Prenatal diagnosis of a huge foetal immature sacrococcygeal teratoma: our experience of a rare case and review of the literature

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Abstract

Introduction
Sacrococcygeal teratomas are rare germ cell tumours associated with high perinatal and postnatal mortality and morbidity. The purpose of our study was to report a case of a foetal huge immature sacrococcygeal teratoma diagnosed prenatally and managed successfully in the early neonatal period with surgical resection of the tumour.

Case report
A foetal mass with solid and cystic components in the sacral region of the foetus measuring 42 × 34 mm was detected during the foetal anatomy ultrasound scan, in a 28-year-old Greek woman, gravida 2, para 1. The foetal karyotyping showed normal number of chromosomes 13, 18 and 21 (46 XY). Polyhydramnios was seen, at 31 weeks of gestation, and the patient was admitted to our hospital owing to a risk of premature labour. Ultrasound examination showed the sacrococcygeal mass to be enlarged with maximum diameter of 20 cm. There were no signs of ascites, pleural or pericardial effusion or placentalomegaly. Doppler ultrasound examination showed the sacrococcygeal mass to be multilocular or cystic, and solid and variable in size. The feasibility of flow velocity waveforms on the tumoural arteries was to be 0.51. Amnioreduction of 740 cc amniotic fluid was performed under ultrasonographic examination. Caesarean section was performed at 33 weeks’ gestation due to profuse polyhydramnios via an upper vertical incision in the uterus. After the stabilization of the newborn, tumour resection was successfully performed on the first day after delivery. Grossly, in the surgical specimen the tumour measured 18 cm in its maximum diameter and weighted 1500 g.

Conclusion
Prenatal diagnosis and ultrasonographic follow-up are needed for the good prognosis of sacrococcygeal teratomas. Prenatal intervention should be considered when the foetus develops hydrops for foetal salvage or in cases with placentomegaly to avoid the maternal risk of mirror syndrome.

Introduction
Teratomas are the most common perinatal tumours developed from multipotent stem cells, are usually extragonadal and contain tissues of ectodermal, endodermal and mesodermal origin, foreign to the anatomic site, in which they arise. Teratomas account for 25%–52% of all congenital tumours and have a yearly incidence of one in 20 000 to one in 35 000–40 000 live births. Sacrococcygeal teratomas have an incidence of 1 in 20 000 to one in 35 000–40 000 live births and have usually a female predominance. They are classified as mature, immature or malignant based on their histopathologic appearance and behaviour. Sacrococcygeal teratomas arise from the Hensen’s node located on the anterior surface of the sacrum or coccyx and may be cystic, multilocular or cystic, and solid and variable in size.

The morbidity and mortality of the sacrococcygeal teratomas are low when they are diagnosed prenatally and the surgical management is performed during the neonatal period. The prognosis is usually poor when they are diagnosed prior to 30 weeks’ gestation and are predominantly solid with high vascularisation due to high-output cardiac failure, development of hydrops fetalis, premature delivery and intrauterine foetal demise. Arteriovenous shunting through the tumour causes the high-output cardiac failure. The causes for the prematurity are usually the uterine distension from the neoplasm and the polyhydramnios, while the intrauterine foetal demise is secondary to the vascular steal syndrome and the increased metabolic demands of a huge neoplasm.

In addition, the foetus is at risk of chronic foetal anaemia due to haemorrhage within the tumour. The successful management of sacrococcygeal teratomas depends on the mode of delivery and the classification of the tumour. Delivery of the foetus through a caesarean section prevents dystocia, tumour rupture and profuse tumour bleeding. The risk of sacrococcygeal teratoma rupture is increased during the ablative tumour resection and particularly when the diameters of the neoplasm exceed 10 cm. The middle sacral artery usually derives the most blood supply of these neoplasms. The prognosis is influenced by the presence of...
immature elements in the neoplasm and there is a benign behaviour in cases with only neuroectodermal components. It is estimated that at delivery 4%-20% have malignant tissue. Severe clinical consequences and frequent recurrences are observed when the neoplasms are discovered after the age of two months or the surgeons fail to perform proper coccygectomy or when they contain foci of yolk sac tumour, even an optimal surgical resection. Gilcrease et al. suggested that microscopic foci of yolk sac tumour can be identified in low-grade immature teratomas as well and there is a possibility for malignant recurrences in these cases. In severe cases, sacrococcygeal teratomas with hydrops are associated with maternal risk for development of mirror syndrome, which is a severe form of preeclampsia and is associated with placentalomegaly.

