The role of prenatal ultrasound assessment in management of fetal cervicofacial tumors

Rafał Zieliński[1], Maria Respondek-Liberska[2]

[1]Department of Pediatric Otorhinolaryngology, Medical University of Lodz, Lodz, Poland
[2]Department of Diagnosis and Prevention of Congenital Malformations, Polish Mother's Memorial Hospital, Chair of Morphology and Embryology, Medical University of Lodz, Lodz, Poland

Submitted: 5 September 2014
Accepted: 15 November 2014

Arch Med Sci 2016; 12, 4: 850–855
DOI: 10.5114/aoms.2016.60972

Corresponding author:
Rafał Zieliński MD
Department of
Pediatric Otorhinolaryngology
Medical University of Lodz
36/50 Sporna St
91-738 Lodz, Poland
Phone/fax: +48 42 617 77 20
E-mail: rafal.zielinski@umed.lodz.pl

Abstract

Ultrasound prenatal examination enables one to assess the facial skeleton and the neck from the first weeks of gestation. Cervicofacial tumors detected via prenatal ultrasound are very rarely reported fetal pathologies. They include cystic hygromas, teratomas, epulides, vascular tumors, and thyroid tumors. The tumor category, its location and vascularization pattern allow one to accurately establish a diagnosis which is usually confirmed by clinical examination of the neonate or a pathological examination (surgical specimen, biopsy, autopsy). The prenatal ultrasound diagnosis of cervicofacial tumor in the fetus allows planning of pregnancy management and fetal therapy, preparation of the delivery, and perinatal as well as neonatal treatment.

Key words: prenatal, ultrasound, fetal, cervicofacial, tumor.

Introduction

Ultrasound assessment allows the facial skeleton and the neck of a fetus to be evaluated from the first trimester of pregnancy. However, the difficulties experienced in evaluating two-dimensional images and three-dimensional reconstructions result in fetal cervicofacial pathologies rarely being detected.

As these are rare anomalies, only a limited number of cases are typically reported by a single institution. Therefore, the newest information is of high value. The appearance of the fetal face changes in the course of pregnancy, and is associated with the deposition of fatty tissue, particularly in the region of the maxilla and cheeks. As the evaluation of the fetal face and the neck may present problems in the third trimester, due to the position of the fetus or location of the placenta on the anterior wall of the uterus being unfavorable, ultrasound assessment is usually most effective when performed prior to the 23rd–24th week of gestation. Two-dimensional ultrasonography performed by an experienced diagnostician is considered to be a very accurate tool in the assessment of prenatal fetal cervicofacial malformations [1].

3D ultrasonography is of great value in visualizing the surfaces of the head and neck and presenting the results to parents or other physicians involved in the care of neonates and infants [2]. Sharing this information

is especially important as cervicofacial tumors may compromise the upper airways, thus affecting the planning of *in utero* and perinatal treatment. Other methods such as magnetic resonance imaging (MRI) and fetoscopy may also be helpful in diagnosing pathologies resulting in upper airway patency in the fetus [3, 4].

Sonographic assessment allows a precise diagnosis to be established based on tumor category, location and vascularization pattern. However, the approach is much more difficult than a newborn evaluation or pathological study of a fetus, and differential diagnosis should be taken into consideration [5].

Fetal cervicofacial tumors in prenatal ultrasound assessment

Cystic hygromas are fetal tumors occurring within the neck region [6] which can be described as bilateral hypoechogenic cyst-like cavities under ultrasound examination. They are best visualized in the coronal plane and may be detected as early as at the end of the first trimester of pregnancy [7]. The presence of septations within the tumor may indicate the coexistence of aneuploidy [8]. In cystic hygromas, a tendency towards regression can be observed in up to 10% of cases (Figure 1).

Other tumors detected by ultrasound examination of the fetal head and neck include lymphatic-venous malformations, lymphangiomas and hemangiomas. Although lymphatic-venous malformations are rare, they do not tend to demonstrate spontaneous involution during the first year of a child's life. Prenatal ultrasound identifies them as cystic tumors with multiple thin septations. Glossal lymphangiomas are also rarely found: ultrasound examination reveals solid or hyperechogenic tumors growing within the oral cavity. These anomalies seldom extend beyond their initial locations.

