Etiology and Perinatal Outcome of Polyhydramnios

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Etiology and Perinatal Outcome of Polyhydramnios

Polyhydramnion – Ätiologie und perinatales Outcome

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Key words
- obstetrics
- fetus
- ultrasound

Abstract

Purpose: To determine causes of polyhydramnios and the respective perinatal outcome.

Materials and Methods: We retrospectively analyzed cases with polyhydramnios at the Medical University Graz, Austria from 2003 – 2011. Inclusion criteria were single deepest pocket ≥ 8 cm, amniotic fluid index ≥ 25 cm, each of the latter parameters > 95th percentile or subjective impression. Etiologies, including TORCH infection, diabetes and congenital malformations, as well as perinatal outcome were evaluated.

Results: Out of 860 singleton pregnancies with polyhydramnios, 2.9 % had positive TORCH serology, 8.5 % had congenital anomalies, 19.8 % had maternal diabetes, and 68.8 % were idiopathic. The most common fetal anomalies were cardiac defects (32.9 %). Elective caesarean sections were more common in the groups with malformations and maternal diabetes. Low birth weight combined with severe polyhydramnios or maternal diabetes was associated with malformations.

Conclusion: Diagnosis of polyhydramnios should prompt glucose-tolerance testing, detailed sonography including fetal echocardiography, and TORCH serology. Especially pregnancies with polyhydramnios and small fetuses as well as those with maternal diabetes should be carefully evaluated for malformations.

Zusammenfassung

Ziel: Ein Polyhydramnion tritt in 1 – 2 % aller Schwangerschaften auf. Ziel der vorliegenden Studie ist die Ermittlung repräsentativer Zahlen über mögliche Ursachen und das perinatale Outcome betroffener Schwangerschaften.

Material und Methoden: In einer retrospektiven Analyse wurden Einlingsschwangerschaften mit einem Polyhydramnion, welche zwischen 2003 und 2011 an der Universitätsklinik für Frauenheilkunde und Geburtshilfe in Graz betreut wurden, evaluiert. Ein Polyhydramnion wurde definiert als „single deepest pocket“ (SDP) ≥ 8 cm, „amniotic fluid index“ (AFI) ≥ 25 cm, das Überschreiten der 95. Perzentile des entsprechenden Gestationsalters einer der beiden Parameter oder der subjektive Eindruck. Zielparameter waren die zugrundeliegende Ätiologie, im speziellen eine Infektion mit Toxoplasmose, anderen Viren, Röteln, Cytomegalovirus oder dem Herpes simplex Virus (TORCH), ein mütterlicher Diabetes oder angeborene fetale Fehlbildungen sowie das perinatale Outcome.

Ergebnisse: Im untersuchten Zeitintervall trat bei 973 Einlingsschwangerschaften ein Polyhydramnion auf. Bei 2,9 % der Patientinnen lag eine positive TORCH-Serologie vor, in 8,5 % konnte prä-, oder postnatal eine strukturelle Anomalie oder eine Aneuploidie festgestellt werden. 19,8 % waren mit einem mütterlichen Diabetes assoziiert und 68,8 % der Fälle waren idiopathisch. Die primäre Sectiorate war höher in den Gruppen mit fetalen Fehlbildungen und mütterlichem Diabetes. Niedriges Geburtsgewicht mit ausgeprägtem Polyhydramnion und mütterlicher Diabetes waren häufiger mit fetalen Fehlbildungen assoziiert.

Schlussfolgerung: Die diagnostische Abklärung bei vorliegendem Polyhydramnion, sollte ein Diabetesscreening, eine detaillierte Ultraschalluntersuchung mit Echokardiografie, sowie eine TORCH-Serologie umfassen. Ist das Polyhydramnion mit

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einem kleinen Kind oder mütterlichem Diabetes assoziiert sollte ein sorgfältiger Fehlbildungsausschluss erfolgen.