We report a case of a huge sacrococcygeal teratoma diagnosed prenatally at 21 weeks' gestation by two-dimensional ultrasound scan, with foetal delivery via caesarean section at 33 weeks because of polyhydramnios and successful tumour resection management on the first day after caesarean section.

**Case report**

In a 28-year-old Greek woman, gravida 2, para 1, during the foetal anatomy ultrasound scan at 21+2 weeks of gestation, a foetal mass in the sacral region was detected containing both solid and cystic elements and measuring 42 × 34 mm. The neoplasm had increased vascularity. Foetal biometry was normal for gestational age: biparietal head diameter (BPD): 50.00 mm, head circumference (HC): 187.00 mm, cisterna magna: 4.8 mm, transverse cerebellar diameter: 21 mm, abdominal circumference (AC): 160.00 mm, femur length (FL): 32 mm, humeral length: 33.00 mm, HC/AC: 1.17. The amount of amniotic fluid was normal and the umbilical cord had three vessels. Foetal nuchal fold was measured to 4.5 mm (normal upper rate 6.00 mm). The spine appeared normal and the morphology of the cerebellum as well. The estimated foetal weight was 368 g by ultrasounds.

No other abnormalities were detected. A diagnosis of sacrococcygeal teratoma was made. Foetal karyotyping was recommended.

However, during the first trimester ultrasound scan for nuchal translucency thickness measurement at 12 weeks of gestation, the neoplasm was not detected. The foetal crown-rump length was 62 mm and the nuchal translucency thickness was 1.4 mm. No signs of cardiac dysfunction, such as tricuspid regurgitation and/or absent or reverse flow in the ductus venosus during atrial contraction were found in the foetus during the first trimester ultrasound scan.

A repeat scan at 24+5 weeks was performed for amniocentesis and foetal karyotyping and for checking the development of the foetus. The foetal biometry showed: BPD: 70.73 mm, HC: 235.56 mm, AC: 202.15 mm, FL: 48.14 mm. The amount of amniotic fluid was normal. The estimated foetal weight was 807 g by ultrasounds. The foetal heart rate was 167 beats per minute. The neoplasm contained both solid and cystic elements and measured 82 × 63 × 75 mm. The normal number of chromosomes 13, 18 and 21 was found (46 XY). The mutation DF508 for cystic fibrosis was not detected.

Polyhydramnios was seen, at 31 weeks of gestation, and the patient was admitted to our hospital owing to a risk of premature labour. The patient stated that she had regular follow-up in a medical centre of another city throughout the previous gestational weeks. The foetal biometry showed: BPD: 91.40 mm, HC: 304.00 mm, AC: 299.00 mm, FL: 64.20 mm. The ultrasonographic age of the foetus corresponded to 33+5 weeks. The foetus was with cephalic presentation. The estimated foetal weight was 2314 g by ultrasounds. Ultrasound examination showed the sacrococcygeal mass to be enlarged; the lesion was with solid and cystic components and maximum diameter of 20 cm (Figures 1 and 2). Polyhydramnios was found. There were no signs of hydrops as demonstrated by the absence of ascites, pleural or pericardial effusion or placentalomegaly. Middle cerebral artery peak systolic velocity was normal. M-mode ultrasound examination showed that neither heart ventricle was dilated and the fractional shortening of both ventricles were found normal. The inferior vena cava was not enlarged and the preload index of the inferior vena cava was normal. The heart rate was 150 beats per minute. Colour Doppler ultrasound examination showed extensive vascularity within the mass, suggesting increased blood flow.
flow into the tumour (Figure 3). Pulsed Doppler showed the resistance index (RI) of flow velocity waveforms on the tumoural arteries to be 0.51 (Figure 4). The patient was hospitalized and monitored with serial non-stress tests. Corticosteroid therapy was initiated for pulmonary maturation and indomethacin for preventive tocolysis. No cervical dilatation was found. Three days later amnioreduction of 740 cc amniotic fluid was performed under the ultrasonographic examination. Consultation by paediatricians and paediatric surgeons was given to the parent and it was concluded that postpartum surgery should be performed.