Large hemangiomas are detected by prenatal ultrasound examination in the region of the face, occiput and neck. They are characterized by rich, occasionally heavily calcified, vascularization [9]. These tumors may be a component of Kasabach-Merritt syndrome. Severe thrombocytopenia, a life-threatening condition to a fetus or a neonate, accompanies the occurrence of these hemangiomas [10].

Among other pathologies, richly vascularized tumors such as vascular lesions can significantly impair the cardiovascular system of the fetus, causing congestive heart failure [11, 12]. Unfortunately, no data exist concerning the problem in cases of cervicofacial tumors.

Epulis (Neumann's tumor), gingival pyogenic granuloma, is a benign abnormality most frequently originating from the maxillary gingiva. It is characterized by slow growth and is typically recognized as late as in the third trimester of pregnancy. Prenatal ultrasonography reveals it to be a solid tumor with poor vascularization (Figure 2).

Epignathus is a very rare teratoma which develops within the oral cavity and the throat. It occasionally projects into the nasal cavity and the anterior cranial fossa. Histopathologically, it is most frequently a non-malignant tumor. However, there are some reports on partially malignant texture [13]. Epignathus frequently arises from the sphenoid bone, hard or soft palate, pharynx, tongue or mandible. Ultrasound assessment allows a solid tumor of the oral cavity with elements of cysts and calcifications to be identified. In such cases, a detailed evaluation of the brain is necessary because the tumor can grow intracranially, resulting in hydrocephalus. Another oral cavity neoplasm occurring in the fetus is myoblastoma (Abrikosov's tumor), a rare non-malignant anomaly developing only in the oral cavity of female fetuses. On ultrasound examination, it presents as a solid tumor attached to the oral cavity floor.

Prenatal ultrasound scanning is also a reliable method of detecting superficial cervicofacial teratomas and thyroid tumors. Teratomas are typically solid hyperechogenic masses with the likely occurrence of cystic hypoechogenic spaces and calcification foci.

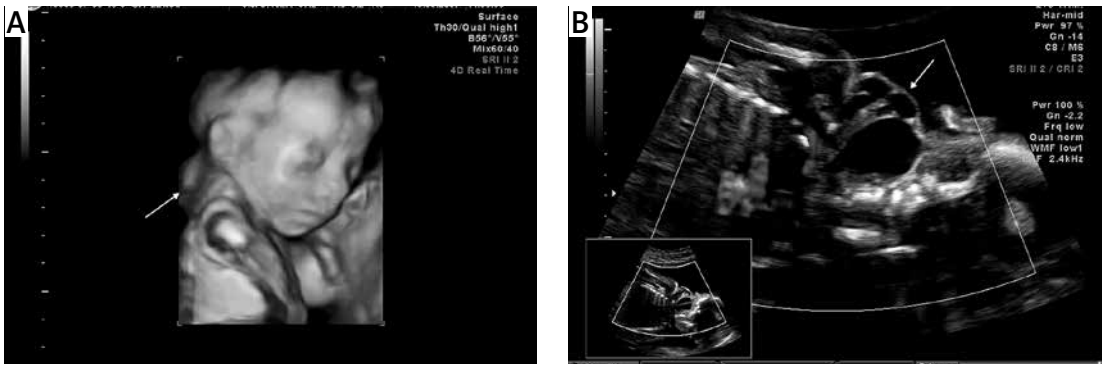

Figure 1. Cystic hygroma of the neck in the fetus at 22 weeks' gestation. **A** – 3D ultrasound scan of the fetal head and neck. **B** – 2D ultrasound of the fetal head and neck, frontal plane

