Pericardial effusion (PE) is occasionally reported in children with Down’s syndrome (DS) either in isolation\(^1\) (isolated PE) or as part of hydrops.\(^5\) It can be associated with congenital hypothyroidism\(^2\) and transient myeloproliferative disorder (TMD).\(^4\) The pathogenesis of PE in DS is unclear. We describe a case of antenatally detected isolated pericardial effusion in DS in association with TMD, liver failure, hypothyroidism, and hypotension due to possible adrenal insufficiency. We reviewed the literature to understand the underlying mechanism, demography, association, and natural course of PE.

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Case Report

Antenatal morphology scan and fetal echocardiography in a 39-year-old G3P3 mother revealed isolated PE with structurally normal heart, first identified at 20 weeks of gestation. Subsequent amniocentesis confirmed DS (47,XY). A male neonate at 35 4/7 weeks gestation, birth weight 1,880 g (< 10th centile) was vaginally born at home through precipitous labor, needed no resuscitation and was retrieved to a tertiary Neonatal Intensive Care Unit by ambulance at 40 minutes of age. Initial examination showed moderate respiratory distress with FiO2 (fraction...
of inspired oxygen) 0.3, pallor (Hb 83 g/L), normal cardiovascular examination with normal noninvasive blood pressure (60/32, mean: 45), massive hepatomegaly (6 cm below costal margin) in the background of phenotypic DS. There was no hydrops, ascites or splenomegaly. He was stabilized with mechanical ventilation and packed cell transfusion (10 mL/kg twice). His liver function and coagulation profile were deranged: alanine transaminase (ALT) 318 IU/L, aspartate transaminase (AST) 1,147 IU/L; total bilirubin 41 micromol/L, direct bilirubin 6 micromol/L; alkaline phosphatase 163 IU/L; gamma glutamyl transferase (GGT) 389 IU/L; prothrombin time 46 second; activated partial thromboplastin time (APTT) 128 second international normalized ratio (INR) 5.2; fibrinogen 1.2 g/L; ammonia 69 micromol/L. There was no spontaneous bleeding. He received fresh frozen plasma (10 mL/kg). Echocardiography showed normal structure apart from a generous interatrial communication with predominant left to right shunt. There was a global pericardial effusion measuring 5 mm in four chamber view in diastole, with a larger pocket located anteromedially (►Fig. 1). There was a good biventricular function and no evidence of tamponade.

Over the next 6 hours, he developed progressively worsening hypotension (lowest invasive BP [blood pressure] of 31/18, mean: 23) refractory to volume boluses and multiple inotropes (Dopamine 20 microgram/kg/min; Dobutamine 20 microgram/kg/min; adrenaline 0.5 microgram/kg/min) in escalating doses. Blood pressure started to improve after commencing hydrocortisone (2 mg/kg/loading dose, once followed by 1 mg/kg/dose 6 hourly). Cortisol level was not obtained prior to commencing on hydrocortisone. He was then restarted on hydrocortisone at 1 mg/kg/dose 6 hourly with good response. Unfortunately, no cortisol level was obtained prior to commencing on hydrocortisone.

He developed progressive liver failure, splenomegaly with ascites. Investigations showed elevated transaminases and deranged coagulation profile. TORCH screening (Toxoplasma, Others, Rubella Cytomegalovirus, Herpes Simplex Virus), metabolic work-up including α1 antitrypsin, urine metabolic screen, and transferrin isoform were negative. Tense ascites needed peritoneal drainage of large amount of transudate. Ultrasound showed coarse echogenicity consistent with liver fibrosis/cirrhosis and collaterals suggestive of portal hypertension.

![Fig. 1](image) Echocardiographic image showing pericardial effusion.
Multidisciplinary team opined that in view of continued deterioration despite maximal supportive therapy in the background of multiple issues, redirection of care was thought to be in his best interest. The family accepted the offer of palliative care course. He died on day 39, soon after extubation in the presence of his family. The post mortem autopsy was not performed as per the parental request.

Discussion

Our case with DS exhibited isolated PE without hydrops, TMD, hypothyroidism, liver failure with portal hypertension and possible adrenal insufficiency. The literature review (summarized in Table 1) was undertaken to establish the etiopathogenesis, presentation, associated findings, natural course, and management of fetal and neonatal pericardial effusion.

Pathogenesis of PE in DS

Mechanisms producing isolated PE in fetus/neonate are not completely understood. TMD develops in 3 to 10% of newborns with DS, 5 is characterized by clonal proliferation of blast cells in blood/bone marrow and may be responsible for pericardial effusion. 1,2,4,6–13 Pericardial effusion in TMD may occur due to myocardial infiltration by degranulating eosinophils 13 or epicardial infiltration by atypical myeloid cells. 10 It is also presumed that effusion could be related to an abnormal production of cytokines at the effusion site. 6 PE has been demonstrated to be in association with hypothyroidism and celiac disease in early childhood 3,14–16 but not in the perinatal period. Our case had both TMD and hypothyroidism.

