes para teratoma intrapericárdico y los resultados son alentadores, aunque la evidencia es escasa. El tratamiento prenatal de embarazos gemelares que presentan esta patología solo debería considerarse en el contexto de un equipo de atención multidisciplinario altamente capacitado.

Palabras clave. Embarazo gemelar, Teratoma, Cardiopatías congénitas, Terapias fetales, Diagnóstico prenatal, Pericardiocentesis

Introduction

Primary congenital cardiac tumors are rare and account for 0.14% of all patients referred for fetal echocardiography, with teratomas affecting less than 2% of such cases[1,2]. Intrapericardial teratomas originate in the myocardium or pericardium and grow into the pericardial cavity[2]. They are usually diagnosed by prenatal ultrasound as a well-demarcated mass, which may have a cystic component and involve the outflow tracts and are typically associated with pericardial effusion[3]. The differential diagnosis includes other cardiac tumors such as rhabdomyomas, lymphangiomas, fibromas, myxomas and hemangiomas, as well as pulmonary and mediastinal tumors[1-5].

Teratomas are generally benign and are not usually associated with other cardiac or extracardiac abnormalities[6]. However, due to their rapid growth and the development of severe pericardial effusion they can cause thoracic organ pressure[7]. Cardiac and vascular compression can lead to cardiac tamponade, hydrops and fetal death. Lung compression may cause pulmonary hypoplasia and esophageal constriction can lead to polyhydramnios with an increased risk of premature rupture of membranes (PROM) and preterm delivery[6-8].

Using ultrasound guidance, serial pericardiocentesis can be performed, as well as placement of a pericardium-amniotic shunt to drain the pericardial effusion and decrease intrathoracic pressure[9-12]. Similarly, ultrasound-guided percutaneous laser ablation of the tumor nutrient artery and intratumoral laser have been reported to be effective in delaying its growth and the recurrence of pericardial effusion[6,13]. Postnatal surgical resection is generally curative, but follow-up based on echocardiography, magnetic resonance imaging (MRI) and serum tumor markers (alpha-fetoprotein, sub-beta hCG) is recommended to confirm complete remission[14].

In twin pregnancies discordant for cardiac teratoma, the perinatal team is faced with the dilemma of trying to prevent fetal death of the affected twin by invasive prenatal treatment and/or planned preterm delivery, but at the same time preserving the well-being of the normal twin by avoiding prematurity[7,15-20].

This publication aims to report a recent case of a dichorionic diamniotic (DCDA) twin pregnancy discordant for intrapericardial teratoma, and also to perform a review of the literature to analyze the presentation, management and perinatal outcomes of all reported cases of twin pregnancies with prenatal diagnosis of this condition.

