

# Sudden Intrapartum Fetal Death in Fetuses with Absent Pulmonary Valve Syndrome: Report of Two Cases

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## Abstract

**Objective** To describe potential intrapartum complications for fetuses affected by absent pulmonary valve syndrome.

**Study Design** Two cases of intrapartum fetal death at full term were collected from our institution's labor and delivery unit records.

**Results** In both cases of intrapartum fetal death, the fetuses had been diagnosed with absent pulmonary valve syndrome and had likely experienced acute cardiac events during labor. Both were delivered as stillbirths despite emergency cesarean delivery.

**Conclusion** Patients should be counseled prior to labor about potential intrapartum complications for a fetus with absent pulmonary valve syndrome. Plans for fetal monitoring and the extent of aggressive intervention should be in place before labor in case sudden complications occur.

## Keywords

- ▶ absent pulmonary valve syndrome
- ▶ intrapartum fetal demise
- ▶ high-risk pregnancy

Absent pulmonary valve syndrome (APVS) is a rare congenital condition of uncertain etiology often associated with tetralogy of Fallot (TOF). First described by Cheevers in 1847, malformations include an absent or dysplastic pulmonary valve, annular pulmonary stenosis with regurgitation, and aneurysmatic dilation of the main pulmonary artery. Historically, the majority of cases have been diagnosed postnatally as a result of dilated pulmonary arteries compressing bronchial airways, with a risk of perinatal death as high as 60%.<sup>1,2</sup> Few studies have followed the antenatal course of fetuses affected by APVS, and no study to date has described intrapartum fetal death.

## Case Reports

Our first case was a nulliparous 16-year-old woman with abnormal fetal cardiac findings on an 18-week ultrasound. Fetal echocardiogram at 20 weeks visualized a nubbin-like

pulmonary valve with a small 2.5-mm annulus, mild pulmonary stenosis with severe pulmonary regurgitation, enlarged main and branch pulmonary arteries (6 to 7 mm), mild right ventricular hypertrophy (RVH) and dilation, and an absent ductus arteriosus (DA). Subsequent echocardiograms displayed enlarging pulmonary arteries (9 to 11 mm), one small perimembranous and one midmuscular ventricular septal defect (VSD), and normal aortic architecture. Evaluation of the fetus included a normal karyotype (46, XX). The patient had no significant past medical history, and the fetus had no extracardiac abnormalities.

Labor was induced at 38 weeks and 6 days for intrauterine growth restriction [estimated fetal weight (EFW) 2620 g (<10th percentile); 2 weeks prior the EFW = 2524 g (21st percentile)]. Doppler studies and amniotic fluid index (AFI) were in the normal range. Cervidil (Forest Pharmaceuticals, St. Louis, MO) (10 µg) was placed vaginally, followed by a standard oxytocin

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infusion. Nubain (APP Pharmaceuticals, Schaumburg, IL; nalbuphine hydrochloride) and promethazine were given for patient discomfort at midnight. After the medications were administered, there was decreased fetal heart rate (FHR) variability on the external fetal monitor (EFM) but no decelerations were noted, findings commonly seen in the FHR after Nubain administration. At 2:50 AM, the patient was disconnected from the EFM for 10 minutes to void. Upon reconnection, no FHR could be detected. Ultrasound showed fetal cardiac asystole. The cervix was 1 to 2 cm dilated, 50% effaced. Fetal membranes were intact. There was no cord prolapse. The patient had no vaginal bleeding or abdominal pain, and no contractions were palpable or demonstrated on the monitor. An emergency cesarean delivery was performed under general anesthesia, and a stillborn infant female was delivered. There was no nuchal or body cord and no evidence of a placental abruption. The birth weight was 2650 g. Cord arterial blood gas was pH 7.09/ $p\text{CO}_2$  79/ $p\text{O}_2$  21 and venous blood gas was pH 7.14/ $p\text{CO}_2$  65/ $p\text{O}_2$  26. The infant was intubated, ventilated, and aggressively resuscitated. The neonate received eight doses of norepinephrine and bicarbonate. The Apgar score was zero from 1 until 20 minutes. Twenty-three minutes after birth, a heart tone and improved skin color were detected (Apgar score of 3 at 25 minutes) and the infant was brought to the neonatal intensive care unit and maintained on mechanical ventilation support.