Age of Onset

Most of the reported cases have been diagnosed either in the second or third trimester as PE is easily detected with ultrasound. PE has been diagnosed as early as (11 6/7–16 47) weeks. 2 Sharland and Lockhart 17 reported 35 cases of PE detected at 18 to 25 weeks gestational age (GA) out of which 9 were confirmed to have DS arguing the importance of fetal karyotyping in cases of PE. Our case was diagnosed at 20weeks GA and was monitored in utero. The others 1,6,8–10,12,13 have diagnosed them at 30 to36 weeks GA. Two cases were diagnosed in neonatal period (2 weeks) as one of them had no antenatal care 8 and the authors have not reported about antenatal screening in other case. 7 Al-Kasim et al 11 have reported six cases of PE, all diagnosed within 2 weeks of birth at full term gestation except one who was diagnosed at 35 weeks.

Cardiac Manifestation

In most reported cases the heart was structurally normal but some have reported associated ASD (atrial septal defect) 1,4,11 VSD (ventricular septal defect), 1,11 dextrocardia, 12 and PDA (patent ductus arteriosus). 11 PE has been reported to be either isolated or associated with hydrops, 2,8,10,11 manifesting either without cardiovascular compromise 1,4,6,13,17 or with cardiac tamponade 9–11 needing intervention. Isolated PE has been reported to progress to worsening hydrops 8,10,11 and intra uterine death 2 or complete resolution. 11 Our case presented with isolated PE with no structural cardiac anomalies or cardiac tamponade and resolved spontaneously.

Associated Malformation

Hepatomegaly 2,4,6–8,10,11,13 spleenomegaly, 2,8,10,11,13 skin nodules, 11 and petechiae 12 raises the possibility of TMD and has been consistently found in most of the cases of PE. 1,2,4,6–8,10–13 Occasionally, PE can be associated with acute myeloid leukemia 9 and congenital hypothyroidism. 1 Our patient had TMD and hypothyroidism. An interesting finding in our case was the temporal association between the administration of hydrocortisone and resolution of circulatory collapse on more than one occasion creating a convincing argument for possible adrenal insufficiency. Such an association has not been previously reported to the best of our knowledge.

Treatment

In utero

Pericardiocentesis in utero 8–10 has been occasionally attempted successfully so as to prolong the pregnancy but others have chosen expectant management 12 when PE was not associated with cardiovascular compromise.

Postnatal

Isolated PE can be managed expectantly until its spontaneous resolution. Sharland and Lockhart 17 have reported complete resolution of PE without treatment in one preterm (28 weeks) and two term neonates. Pericardiocentesis is usually undertaken when PE leads to either cardiac tamponade 1 or contributes to significant respiratory compromise. 9,6,13 A short course of steroid (prednisolone) therapy for 2 weeks 1,4,7 has been used to facilitate resolution of PE. Occasionally a prolonged course of steroid over 6 to 12 weeks 13 was required to achieve resolution of PE. Most of the cases of PE are associated with TMD. TMD has favorable outcome with complete remission within the first 3 months in most cases; however, in infants with severe and life-threatening symptoms (high white cell count, bleeding diatheses, liver fibrosis, and effusion) treatment with low dose cytarabine (1 mg/kg/day × 7 days) has a beneficial effect. 18 In two term neonates with haemodynamically significant PE associated with TMD, a short course of cytarabine resulted in remarkable improvement and resolution of PE. 11 Oh et al 12 have used low-dose cytarabine in their patient with a large PE associated with TMD to prevent the development of hepatic fibrosis and achieved complete resolution of PE and TMD. In one of the case reports 1 thyroxine was used for hypothyroidism but it was started when PE had already resolved with steroid therapy. In our case, the short course of hydrocortisone for first 3 days given for the management of hypotension may have expedited resolution of PE. It had already resolved by the time thyroxine was commenced, thereby negating its role in facilitating PE resolution in our case.

Outcome

The outcome of neonates with PE in DS is difficult to ascertain as sometimes the parents opt for termination of pregnancy. 10,17 The prognosis is worse if PE is associated