Introduction

Polyhydramnios is the excess of amniotic fluid and may be present in 1 – 2 % of pregnancies [1 – 3]. Diagnosis is typically made sonographically by evaluating the single deepest pocket (SDP) [4] or the amniotic fluid index (AFI) [5 – 7] or by subjective impression [8]. The amniotic fluid volume rises from 25 ml at 10 weeks to 400 ml at 20 weeks and plateaus at about 800 ml at 28 weeks to decrease around term to 400 ml, approximately [9, 10]. Polyhydramnios may be defined as SDP ≥ 8 cm, AFI ≥ 25 cm, each of the latter parameters exceeding the 95th percentile of the respective gestational age-dependent reference range or the very subjective impression [1, 11, 12]. An association of polyhydramnios and adverse perinatal outcome has been reported repeatedly since 1953 [2, 13 – 15]. Both maternal and fetal conditions, including fetal anomalies [16 – 18], maternal gestational and pregestational diabetes [19 – 21] as well as TORCH infections (toxoplasmosis, other [syphilis, varicella zoster virus, parvovirus B19], rubella, cytomegalovirus [CMV], and herpes simplex virus infections) [22, 23] may lead to an excess of amniotic fluid, while 50 – 60 % of polyhydramnios cases appear to be idiopathic [1]. However, in counseling patients about the cause and eventually related complications, physicians should refer to realistic numbers, according to comparable populations. The aim of our study was to determine presentable numbers of the proportion of causes of polyhydramnios and the respective perinatal outcome in a tertiary referral hospital.

Materials and methods

We performed a retrospective study on the etiology and perinatal outcome of singleton pregnancies beyond 20 weeks of gestation diagnosed with polyhydramnios at the Department of Obstetrics and Gynecology of the Medical University Graz, Austria, between June 2003 and March 2011. The study was approved by the local ethics committee (no.: 23 – 218 ex 10/11). Primary outcome was the underlying etiology while secondary outcome parameters were perinatal data including gestational age at delivery, birth weight, mode of delivery as well as neonatal mortality and morbidity. Data were extracted from the local electronic perinatal database (PIA, ViewPoint, GE Healthcare, Zipf, Austria) and the medical documentation system or patient files. Information on fetal and neonatal malformations was retrieved from the Styrian registry for congenital anomalies. This population-based registry on congenital anomalies was founded in 1986 and has been part of the EUROCAT network since 1995 [24]. Polyhydramnios was defined as either SDP ≥ 8 cm, AFI ≥ 25 cm at any time of gestation, each of the latter parameters exceeding the 95th percentile of the respective gestational age dependent reference range implemented in ViewPoint [12, 25], or the subjective impression. Examinations were performed at the ultrasound unit of our department by residents with sonography experience. Suspicious cases, however, were presented to specialists in obstetric ultrasound for detailed sonography. In cases with associated pre- or postnatal anomalies, genetic analysis was performed while this was not done in clinically normal fetuses and infants. In our unit diagnosis of polyhydramnios is routinely followed by performance of TORCH serology and review of oral glucose tolerance test (oGTT) results. The study cohort was retrospectively stratified into four groups for analysis of the causes of polyhydramnios: 1.) TORCH, with recent TORCH infection (positive serology); 2.) MALF, with major structural anomalies or aneuploidies; 3.) DIAB, with maternal gestational or pregestational diabetes; 4.) IDIOP, for idiopathic cases. Perinatal outcome parameters included gestational age at delivery, birth weight, 5-min Apgar score and arterial pH as well as infant morbidity and mortality. Maternal gestational diabetes was diagnosed based on oGTT (HemoCue, Ängelholm, Sweden) which is implemented in routine pregnancy care in Austria as well as on cord blood insulin testing that is routinely performed in our unit in all infants born with a weight ≥ 4000 g. In the observed period oGTT was performed between 24 and 28 weeks of gestation by capillary blood analysis after 12 h of fasting and one and two hours after administration of 75 g glucose. Cut-off values were 90 / 160 / 140 mg/dl or 5 / 8.9 / 7.8 mmol/l. In terms of severity, polyhydramnios was further categorized as mild or severe if the SDP was < 10 cm or ≥ 10 cm, respectively [1, 26].

Statistical analysis was performed by using the Kruskal-Wallis Test followed by Dunn's multiple comparisons test for continuous variables applying a significance level of $\alpha = 0.05$ (PRISM 6, GraphPad Software Inc., La Jolla, CA, USA).