Case report

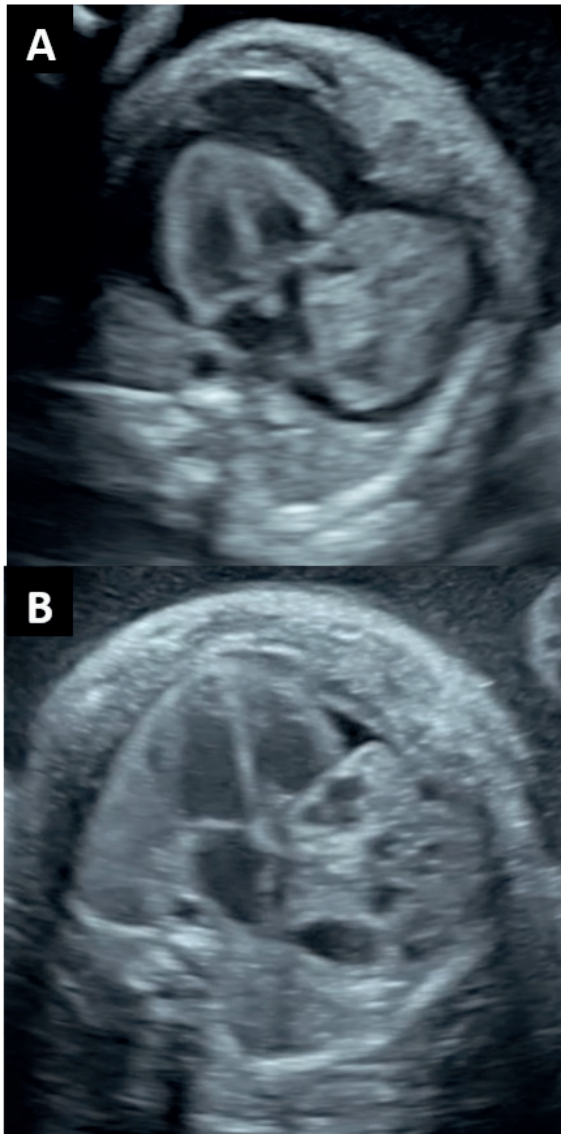
A 33-year-old healthy nulliparous primigravid woman conceived a DCDA twin pregnancy by in vitro fertilization (IVF) with double embryo transfer at blastocyst stage. The first trimester combined trisomy screening was low risk and reported a normal anatomical examination for both fetuses, so she was referred to her local hospital for follow-up from 20 weeks gestation.

At 26+3 weeks+days she was referred to the Hospital Privado Universitario de Córdoba (HPUC), Argentina, after an abnormal cardiac mass was identified in one of the fetuses.

On ultrasound examination, fetus A (unaffected) had an estimated fetal weight (EFW) of 866 g (pc20). Amniotic fluid, anatomy and Doppler velocimetry were normal. Fetus B (affected) had an EFW of 1,193 g (pc96) and polyhydramnios with a maximum vertical pocket (MVP) of 12 cm. Echocardiography reported a heterogeneous mass measuring 30 mm x 26 mm x 23 mm with multiple cysts originating from the anterolateral wall of the right atrium, in close relation to the left outflow tract and protruding into the pericardial space, accompanied by massive pericardial effusion with bilateral pulmonary compression (Figure 1A). Cardiac contractility was preserved and both the biometry of the right and left ventricular outflow tracts and their Doppler parameters were normal. Cervical length on transvaginal examination was 24 mm. We hypothesized that the polyhydramnios was a consequence of esophageal compression caused by severe pericardial effusion, but in the absence of fetal hydrops we opted for expectant management and close monitoring of cervical length, since we had no previous cervical measurements that would allow us to ensure that there was progressive shortening. Fetal lung maturation with betamethasone had already been completed before referral to HPUC.

One week later, although the cervical length remained stable, the affected fetus developed ascites and the multidisciplinary team suggested the parents active management. Although we have experience with ultrasound-guided laser interventions and intrauterine shunt placement, we considered that intratumoral laser ablation and pericardial-amniotic shunting might be more aggressive, riskier, more protracted interventions with limited evidence on their potential benefits. Amniodrainage followed by pericardiocentesis was proposed to the parents. At 27+6 weeks+days, under local anesthesia and under ultrasound guidance, a 17-gauge needle was inserted into the amniotic sac of the affected fetus in the direction of the fetal thorax. A rapid amniodrainage of 2,000 mL was performed using central aspiration until an MVP of 8 cm was reached. A metal guide wire was then introduced through the needle to protect its tip and prevent it from causing possible injury to the fetus, membranes or placenta while ultrasound monitoring was interrupted to proceed with fetal anesthesia. Intramuscular anesthesia was administered in the fetal thigh (fentanyl, atropine and rocuronium) under ultrasound guidance using a 21-gauge needle. Once fetal paralysis was confirmed, the guide wire of the 17-gauge needle was removed and pericardiocentesis was performed under ultrasound guidance. A total of 20 mL of clear pale-yellow fluid was drained (Figure 1B) and the needle was removed. The procedure was concluded without complications. The patient was started on a 48-hour course of intrarectal indomethacin for tocolysis. She was discharged home asymptomatic 12 hours after the procedure. Pericardial fluid cytology revealed the presence of mesothelial cells without atypia.