Some days later, the risk of continuing with the pregnancy was explained and, following counselling, a caesarean delivery was performed at 33 weeks of gestation through a midline vertical incision in the abdominal wall and upper vertical incision in the uterus as well (Figure 5). A male infant weighing 4 000 g was delivered with Apgar score of 5–6 at one minute and 7–8 at five minutes (Figure 6). The newborn underwent emergency surgical resection of the tumour on the first day after delivery at the Department of Paediatric Surgery. Postoperatively, the baby did well. At the time of writing he was over nine months of age and continued to do well.

Pathology

Macroscopic examination

Grossly, the surgical specimen of soft tissues had dimensions 20 × 16 × 13 cm, weight 1 500 g and consisted of fibro-adipose tissue and part of striated muscle fibres (Figure 7). A relatively circumscribed neoplasm with dimensions 18 × 14 × 12 cm, which was partially covered by a fusiform epidermal piece measuring 17 × 13 cm, occupied the surgical specimen. The tumoural sections showed partially a cystic conformation consisting of a cystic area underneath the skin with dimensions 12 × 8 × 3 cm and some smaller cystic areas with maximum diameters between 0.8 and 2.00 cm, which were full of mucous materials. Solid neoplastic areas were seen between the cystic areas; the larger solid neoplastic area had dimensions 5 × 4 × 3.5 cm and was in continuity with the cystic cavity, which had maximum diameter of 12 cm. They had yellowish/whitish hue and elastic consistency with places of important haemorrhagic infiltration and necrosis. At the periphery of the tumour by one pole,
opposing to the epidermal covering, there was recognised a continuous fractured part of cartilage and coccyx bone measuring 1.5 × 0.7 cm.

Microscopical examination
Histological type of the epidermal piece, subcutaneous adipose tissue and striated muscular fibres with localisation of extragonadal tumour from germ cells. Teratoma consisting of immature tissues of embryonic type and partially mature tissues of adult type, with representation of the three blastic layers with prevalence of the ectoderm (50%), notable presence of the endoderm (30%) and the mesoderm (20%).

The ectoderm was represented by prevalence of cerebral substance under the form of mature neuroglia and neurons, oligodendroglial cells, ependymal tubules and many cavities invested by ependyma and choroid plexus. Characteristic was the noticeable presence (20% of the total volume) of immature neuroepithelium with mild to severe cellularity, which was composed of small and average size cells with scarce cytoplasm, thin-walled nucleus without evident nucleoli, absence of notable nuclear atypia with high mitotic activity (15–50 mitotic divisions per 10 optic fields ×40) and with formation of nodules, tubules and focally papules. In addition, recognised were sites and cavities with investment of melanochroistic epithelium, neuronal fasciae and agglomerations of ganglia cells and cavities with epithermal investment, presence of chorion in developmental phase and adnexal particles and spheres of squamous non-keratinized epithelium.

The endoderm was represented with multiple cavities invested by respiratory type epithelium, other coated with cylindrical or transitional type epithelium with squamous metaplasia, cavities invested with gastric epithelium and colonic mucosa, other cavities lined with serosal paramesonephric type or mucosal of endocervical type agglomerations of seromucinous glandules. Characteristics were: (i) the presence of multiple individual islets of foetal hepatic parenchyma in various stages of development and foetal pancreatic tissue and foetal gastrointestinal structures in various stages of development; (ii) the emergence of multiple bi-layer clear-cell glandules with sub-nuclear or extra-nuclear vacuoles, focally contiguous with high cellularity aggregations of asteroid/roundish cells without marked nuclear atypia and low mitotic activity (3–7 mitotic divisions/10 optic fields ×40); (iii) few cystic cavities and communicating cavernous spaces with clear-celled investment or investment from highly eosinophilic cells; (iv) aggregations of follicles of thyroid gland in growth phase.

The mesoderm was represented from the meninge, the smooth muscle fasciae in developmental phase and organising in smooth muscle layer, the striated muscle fibres of embryonal type, the multiple sites of immature mesenchyma, the areas of embryonal and mature adipose tissue, the islets of immature and mature hyaline cartilage, the islets of neo-formed coarse bone tissue and the osteoid with mild hyperplasia of the osteoblasts. Multiple foci of extramedullary haematopoiesis and important haemorrhagic infiltration in some areas, and ischaemic type necrosis (20%) and focal deposits of calcium salts were also observed.