Results

From June 2003 to March 2011, a total of 973 singleton pregnancies were diagnosed with polyhydramnios. 113 cases without malformation or diabetes were retrospectively excluded due to missing TORCH serology. In 860 cases assignment to one of the study groups (TORCH, MALF, DIAB or IDIOP) was feasible (**Fig. 1**): In 25 (2.9 %) women a recent TORCH infection was present, in 73 (8.5 %) infants structural (8.1 %) or significant genetic anomalies (0.4 %) were detected pre- or postnatally, 170 (19.8 %) women had pregestational or gestational diabetes and 592 (68.8 %) cases were classified as idiopathic. In 3 (12 %) women with TORCH infection and in 14 (19.2 %) women with a fetal malformation, additional gestational diabetes was diagnosed. We did not find TORCH infections in combination with fetal malformations. The overall mean maternal age was 30 [14 – 44] years and diagnosis of polyhydramnios was made at a mean gestational age of 34 [20 – 42] weeks (**Fig. 2**). Diagnosis was based on SDP in 660 cases (76.7 %), AFI in 33 cases (3.8 %) and both parameters together in 48 cases (5.6 %), while subjective impression was applied in 119 cases (13.8 %). The mean SDP at diagnosis was 8.1 [6.7 – 10.5] cm, 8.9 [6.2 – 15] cm, 8.3 [6 – 12] cm and 8.3 [6 – 15] cm in the TORCH, MALF, DIAB and IDIOP groups, respectively. Accordingly, the mean maximum SDP, which was available in 761 cases, was 8.8 [6.7 – 13] cm, 9.9 [7 – 17.6] cm, 8.7 [6.4 – 13] cm and 8.8 [5.7 – 19.5] cm (**Fig. 3**). In the 25 women of the TORCH group, 12 (48.0 %) were infected with CMV, 9 (36.0 %) with parvovirus B19, 2 (8.0 %) with toxoplasmosis, 1 (4.0 %) with rubella and 1 (4.0 %) with varicella zoster virus (**Table 1**). In our population no additional sonographic signs suggestive for fetal infections were present.

The most common of the 73 anomalies in the MALF group were cardiac defects (32.9 %), accounting for 2.8 % of the total study pop-

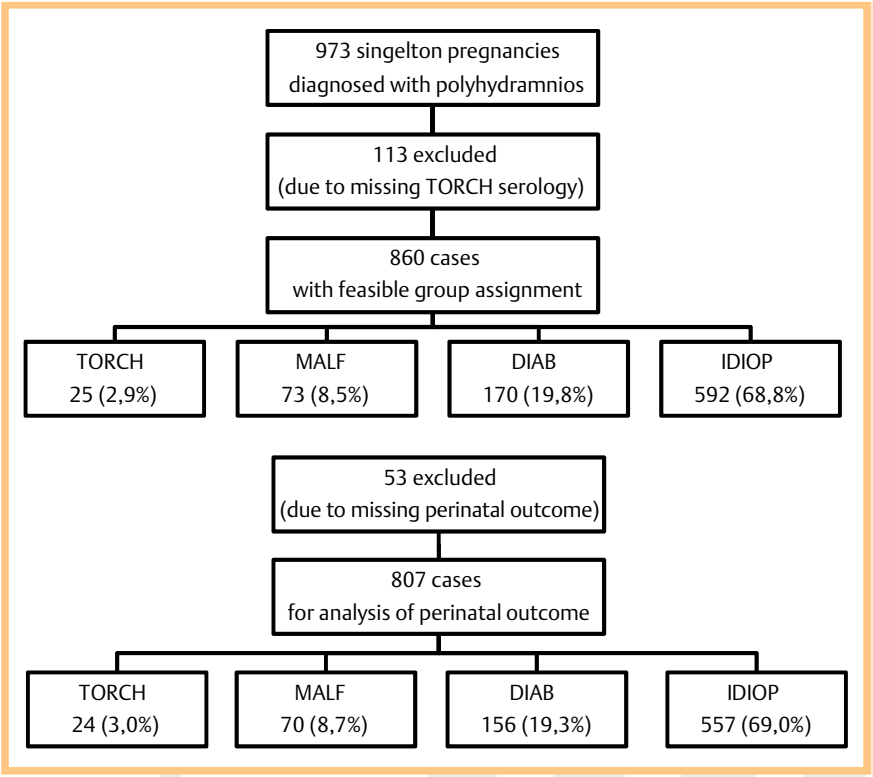

Fig. 1 Flow chart shows the study population and distribution (TORCH, MALF, DIAB, IDIOP).

Abb. 1 Das Flussdiagramm zeigt die analysierte Studienpopulation und die Verteilung der vier Gruppen (TORCH, MALF, DIAB, IDIOP) an.