Figure 1. Axial view of the affected fetus at the level of the four-chamber view of the heart. A: At 26+3 weeks, showing the tumor in relation to the right atrium associated with severe pericardial effusion surrounding the heart and the tumor and compressing both lungs against the posterior chest wall. B: At 28 weeks, the day after the first pericardiocentesis, showing minimal pericardial effusion and lung re-expansion.



At subsequent follow-up, the mother developed pregnancy-induced hypertension with severe lower extremity edema, which was treated with labetalol. Urinalysis, platelet count and liver enzymes were normal. In the affected fetus ascites persisted while pericardial effusion and polyhydramnios rapidly recurred. At 29+4 weeks+days (12 days after the invasive procedure), the severity of pericardial effusion and extent of polyhydramnios reached levels similar to those observed on the day of the initial pericardiocentesis (MVP 12 cm), the fetus was hydropic, and the cervix had shortened (12 mm). The amniodrainage procedure was repeated followed by pericardiocentesis using the technique already described, draining 2,500 mL of amniotic fluid (to achieve an MVP of 8 cm) and 30 mL of clear pale-yellow pericardial fluid.

Due to the high risk of an untimely preterm delivery, the multidisciplinary team offered the parents a planned cesarean section to maximize the chances of providing adequate care for both neonates. At 30+5 weeks+days, after a single dose of betamethasone to enhance fetal lung maturation, and having established neuro-

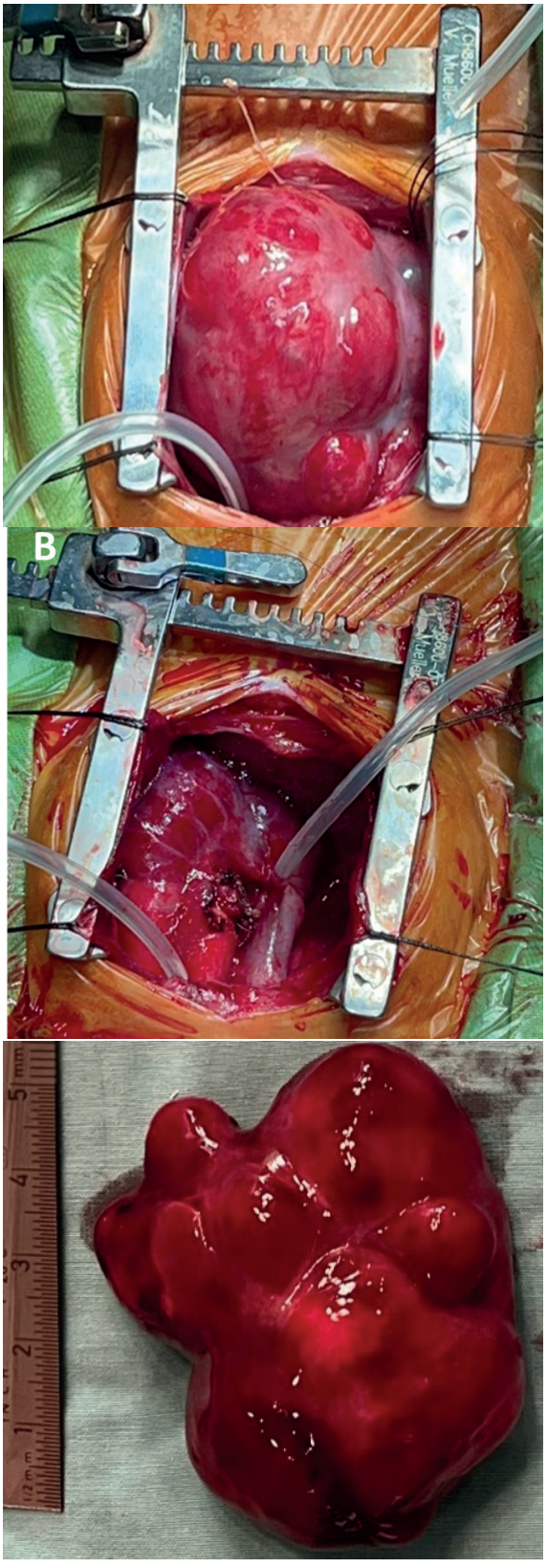
protection with magnesium sulfate, a planned cesarean section was performed. Each neonate was attended by a full neonatology team that included neonatologists and pediatric cardiologists. The entire pediatric cardiac surgery team was on site ready to intervene, and an adjacent operating room was prepared.