Echocardiogram confirmed the absence of a pulmonary valve and the presence of a dilated pulmonary artery that appeared to be compressing the trachea. The infant showed no tone or reflexes on day 2. Although electrocardiogram showed normal sinus rhythm at 180 beats/min, electroencephalogram noted minimal cortical function with bilateral basal ganglia infarctions seen on cranial magnetic resonance imaging on day 3. Ventilation support was withdrawn on day 4 after extensive counseling, and the neonate died shortly thereafter. The patient was medically stable during her postpartum course and on postoperative day 4 was discharged home. The 430-g placenta (25th to 50th percentile) contained three infarcts (<5% of the placental disc), and a three-vessel umbilical cord. Autopsy showed a stenotic pulmonary valve annulus with minimal dysplastic tissue in the region of the pulmonary valve, dilation of the main, right and left pulmonary arteries, two VSDs, absence of a DA, an atrial septal defect secundum type, RVH, and bilateral lung congestion with evidence of atelectasis. In addition, coagulative necrosis consistent with ischemic injury was noted in the myocardium of the left and right ventricles and right atrium.

Our second case was a nulliparous 24-year-old woman with abnormal fetal cardiac findings on an 18-week ultrasound. A subsequent 25-week ultrasound showed a hypoplastic right ventricle and possible tricuspid atresia. Initial fetal echocardiography at 26 weeks showed a hypoplastic right ventricle, small pulmonary artery (2.7 mm), and small tricuspid valve with antegrade flow and no regurgitation. Subsequent echocardiograms visualized moderate pulmonary insufficiency with antegrade and retrograde flow through the hypoplastic pulmonary artery and no evidence of the pulmonary valve, consistent with APVS. The ascending aorta and aortic arch were dilated and a patent DA with retrograde flow was visualized. No

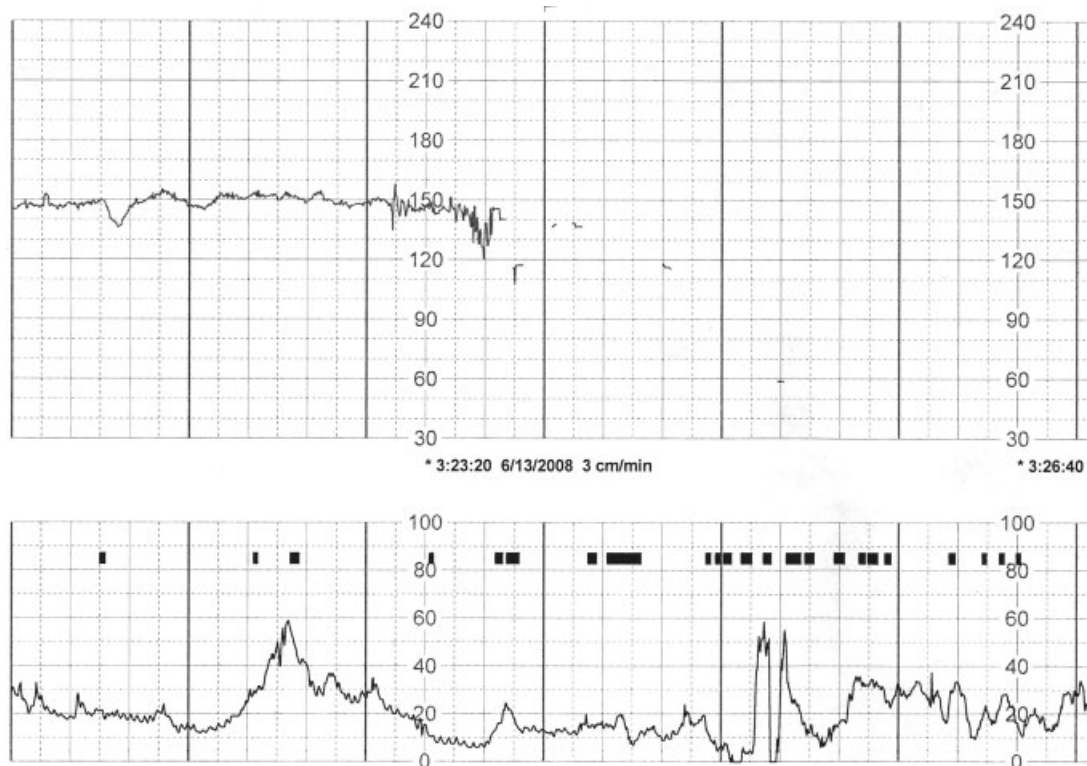
VSDs were noted. The patient had no significant past medical history, and only mild polyhydramnios was noted on serial ultrasound examinations until the day of admission. She had declined amniocentesis.