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| Reference | No of patients | GA/weight at birth | Age of onset/detection | Presenting features | Size of PE | Associated structural and functional defects of heart | Associated anomalies | Treatment | Outcome |
|-----------|----------------|-------------------|------------------------|--------------------|------------|-----------------------------------------------------|---------------------|-----------|---------|
| Hirashima 2000 | 1 | 35 wk, 2,044 g | Antenatal: 34 wk | Isolated PE | Not reported | VSD (7 mm); no cardiovascular compromise | TMD and hypothyroidism | Steroid on d 8 (prednisolone 2 mg/kg/d), thyroxine on day 100, VSD closure at 81 d | PE began to decrease after steroid therapy on d 8 and resolved completely |
| Smrcek 2001 | 11 | Not reported | Antenatal: 5 cases at 11 6/7 – 16 4/7 wk; 6 cases at 18 1/7 – 32 5/7 wk | In utero hydrops (4 babies also had hepato-splenomegaly) | Not reported | Normal structure; hydrops | TMD in 4 cases | No in utero intervention | 4 cases: in utero fetal death (GA 28 0/7, 29 6/7, 30 9/7, 31 5/7); 7 cases: outcome not reported |
| Shenoy 2008 | 1 | Full term, 3,390 g, | Postnatal: 2 wk | Respiratory distress, hepatomegaly | Moderate | ASD (3 mm); no cardiovascular compromise | TMD | Pericardiocentesis (40 mL); steroid (prednisolone 2 mg/kg/d) for 10 d | PE resolved in 10 d; TMD resolved in 3 mo |
| Shitara 2017 | 1 | 37 wk, 2,413 g | Antenatal: 36 wk | Not reported | Normal structure; no compromise | TMD, eosinophilia, GATA1 mutation | Pericardiocentesis followed by a pericardial drainage tube; steroid (prednisolone) therapy due to reaccumulation after removal of drainage tube, steroid × 1 wk | Resolution of PE and TMD, discharge home on 49th d |
| Buyukkale 2012 | 1 | 40 wk weight: not reported | Postnatal: 13 d | Respiratory distress, hepatomegaly | Not reported | Cardiac tamponade | TMD | Pericardiocentesis followed by a pericardial drainage tube; steroid (prednisolone 2 mg/kg/d) from the 10th–51th d of life | Complete regression of PE and TMD; discharge home on 49th d |
| Strobelt 1995 | 1 | 35 wk, 2,120 g | Antenatal: 31 wk | Hepato-splenomegaly noted at 31 wk and progressing to hydrops at 33 wk | Not reported | Normal structure and function | TMD diagnosed by cordocentesis at 31 wk | In utero: pericardiocentesis 40 mL at 33/40, no reaccumulation, no hydrops; ex utero: PE with normal heart on echocardiography but no treatment required | Spontaneous resolution of PE and TMD at 1 mo |
| Azancot 2003 | 1 | 32 2/7 wk, weight not reported | Antenatal: 31 wk | Isolated PE | 12 mm | Normal structure; abnormal diastolic function | AML | In utero: pericardiocentesis | Termination of pregnancy at 32 2/7 wk |
| Rougemoit 2010 | 1 | 32 wk; weight: not reported | Antenatal: 30 3/7 wk | Hydrops | 8 mm | Normal structure and function | Myeloid proliferation | PM findings: PE of 36 cc, hydropic with hepatosplenomegaly | Termination of pregnancy at 32 wk |
| Al-Kasim 2002 | 6 | 5 babies: full term; 1 baby: 35 wk; weight: not reported | Postnatal: preterm: 35 wk at birth, full term: 3 at birth, 1 at 7 d and 1 at 14 d | 5 term infants presented with hepatosplenomegaly, 2 of them had respiratory distress and skin nodules; preterm (35 wk) hydrops with splenomegaly | Not reported | 1 term neonate: tamponade; 35 wk preterm hydrops; 2 term neonates: ASD, VSD, PDA; 1 term neonate: ASD, PDA | TMD in all 6 cases | 1 term neonate: pericardiocentesis and pericardial drain, 2 term neonates: Ara-C for 7 d; no treatment needed in 4 neonates | Spontaneous resolution of PE in 4 babies; resolution following Ara-C therapy in the other 2 babies; one of these babies developed AML at d 185 and died at d 204. |
### Table 1 (Continued)

| Reference | No of patients | GA/weight at birth | Age of onset/detection | Presenting features | Size of PE | Associated structural and functional defects of heart | Associated anomalies | Treatment | Outcome |
|-----------|----------------|--------------------|------------------------|--------------------|-----------|--------------------------------------------------|----------------------|-----------|---------|
| Oh 2014   | 1              | 35 wk, 2,700 g     | Antenatal: 32 wk       | Petaehaia          | 22 × 13.6 × 12 mm | Normal structure and function | TMD                  | Short course of low-dose cytarabine for TMD | Resolution of PE and TMD by 4 mo, AMKL at 4 y, cancer free at 5 y |
| Kusanagi  | 1              | 35 wk, 2,478 g     | Antenatal: 35 wk       | Hepatosplenomegaly. | Not reported | Thickened interventricular septum/normal function | TMD and hyper eosinophilic syndrome | Pericardiocentesis: 14 mL showed eosinophils; steroid (prednisolone 2–5 mg/kg/d) for 12 wk | Pericardial effusion, cardiomegaly and TMD resolved after 8 wk. |
| Sharland  | 9              | 1 baby: 28 wk; 2 other babies: full term. remaining 6–terminated in utero; weight not reported | Antenatal: 18–25 wk | Isolated PE | 2–4.5 mm | 1 baby had dextrocardia with normal structure; all had normal function | 6 pregnancies terminated in utero; other 3 required no treatment | Spontaneous resolution of PE in all 3 babies |

**Abbreviations:** AMKL, acute myelokaryoblastic leukaemia; AML, acute myeloid leukaemia; Ara-C, cytosine arabinoside; ASD, atrial septal defect; GA, gestational age; PDA, patent ductus arteriosus; PE, pericardial effusion; PM, post mortem; TMD, transient myeloproliferative disorder; VSD, ventricular septal defect.

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**Ethical Approval**

The article is a case report and does not contain any studies with human or animal participants performed by the authors.

**Conflict of Interest**

The authors declare that they have no conflict of interest.
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