The unaffected twin (1,230 g, female) had a low heart rate (<100 beats per minute), cyanosis and poor respiratory effort, requiring T-piece resuscitation with a good response within 2 minutes of initiation. Noninvasive ventilation was maintained for 48 hours.

The affected twin, also female, had an estimated birth weight of approximately 1,500 g and presented bradycardia and respiratory distress requiring cardiac massage for less than 1 minute and orotracheal intubation. Under ultrasound guidance, 50 mL of ascitic fluid was drained. The neonate was immediately taken to the operating room. Median sternotomy was performed. Once the pericardial cavity was opened, a multilocular mass of approximately 5 cm in diameter was found (Figure 2A). The tumor cysts were aspirated with a needle to reduce their size. The tumor was attached to the lateral root of the aorta through a vascular pedicle. Complete tumor resection was achieved without complications (Figure 2B). Histopathological examination revealed an immature intrapericardial teratoma measuring 55 mm x 45 mm x 23 mm (Figure 2C).

Both twins were discharged at 34 days of age. At one year of age, both girls show normal neurological development, and the affected twin shows no signs of tumor recurrence.

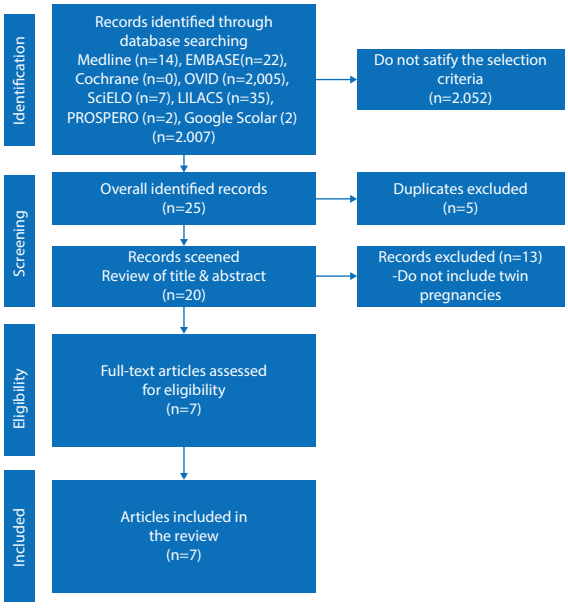
Figure 2. Images taken during neonatal surgery. A: Appearance of the cardiac mass after median sternotomy. B: Once complete tumor resection has been achieved. C: Surgical specimen sent for anatomopathological study.



Materials and methods

Based on the research question "What are the perinatal outcomes in twin pregnancies discordant for prenatally diagnosed intrapericardial teratoma?", a review of the literature was performed following the Cochrane manual and PRISMA guidelines[21,22]. The protocol was agreed upon by all authors, following the PICO format (population, intervention, control and outcome) for observational studies where: 1) the population was pregnant women with twin pregnancies with involvement of one of the fetuses by intrapericardial teratoma; 2) who underwent any of the following interventions: observation,

Figure 3. Flowchart of study selection.



drainage (either by pericardiocentesis and/or pericardio-amniotic shunt), laser therapy, open fetal surgery or resection in ex utero intrapartum treatment (EXIT); 3) given the types of studies found the definition of a control population is not precise; and 4) the outcome was the perinatal outcome of both fetuses.