Labor was induced at 39 weeks and 1 day for a decrease in AFI from 17 to 6 cm over a 1-week period. One dose of 25  $\mu\text{g}$  of misoprostol was placed vaginally and repeated 4 hours later. This was followed by a standard oxytocin infusion. The FHR was reactive at 3 AM with a baseline of 140 seconds and moderate variability on the EFM. The tracing was unremarkable until 3:23 AM when the baseline appeared as a rapid, oscillatory pattern which lasted 30 seconds followed by apparent loss of the FHR (**Fig. 1**). There were no contractions, abdominal pain, or vaginal bleeding. Fetal membranes were intact. Bedside ultrasound showed a FHR in the 60s and the patient was brought back to the operating room for an emergent cesarean delivery under general anesthesia. A stillborn male infant was delivered in the vertex position. There was no nuchal or body cord, and there was no evidence of an abruption. The birth weight was 3282 g. Aggressive resuscitation was instituted but cardiac asystole persisted. Resuscitation efforts were abandoned after 30 minutes. Cord venous blood gas was pH 7.31/ $p\text{CO}_2$  47/ $p\text{O}_2$  41. The 491-g placenta (75th to 90th percentile) contained intervillous fibrin deposition and a three-vessel umbilical cord. Cytogenetic analysis detected normal male karyotype 46, XY. The patient desired no autopsy to be preformed.

## Discussion

Improvements in obstetric ultrasound have allowed for earlier and more precise prenatal diagnosis of APVS. Recent studies have diagnosed APVS at 11 to 13 weeks' gestation and have found associations with an increased first-trimester nuchal translucency, congenital diaphragmatic hernia, nonimmune hydrops, polyhydramnios, and the chromosomal 22q11 microdeletion.<sup>2-5</sup> Varying presentations of APVS have also been documented. APVS is most commonly associated with TOF and often accompanying VSD. Regurgitant flow results in volume overload of both ventricles, especially in fetuses with a patent DA. The severe chronic volume overload makes this combination incompatible with fetal life. APVS with an absent DA (10 to 20% of these patients) may allow the fetus to reach the second trimester.<sup>2</sup> In these fetuses, the pulmonary trunk and branches are often severely dilated, as in our first case. The rarer variant is APVS with tricuspid atresia, an intact interventricular septum, saclike dilation of the right ventricle, and a patent DA.<sup>6</sup> This variant, due to increased aortic flow, results in more aortic and less pulmonary artery branch dilation. Some features of this condition are noted in our second case.

The detection of structural details by ultrasound has also been shown to have prognostic significance. Fetuses with hydrops or larger right pulmonary artery volume and annulus size have been linked with poorer prognosis.<sup>7</sup> Infants with an intact interventricular septum and/or diagnosed after 6 months of life have a more benign prognosis than those with a VSD or who develop respiratory symptoms in infancy.<sup>8</sup> The more frequent variant of APVS may also have slightly better outcomes



**Figure 1** Rapid oscillatory pattern of fetal heart rate immediately prior to sudden loss of fetal heart rate.

than that of the rare variant.<sup>9</sup> Consequently, precise sonographic evaluation of the fetal heart and vessels in APVS may be of prognostic benefit, as suggested in a recent study on the use of three- and four-dimensional ultrasonography in APVS.<sup>10</sup>

The intrapartum monitoring and clinical findings in our cases suggest acute fetal cardiac events when the patients were in early labor. The cause may have been electrophysiological as there were no findings to suggest progressive mechanical cardiac failure prior to labor and no evidence to suggest other common causes of intrapartum fetal death, such as abruption, cord accident, tetanic uterine contraction, or ongoing hypoxia/acidemia. The advantages and timing of early amniotomy and fetal scalp electrode placement to more accurately monitor and intervene in the labor of fetuses with APVS is a question to consider.

Acute intrapartum fetal demise with APVS has not been previously reported and further adds to the well-accepted poor prognosis of affected fetuses. Larger studies of the intrapartum course of fetuses affected by APVS are needed to determine if factors that may increase sudden fetal death exist. In the meantime, in-depth parental counseling with maternal-fetal medicine and pediatric cardiology should include the possibility of acute fetal cardiac events in labor and the still uncertain fetal benefit of emergency cesarean delivery.

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