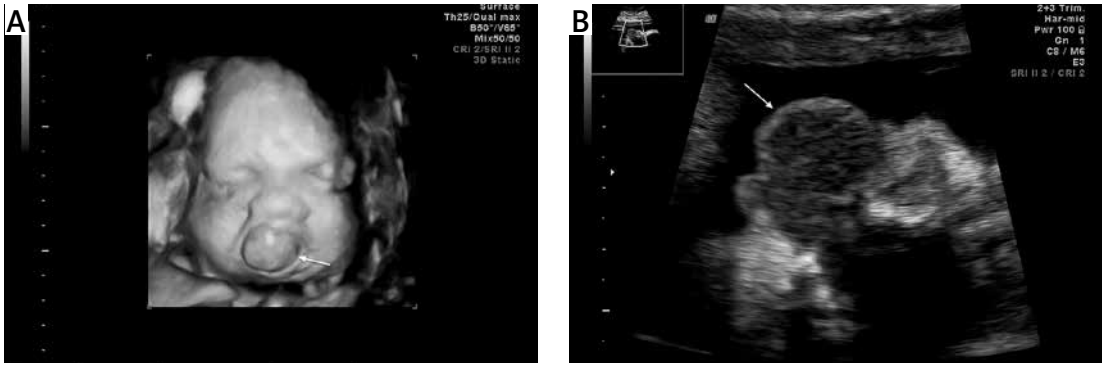

Figure 2. Epulis in the fetus at 36 weeks' gestation. **A** – 3D ultrasound scan of the fetal head. **B** – 2D ultrasound scan of the fetal head, sagittal plane

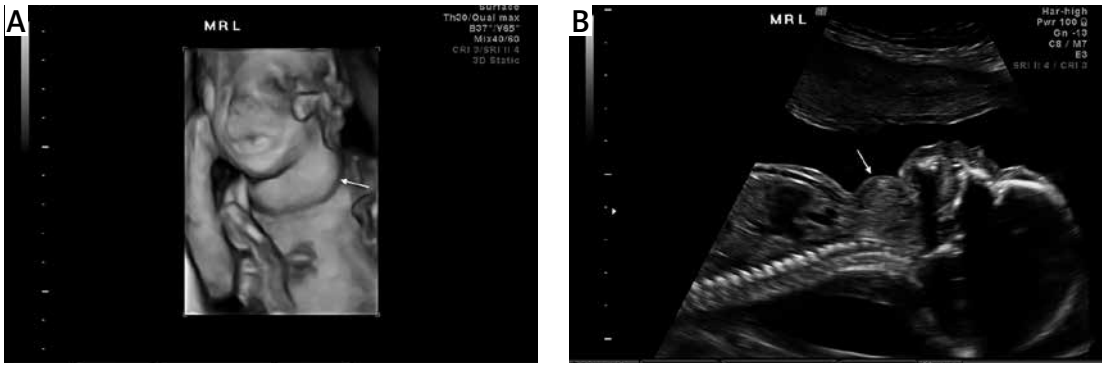

Figure 3. Goiter in the fetus at 22 weeks' gestation. **A** – 3D ultrasound scan of the fetal head and neck. **B** – 2D ultrasound scan of the fetal head and neck, sagittal plane

On prenatal ultrasound examination, thyroid tumors are well-isolated hyperechogenic tumors connected with the gland. Prenatal ultrasound color Doppler examination may reveal increased vascularity; however, discriminating between fetal hypothyroidism and hyperthyroidism based only on ultrasound may be difficult. Fetal tachycardia is known to be a good indicator of hyperthyroidism. Delayed bone maturation is a specific feature in fetuses with hypothyroid goiters [14]. The occurrence of goiter in the fetus in subsequent gestations has also been documented [15] (Figure 3).

Other hyperechogenic tumors within the fetal head and neck, such as rhabdomyoma and rhabdomyosarcoma, have also occasionally been described [16] (Tables I and II).

In utero treatment, gestation planning and postnatal treatment in cases of prenatally diagnosed fetal cervicofacial tumors

Initial reports suggest the possibility of *in utero* removal of fetal cervicofacial tumors. Removal of tumors *in utero* has already been employed in the treatment of fetal malformations in other localizations, such as teratomas in the sacrococcygeal region [17, 18]. The first successful intrauterine removal of a fetal cervicofacial tumor was performed by Kontopoulos *et al.*, University of Miami/Jackson Memorial Hospital, in 2012 [3].