A literature search from January 1, 1982 (year in which the first case of a prenatally diagnosed cardiac tumor was published)[23] through December 18, 2023 was performed through MEDLINE, EMBASE, Cochrane, Ovid, SciELO, LILACS, and PROSPERO, in order to identify relevant articles. Some articles were manually searched, and Google Scholar was also used to locate potentially relevant information. The case reported in this publication was included in the final analysis.

Randomized controlled clinical trials (RCTs), non-randomized studies, prospective and retrospective observational studies, case series and case reports evaluating the perinatal outcome of twin gestations with prenatal diagnosis of discordance for intrapericardial teratoma were included.

Publications on twin pregnancies that had cardiac tumors other than intrapericardial teratoma and those that were diagnosed postnatally were excluded.

In the search strategy, the following MeSH terms were used: (twin OR twins) AND ("cardiac teratoma" OR "pericardial teratoma" OR "intrapericardial teratoma" OR "cardiac tumor") AND (fetal) AND ("perinatal outcome"). To broaden the literature search algorithm, other common terms were included. Two of the authors (GPS and RD) independently searched and reviewed studies for credibility and assessed the risk of biased results. Disagreements found were resolved by discussion between the two reviewers and if necessary, by a third and fourth author (SM and WE). The type of studies included did not allow the use of other assessment tools such as those available from the Joanna Briggs Institute (JBI).

Data on perinatal findings, management, and outcomes were extracted and analyzed using an Excel designed database (MS Office 365; Microsoft Corp.; Montain View, CA, USA). Quantitative and qualitative analysis of each of these data was performed as appropriate.

Results

The review of the literature identified 2,077 records, of which 2,052 were excluded because they did not meet the inclusion criteria and 5 because they were duplicates. The remaining 20 studies were subjected to full-text evaluation; of these, 13 were excluded because they were singleton pregnancies. Finally, 7 records of twin pregnancies discordant for prenatally diagnosed intrapericardial teratoma were included in the analysis. The PRISMA diagram of the records analyzed and included in this review is shown in Figure 3.

Of the 7 records that met the inclusion criteria, all corresponded to case reports.

Considering the 7 cases found in the review, and including the case reported in the present publication, the final analysis was performed on a total of 8 cases. The median and interquartile range (IQR) for gestational age (GA) at diagnosis was 27.5 weeks (24.75 to 32). All cases reported pericardial effusion, 5/8 (62.5%) had hydrops and 2/8 (25%) developed polyhydramnios.

Regarding fetal invasive therapy, 3/8 cases (37.5%) did not receive any type of treatment. Of these, none had polyhydramnios and 2/3 had hydrops of the affected fetus. On the other hand, 5/8 cases (62.5%) were treated with pericardiocentesis. Of these 3/5 had hydrops of the affected fetus

and 2/5 had polyhydramnios, for which concomitant amniodrainage was performed. No cases of twin pregnancies discordant for intrapericardial teratoma treated with pericardial-amniotic shunt, laser therapy, open fetal surgery or resection in EXIT have been reported.

All cases were terminated by cesarean section and the reasons for termination of pregnancy were hydrops of the affected twin in 3/8 cases (37.5%), threatened preterm delivery in 2/8 cases (25%), hydrops of the affected twin together with severe cervical shortening in 1/8 case (12.5%) and elective termination in 2/8 cases (25%). The median and IQR for GA at birth was 34 weeks (32-35 weeks).

Regarding postnatal surgery, 4/8 cases (50%) were operated within the first day of life, and all within the first 3 days of life. The tumor originated from the ascending aorta in all cases except one, in which the exact origin is not specified. None required extracorporeal circulation during resection.