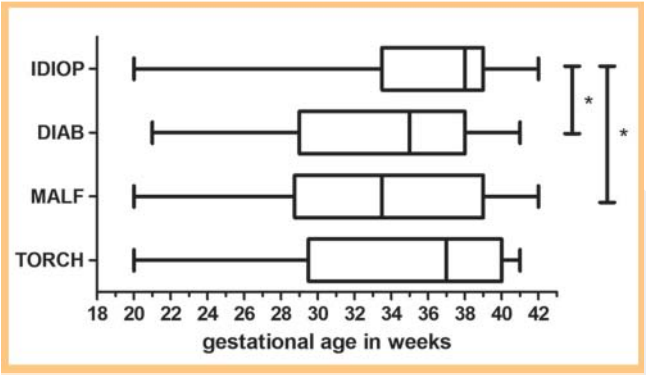

Fig. 2 Box-Whiskers plot of gestational age at diagnosis of polyhydramnios in the four study groups including cases with infections (TORCH), fetal malformations (MALF), maternal diabetes (DIAB) and without detectable pathology (IDIOP). Polyhydramnios occurred significantly (* = $p < 0.05$) earlier in the MALF and DIAB group in comparison to the IDIOP group. Boxes mark the 25th, the median and 75th percentiles, whereas whiskers show minimum and maximum values; statistical analysis was performed by applying the Kruskal-Wallis Test followed by Dunn's multiple comparisons test.

Abb. 2 Der Boxplot zeigt das Gestationsalter bei Diagnose des Polyhydramnions in den vier Gruppen (TORCH, MALF, DIAB, IDIOP) an. Im Vergleich zur IDIOP-Gruppe trat ein Polyhydramnion in den MALF- und DIAB-Gruppen signifikant (* = $p < 0,05$) früher auf. Die Box markiert die 25. und 75. Perzentile, sowie den Median. Die Whisker markieren Minimum und Maximum. Zur statistischen Analyse wurde der Kruskal-Wallis-Test und der Dunn's multiple comparisons Test angewendet.

diagnosis	number of cases (%)
cytomegalovirus	12 (48)
parvovirus B19	9 (36)
toxoplasmosis	2 (8)
varicella zoster virus	1 (4)
rubella	1 (4)

Table 1 Types of TORCH infection associated with polyhydramnios (n = 25/860, 2.9 %).

ulation, followed by genitourinary (21.9 %) and musculoskeletal (11.0 %) malformations. The frequency of gastrointestinal, thoracic, and central nervous system anomalies was low (**Table 2**). The same was true for complex multiple malformations, genetic anomalies and syndromes (**Table 2**). About half (50.7 %) of all fetal anomalies were detected prenatally, including 75.0 % of gastrointestinal and 62.5 % of genitourinary defects. However, only 16.7 % of cardiac defects were diagnosed antenatally. In 14 of the above 73 pregnancies (19.2 %), maternal diabetes was present in addition to the respective fetal anomalies.

The major proportion of the 170 women in the DIAB group had non-insulin-dependent gestational diabetes (70.6 %), followed by insulin-dependent gestational diabetes (21.2 %) and pregestational insulin-dependent diabetes (4.7 %). Six cases (3.5 %) were detected postnatally based on cord blood hyperinsulinemia (> 26.5 international unit/ml) in infants with a birth weight above 4000 g.

Data on perinatal outcome was available in 807 cases (**Fig. 1**, **Table 3**). 53 cases (1 TORCH, 3 MALF, 14 DIAB, 35 IDIOP) were excluded due to missing or incomplete data, mainly regarding information on gestational age at delivery, birth weight and mode of delivery. In this population the mean gestational age at delivery was 40 (35 – 41) weeks in the TORCH group, 38 (24 – 41) weeks in the MALF group, 39 (32 – 42) weeks in the DIAB group and 40 (32 – 42) weeks in the IDIOP group. Infants in the MALF group were delivered significantly earlier than those in the IDIOP group ($p < 0.05$) (**Fig. 4**). Comparing all groups in view of preterm delivery (< 37 weeks), there was a higher incidence in