When the tumor mass is large, impaired swallowing of amniotic fluid may additionally occur, resulting in polyhydramnios at the beginning of the third trimester of pregnancy. Amniodrainage is used to relieve maternal discomfort in cases of polyhydramnios and to prevent the complications associated with increased intrauterine pressure, such us preterm labor, premature rupture of membranes (PROM) and fetal hypoxia [19].

Fetal goiters may accompany mother hypothyroidism and are occasionally induced by propylthiouracil treatment during pregnancy. Some studies report good outcomes of fetal goiter treatment after intra-amniotic injections of levothyroxine [20].

In cases that carry a poor prognosis for the affected fetus due to the presence of the tumor or confirmed chromosomal defects before the 24th week of gestation, termination of pregnancy can be considered, especially when other defects concomitant with cervicofacial tumors of the fetus are diagnosed [21].

A considerable proportion of cervicofacial tumors demonstrate a tendency for postnatal idiopathic regression. Therefore, in cases which do not indicate any need for urgent surgery due to malignancy, large deformations caused by the tumor (torticollis, sternocleidomastoid muscle hypoplasia) or impairment of swallowing and breathing, the treatment of choice is to observe the tumors. If no

Table I. The list of articles identified in Medline concerning fetal cervicofacial tumors detected in prenatal ultrasound examination (years 2003–2012)

Author's name	Publication year	Gestational age [weeks]	Tumor type	Treatment and the fetus history
Kornacki	2012	29	Fetal goiter	Cesarean section at the 29th week of gestation. Newborn died after birth. For the next pregnancy, ultrasound prenatal examination, performed at week 19, revealed fetal goiter. Intra-amniotic levothyroxine pharmacotherapy. Cesarean section at the 37th week of gestation. Child euthyroid. Normal growth and development
Ince	2012	33	Malignant epignathus	Cesarean section at the 33rd week of gestation. Emergency tracheostomy. Partial excision of the tumor on the second day. Second operation with total excision of the tumor on 50th day of life. Discharged from hospital with tracheostomy and gastrostomy
Forys	2010	37	Epulis	Cesarean section at the 37th week of gestation. EXIT procedure and tumor excision. Normal growth and development
Clay	2009	32	Cervical hemangioma	Cesarean section at the 35th week of gestation. Postnatal pharmacotherapy. Scar observed, otherwise normal growth and development
Johnson	2009	25	Cervical teratoma	Cesarean section at the 37th week of gestation. EXIT procedure. Newborn died after birth
Mikovic	2009	21 and 23	Two cases of cystic hygroma	Intrauterine OK-432 in tumor injection. Delivery at the 39th week of gestation (delivered vaginally) and the 40th week of gestation (Cesarean section). Normal growth and development in both children
Dar	2009	12	Epignathus	Pregnancy termination at the 13th week of gestation
Antinolo	2009	21	Epignathus	Twin pregnancy. Other fetus normal. Cesarean section at the 33rd week of gestation. EXIT procedure and tumor excision with reconstruction. No follow-up data
Lassen	2008	31	Fetal goiter	Intra-amniotic levothyroxine pharmacotherapy. Cesarean section at the 40th week of gestation. Normal growth and development
Araujo Jr	2007	15	Cervicofacial teratoma	Cesarean section at the 32nd week of gestation. Orotracheal intubation and observation
Phupong	2007	13	Cystic hygroma	Spontaneous resolution. Delivery at the 40th week of gestation. 47XYY karyotype, otherwise normal growth and development
Valdez	2006	24	Cervicofacial rhabdomyoma	Cesarean section at the 38th week of gestation. Intubation and postnatal tumor excision. Recurrence of the lesion 14 months after the first surgery and repeated excision of the lesion. Four-year follow-up without recurrence. Normal growth and development
Yoshida	2006	35.5	Cervical hemangioma	Cesarean section at the 35th week of gestation. EXIT procedure. Postnatal laser therapy, pharmacotherapy. Scar observed, otherwise normal growth and development
Paladini	2005	21	Cystic hygroma	Termination at the 22nd week of gestation
Sasaki	2003	25	Cystic hygroma	Intrauterine OK-432 injection in tumor. Delivery at the 38th week of gestation. Normal growth and development

regression is observed, a surgical procedure, postnatal surgery involving tumor resection combined with simultaneous reconstructive procedures, is considered in the first year of life of the child [22]. Treatment of cystic hygromas and vascular malformations involves tumor resection or sclerotherapy with picibanil preparation (OK-432 – also *in utero* therapy) and local steroid therapy [23].