All twins (8/8) were discharged alive and 5/8 (62.5%) reported adequate development at 1 year of surveillance. A summary of the findings, management and results during the prenatal and postnatal stages are presented in Table 1 and Table 2, respectively.

Discussion

Of the records that met the inclusion criteria in this review of the literature, all corresponded to case reports, demonstrating the low prevalence of intrapericardial teratoma and in particular its occurrence in twin pregnancies[7,15-20].

Regarding prenatal findings in this type of tumor, a systematic review by Nassr et al. in 2017 that included singleton and twin pregnancies reported that, out of a total of 67 fetuses with intrapericardial teratoma, 70% of cases developed hydrops and 25%, polyhydramnios[9]. Our results in twin pregnancies were similar with 62% of cases presenting hydrops and 25% of cases having polyhydramnios. Regarding prenatal management, Nassr et al. reported that of a total of 40 singleton fetuses with intrapericardial teratoma presenting with hydrops, those who underwent fetal interventions (n = 18) had better survival compared to those who did not receive prenatal treatment (72% vs. 36%, respectively). Of note, the majority (10/18) were treated with pericardiocentesis and had a low rate of complications, accounting for one intrauterine death and one preterm delivery, with no premature rupture of membranes (PROM) or maternal complications. In contrast, other fetal therapies, which were less frequent, showed higher rates of complications. Pericardio-amniotic shunt (+/- previous

Table 1. Prenatal characteristics: finding, management and outcome in twin pregnancies discordant for intrapericardial teratoma.

Author, year	Chorionicity	GA at diagnosis (weeks)	Hydrops	Polyhydramnios	Fetal cardiac intervention	Amniodrainage	GA 1st intervention (weeks)	GA at termination (weeks)	Reason for termination	Mode of termination
Paw et al, 1997	ND	24	Yes	No	Multiple pericardiocentesis	No	30	34	Hydrops	EC
Sklansky et al, 1997	BCBA	20	Yes	No	Pericardiocentesis x 2	No	24	35	Hydrops	EC
Valioulis et al, 1999	BCBA	32	No	Yes	Pericardiocentesis x 1	x3	32	34	Elective	EC
Fagiana et al, 2010	ND	25	No	No	No	No	-	36	Elective	EC
Eyileten et al, 2014	MCBA*	29	No	No	Pericardiocentesis x 1	No	31	32	APP	EC
Milovanovic et al, 2014	ND	32	Yes	No	No	No	-	32	Hydrops	EC
Mohamed et al, 2018	ND	33	Yes	No	No	No	-	35	TPB	EC
Gil Pugliese et al, 2023	BCBA	26	Yes	Yes	Pericardiocentesis x 2	x2	27	30	Hydrops + cervical shortening	EC

*GA: Gestational age, ND: Not declared, EC: Elective cesarean section, BCBA: Bicorporeal biamniotic, MCBA: Monochorionic biamniotic, TPB: Threatened premature birth, *Probably.*

Table 2. Neonatal characteristics: findings, management and outcomes in twin pregnancies discordant for intrapericardial teratoma.

Author, year	Birthweight affected twin (g)	Age at postnatal surgery (days)	Mean tumor diameter (mm)	Tumor location	Cardiopulmonary bypass	Histopathological findings	Double survival
Paw et al, 1997	2,335	1	60	AAo anterior wall	Not required	Intrapericardial teratoma	Yes
Sklansky et al, 1997	2,300	1	60	AAo anterior wall	Not required	Benign teratoma	Yes
Valioulis et al, 1999	2,370	2	40	AAo anterior wall	Not required	Mature teratoma	Yes
Fagiana et al, 2010	ND	1	40	AAo sidewall	Not required	Intrapericardial teratoma	Yes
Eyileten et al, 2014	1,500	2	47	AAo sidewall	Not required	Immature teratoma	Yes
Milovanovic et al, 2014	2,170	3	43	AAo anterior wall	Not required	Immature teratoma	Yes
Mohamed et al, 2018	ND	2	38	Heart base	Not required	Immature teratoma	Yes
Gil Pugliese et al, 2023	1,500	1	40	AAo sidewall	Not required	Immature teratoma	Yes

