Early Signs of Cardiac Failure: A Clue for Parvovirus Infection Screening in the First Trimester?

Teresa Carraca\textsuperscript{a}  Alexandra Matias\textsuperscript{a}  Otilia Brandão\textsuperscript{b}  Nuno Montenegro\textsuperscript{b}

\textsuperscript{a}Obstetrics and Gynecology Service and \textsuperscript{b}Pathology Department, University Hospital of S. João, Faculty of Medicine of Porto, Porto, Portugal

Established Facts
- Although increased nuchal translucency (NT) is not commonly associated with fetal infection, parvovirus B19 infection is the only infection that has been reported in association with increased fetal NT.

Novel Insights
- First-trimester parvovirus B19 infection with reversed a-wave in the ductus venosus (DV) at 11 weeks.
- Whenever an increased NT is found along with an abnormal DV flow in the first trimester of pregnancy (11–14 weeks), the possibility of parvovirus infection must always be considered.

Key Words
Parvovirus · Reversed a-wave · Ductus venosus

Abstract
Parvovirus B19 is a small single-stranded DNA virus and a potent inhibitor of erythropoiesis due to its cytotoxicity to erythroid progenitor cells. Although adult disease is generally mild, fetal parvovirus B19 infection can cause spontaneous abortion in early pregnancy and aplastic anemia, nonimmune hydrops fetalis and in utero fetal demise. The prevalence of parvovirus B19 maternal infection during pregnancy is about 1–2%. The vertical transmission occurs in 10–35%, being highest in the first and second trimesters. The risk of adverse fetal outcome is 10%. In contrast to the second or third trimester, in pregnancies affected by increased nuchal translucency (NT) in the late first trimester, the prevalence of maternal infection was not higher than in the general population. We report a case of first-trimester parvovirus B19 infection with increased NT and reversed a-wave in the ductus venosus (DV) at 11 weeks, with fetal demise 2 weeks later.
Case Report

A 37-year-old woman, gravida 3, para 2, was referred to our unit for first-trimester routine ultrasound. The sonographic evaluation demonstrated a fetus with a crown-rump length of 51.7 mm with an increased NT (4.2 mm) and reversed a-wave in the DV. The echocardiography did not reveal pericardic effusion, nor did it reveal tricuspid or mitral valve insufficiency. The mother was a schoolteacher and reported contact with children with infectious erythema. Maternal parvovirus infection was diagnosed by parvovirus-specific immunoglobulin-G (IgG) and IgM assessment. Two weeks later, fetal demise was diagnosed. The necropsy revealed a large number of immature red cells, including erythroblasts, in the peripheral circulation, with intranuclear inclusion, strongly suggestive of parvovirus, which was confirmed by immunocytochemical study using specific antibodies. The organs involved were lungs, liver, cardiac capillary vessels, kidneys and adrenals glands.

Discussion

The prevalence of first-trimester fetal loss associated with parvovirus B19 infection is low, ranging from 0.8% [5] to 3% [6] in recent studies, but is the only infection that has been reported in association with increased fetal NT [7, 8]. The increased NT has been attributed to myocardial dysfunction and/or fetal anemia [9]. Enders et al. [10] demonstrated a relevant B19-associated risk of fetal hydrops and/or fetal death that is largely confined to maternal infection between 9 and 20 weeks. Parvovirus is a small single-stranded DNA virus and a potent inhibitor of hematopoiesis because it preferentially infects and destroys erythroid precursor cells. The cellular receptor for PV B19 is globoside or P-antigen. It is found on erythrocyte progenitor cells (erythroblasts and megakaryocytes), as well as on erythrocytes, synovium, placental tissue, fetal myocardium and endothelial cells [1]. The fetus seems to be most susceptible to parvovirus B19 infection during the first and second trimesters of pregnancy, which coincides with the major development of the erythroid precursors [11] and the hepatic period of hematopoietic activity.

In the present case, increased fetal NT was found along with reversed flow in the DV during atrial contraction. There are only a few cases of parvovirus infection with reversed a-wave in the DV [7, 12], and our case was the earliest in pregnancy. NT measurement and DV Doppler findings are helpful indicators of the presence of severe fetal anemia [12] and fetal cardiac dysfunction [13, 14]. In fetal anemia, increased fetal cardiac output is believed to be due to a decrease in blood viscosity, which in turn leads to increased venous return and cardiac preload. A recent study suggests that in second- and third-trimester fetuses with a high cardiac output, hypervolemia is the primary cause of hydrops, and cardiac failure will manifest only when cardiac compensatory mechanisms are exhausted [15]. In contrast, in the first trimester, cardiac afterload is significantly greater than that in later gestation because of higher placental resistance and cardiac stiffness, and cardiac failure can appear earlier in the infection process [13, 14]. Parvovirus B19 is toxic not only to fetal red blood cells precursor, but also to megakaryocytes, placental cells, fetal liver cells and myo-
cardial cells. In our case, fetal pathologic examination confirmed these findings.

This case demonstrated that although increased NT is not commonly associated with fetal infection [4], whenever reversed flow in the DV is present, we should not only consider the possibility of aneuploidy or cardiac defect, but also exclude fetal anemia. The risk of fetal demise is highest in the first trimester, and is thought to be as high as 10% in women who are infected prior to 20 weeks of gestation [16]. However, there are cases reported in the literature with transitory hydrops during the first trimester with spontaneous resolution thereafter [17].

In conclusion, whenever increased NT is found along with an abnormal DV flow in the first trimester of pregnancy (11–14 weeks), the possibility of parvovirus infection must always be considered, and middle cerebral artery peak systolic velocity could eventually be assessed to exclude fetal anemia.

References