Surgical removal of hemangiomas is currently only rarely performed. The implementation of non-selective β-blockers such as propranolol and acebutolol has changed the management in the case of juvenile hemangiomas and improved postnatal prognosis. The treatment usually lasts until the end of the first year of life, i.e. until the time of tumor involution [24].

Table II. Fetal cervicofacial tumors. Differential diagnoses by ultrasound and color Doppler

Cervicofacial tumors	Ultrasound characteristics
Cystic hygroma	Solid tumor. Frequent location within the tongue and the cervical region. The presence of septations may suggest chromosomal defects
Teratoma	Solid tumor, occasionally with cystic elements and calcifications in different areas, frequently within the oral cavity and the pharynx
Epulis	Solid tumor with poor vascularization localized within the oral vestibule
Vascular malformation	Cystic tumor with multiple thin septations. Color Doppler would show vascularization
Hemangioma	Well-isolated tumor, increased blood flow in Doppler examination
Myoblastoma	Solid tumor. Frequent localization within the oral cavity
Thyroid tumor	Cervical solid tumor. Well isolated, connected with the thyroid gland, may present with increased vascularization

Perinatal airway management in neonates and outcomes in cases of prenatally diagnosed fetal cervicofacial tumors

At the last stage of pregnancy, the size of the pathological structure is of great significance. Fetal morphological defects such as tumors exceeding 50 mm are regarded as an indication for delivery by cesarean section [25]. Tumors that obstruct the respiratory tract at the level of the upper, middle or lower pharynx, larynx or trachea, either completely or to a great extent, can lead to congenital high-airway obstruction syndrome (CHAOS). In such situations, two possibilities are taken into consideration during perinatal management, with delivery by cesarean section being recommended for neonates.

In the case of airway obstruction, the EXIT procedure, ex-utero intrapartum treatment, is considered. Following the cesarean section, intraoperative ultrasound is performed at the suprapubic region to determine the attachment of the placenta. The attachment of the placenta can be determined clearly before the operation. A hysterotomy is then carried out to reveal the fetal head. The newborn is intubated and its condition is monitored. Next, the umbilical cord is clamped. If intubation is unsuccessful, urgent tracheotomy and possible tumor surgery are considered [26–28].

Although *in utero* therapy and perinatal treatment may considerably improve the chance of survival of fetuses with cervicofacial pathologies, the typical survival rate is poor. Such prenatal risks as hydramnios, preterm birth possibility, PROM, abnormal karyotype, and combined and complex abnormalities worsen the prognosis [29]. According to Kamil *et al.*, considerably higher mortality rates are observed for head and neck fetal tumors and sacrococcygeal tumors than tumors of other locations, the respective rates being 52.6% and 33.3%. Mortality rates are also considerably higher in cases of teratoma. The presence of hydrops fetalis independently predicted an unfavorable outcome in most cases of fetal tumors [5].

Prenatal ultrasound examination provides the necessary information regarding the pathology of the head and neck, including tumors. The presence of a neoplasm as well as its topography in relation to other structures, including the airway, and large cervical vessels can be identified, which allows perinatal care and subsequent procedures to be planned. Cervicofacial tumors identified during fetal life represent not only a diagnostic but also a therapeutic challenge for pediatric specialists. Knowledge of the presence of a tumor obstructing or compressing the upper respiratory tract is extremely important for perinatal care and planning to secure the airway of the neonate. Therefore, greater cooperation should be encouraged between diagnosticians performing the ultrasound assessments of the fetal head and neck, and the pediatric laryngologists, surgeons and anesthetists responsible for the child in the perinatal, neonatal and infantile periods [30].

Conflict of interest

The authors declare no conflict of interest.

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