AAo: ascending aorta, ND: Not declared. Note: Descriptions of histopathological findings were transcribed from the original publications

pericardiocentesis) was used in 5/18 cases and was associated with one fetal death, one PROM and one preterm delivery. Open fetal surgery was used in 2/18 cases resulting in 1 neonatal death and 1 fetal death, which was also accompanied by a severe maternal complication in the subsequent pregnancy with uterine rupture, fetal death, and risk of maternal death. Finally, there was 1 case that was managed with resection in EXIT with favorable outcome. In line with these findings, our review found that pericardiocentesis (with amniodrainage in cases with polyhydramnios) is the only fetal cardiac intervention performed in twin pregnancies discordant for intrapericardial teratoma and was used in 5 of the 8 published cases with this pathology. Its results are promising with survival of both twins in all cases, with no reported PROM or maternal complications, and only 1 of the 5 cases treated presented preterm labor at 32 weeks (one week after fetal pericardiocentesis)[19].

If fetal intervention is necessary, the treating team should consider that, in expert hands, fine needle pericardiocentesis is an uncomplicated procedure that can be repeated if necessary and has had acceptable results. In contrast, intrauterine placement of a pericardio-amniotic shunt requires the use of a thicker trocar, is technically more complex and does not avoid the need for a new intervention in all cases, since catheter migration has been described[18]. The evidence on the use of shunt or intratumoral laser in the treatment of singleton pregnancies is very scarce and its use in twin pregnancies has not been reported. On the other hand, open fetal surgery and tumor resection in EXIT have no role in twin pregnancies and are likely to be completely replaced in the treatment of singleton pregnancies by minimally invasive ultrasound-guided techniques that are safer for the mother.

Chorionicity was reported in only 3 (37.5%) of the cases analyzed in this publication and all corresponded to DCDA pregnancies. The case published by Eyileten et al in 2014 was reported as a monozygotic twin pregnancy, without reference to its chorionicity, so we hypothesized that it could have been a monochorionic biamniotic twin pregnancy (MCBA). In the management of MCBA twins, it should be kept in mind that intrauterine death of the affected twin may result in death or severe neurological impairment of the healthy twin as a consequence of acute hemorrhage through the abnormal vascular anastomoses present in the shared placenta.

Since chest compression during an eventual vaginal delivery of the affected fetus could result in cardiac tamponade, the route of birth of choice for fetuses with intrapericardial teratoma is by cesarean section, beyond the considerations regarding the route of delivery in twin pregnancies[15]. For this reason, when faced with the appearance of progressive cervical shortening or threat of preterm delivery, the team should consider terminating the pregnancy by scheduled cesarean section, allowing at the same time adequate preparation of the reception and neonatal cardiac surgery teams. All cases included in this publication were terminated by cesarean section.

With the aim of preventing fetal death of the affected twin and avoiding prematurity to preserve the well-being of the normal twin, it would seem

reasonable to assume the risks associated with invasive fetal procedures in the face of hydrops or polyhydramnios at gestational ages far from term.

Although twin pregnancies discordant for intrapericardial teratoma represent a challenge, treating teams should remain enthusiastic in these cases, as all twin pairs included in this publication survived.

A limitation of this study is that our results may be influenced by publication bias, as it is possible that the authors or editors did not consider cases with unfavorable outcomes for publication.

In conclusion, when faced with a twin pregnancy discordant for intrapericardial teratoma, it is essential to preserve the well-being of the normal twin. Pericardiocentesis (+/- amniodrainage) of the affected twin is the only fetal therapy reported to date and the results are encouraging, although the evidence is scarce. Prenatal treatment of these cases should only be considered in the context of a highly trained multidisciplinary care team.

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