Extension of infiltrative type was observed in the consecutive striated muscle fibres and in the co-excised portion of cartilage and bone tissue and beyond, in the form of cerebral substance and cavities lined by choroid plexus or clear cells. Also, expansion of the tumour was observed in the form of cavities coated with respiratory epithelium type or mucinous gastric type or colonic cells up to the reticular dermis of the skin and without expansion to the skin. Additionally, within the tumour, an encapsulation of portions of large venous and arterial vascular branches and growth of islets of foetal liver parenchyma and glia in the wall of the middle venous vases of the area of the co-excised cartilage tissue were found. The operative margins showed neoplastic expansion to the fibro-adipose and dense fibrous connective tissue. There was no tumoural infiltration in the two tiny nodes with maximum diameter of 0.4 and 0.5 cm respectively, which were found within the co-excised fibro-adipose tissue.

Immunohistochemistry
The immunohistochemical examination showed expression of keratin 8.18 in the epithelial structures and expression of GFAP in the glia. Also, expression of synaptophysin in the neurons and expression of EMA in the investment tubules and the lumen of the glandular structures including clear-cell glandules were found. In addition focal expression of Glypican 3 in the clear-cell glandules was detected. Expression of AFP was not observed in the epithelial structures including the few clear-cell glandules. The expected expression of AFP and Glypican 3 in the islets of foetal liver was observed as well. The cell proliferation marker Ki-67/ MIB-1 was detected heterogeneously in the epithelial structures (5%) and in the immature foci of the immature neuroepithelium (15%–20%).

Discussion
In our case, the tumour was an extragonadal teratoma of the sacrococcygeal area of the immature type with a maximum diameter of 18 cm and maturity level 3. In the tumour there was representation of all the three blastic layers with prevalence of ectoderm elements, mostly neuroectoderm, important representation of the endoderm and visible representation of the mesoderm. Infiltrative type extension of the neoplasm in the adjacent striated...
Case report

Rapidly growing 12-
st.

In the first 17,34,35 In addition, europathic bladder, vesicoureteric reflux, incontinence, recurrent uri-
nary tract infections and impo-
tence are possible complications after resection of sacrococcygeal teratomas 10,29,32,33.

The prenatal diagnosis of the sac-
rococcygeal teratomas can be easily made with conventional two-dimen-
sional ultrasound scan 12. In the first trimester these neoplasms usually escape the ultrasonographic diagno-
sis because of their small size 12,13. The advantages of the three-dimensional ultrasound scan are the definition of the total volume of the neoplasm, its extension to the pelvis and the possible skeletal involvement for a better surgical excision 12. Rapidly growing huge tumours with predominantly solid components are often recog-
nised in cases with an immature his-
tology as in our case or malignant histology. Also, in these cases a high vascularisation during the colour Doppler examination is usually recog-
nised 17,34,35. In our case, RI of the blood flow was 0.51 and it is in accordance with the other literature reports, in which the blood flow RI is lower in the immature or malignant than in mature sacrococcygeal teratomas but not as low as in adult women with ovarian cancer (cut-off levels <0.40) 17,34,35. The differential diagnosis at mid-gesta-
tion of a sacral cystic mass includes meningo(myelo)cele and urogenital anomalies 12. Although chromosomal anomalies have been found in cases with sacrococcygeal teratomas, foet-
al karyotyping is not usually rec-
ommended because tumoural cells can desquamate into the amniotic fluid and in case with normal foetal chromosomes, foetal karyotyping by amniocentesis may result in mosa-
ism. Therefore, in these cases, the foetal karyotyping should be supple-
mented with foetal blood sampling 12.

In our case the foetal karyotyping was normal. No other foetal abnormalities were found in our patient; the only complication was the polyhydram-
nios from the 31st week to deliver-
by caesarean section. There were no ultrasonographic findings of foetal hydrops or abnormal foetal echocar-
diographic findings. In patients with sacrococcygeal teratomas greater than 5 cm, caesarean section is re-
commended usually with upper verti-
cal uterine incision to avoid dystocia or trauma during normal delivery 18,26. In specific surgical centres, foetal interventions have been performed with some success including in utero open foetal surgery, radiofrequency tumoural ablation, laser vessel abla-
tion and alcohol sclerosis in an attempt to increase survival in foet-
tuses with hydrops, while the mothers are still in good health 25.

Conclusion

Sacrococcygeal teratomas are rare germ cell tumours associated with high perinatal and postnatal mortality and morbidity. Prenatal intervention should be considered when the foetus develops hydrops for foetal salvage or in cases with placental hyperbolism to avoid the maternal risk of mirror syndrome.

Consent

Written informed consent was obtained from the patient for publica-
tion of this case report and accom-
panying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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