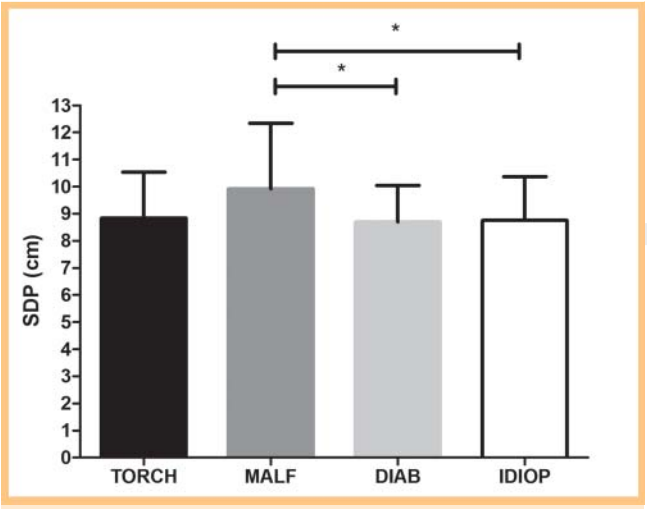

Fig. 3 Mean maximum single deepest pocket (SDP) of amniotic fluid in the four study groups (n = 761) including cases with infections (TORCH; n = 19), fetal malformations (MALF; n = 68), maternal diabetes (DIAB; n = 135) and without detectable pathology (IDIOP; n = 539). Statistical analysis was performed by applying the Kruskal-Wallis Test followed by Dunn's multiple comparisons test and showed a major mean maximum SDP (* = $p < 0.05$) in the MALF group in comparison to the DIAB and IDIOP group.

Abb. 3 Mittleres maximales „single deepest pocket" (SDP) in den vier Gruppen (TORCH, MALF, DIAB, IDIOP; n = 761). Zur statistischen Analyse wurde der Kruskal-Wallis-Test und der Dunn's multiple comparisons Test angewendet. Diese zeigten ein signifikant tieferes SDP in der MALF-Gruppe im Vergleich zur DIAB- und IDIOP-Gruppe (* = $p < 0{,}05$).

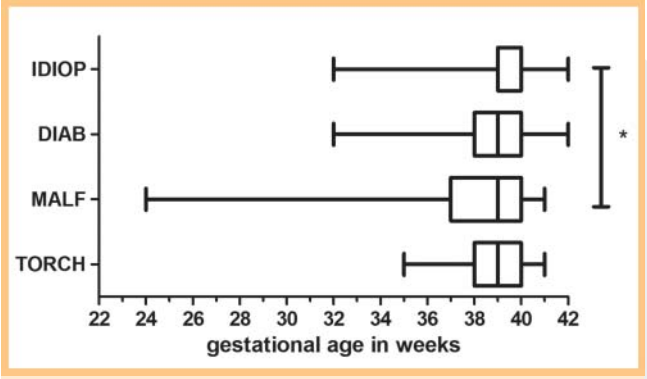

Fig. 4 Box-whiskers blot of gestational age at delivery in the four study groups including cases with infections (TORCH), fetal malformations (MALF), maternal diabetes (DIAB) and without detectable pathology (IDIOP). Boxes mark the 25th, the median and 75th percentiles, whereas whiskers show minimum and maximum values; statistical analysis was performed by applying Kruskal-Wallis Test followed by Dunn's multiple comparisons test and showed that delivery in the MALF group occurred significantly (* = $p < 0.05$) earlier in comparison to the IDIOP group.

Abb. 4 Der Boxplot zeigt das Gestationsalter bei Entbindung in den vier Gruppen (TORCH, MALF, DIAB, IDIOP). Dieses war in der MALF-Gruppe im Vergleich zur IDIOP Gruppe signifikant (* = $p < 0{,}05$) niedriger. Die Box markiert die 25. und 75. Perzentile, sowie den Median. Die Whisker markieren Minimum und Maximum. Zur statistischen Analyse wurde der Kruskal-Wallis-Test und der Dunn's multiple comparisons Test angewendet.

Table 2 Fetal congenital anomalies associated with polyhydramnios (n = 73/860, 8.5 %).

fetal anomalies	number of cases (%)
congenital heart defects	*24 (32.9)*
ventricular septal defect	9
pulmonary valve stenosis	6
atrial septal defect II	5
pulmonary atresia with ventricular septal defect	1
transposition of the great vessels	1
tetralogy of Fallot	1
patent foramen ovale	1
genitourinary system	*16 (21.9)*
hydronephrosis	9
hypospadia	2
multicystic dysplastic kidney	1
unilateral renal agenesis	1
hydrocele	1
ovarian cyst, suspected ovarian torsion	1
urethral stricture	1
musculoskeletal system	*8 (11.0)*
poly-, syndactyly	3
cleft lip and palate	3
malposition of limbs	2
complex malformations	*5 (6.8)*
ileum atresia, dysmorphic face, skeletal malformation, vessel anomalies	1
vessel anomalies, dislocation of stomach, dysmorphic lever, hydronephrosis	1
ventricular septal defect, cerebral anomalies	1
osteogenesis imperfecta, malformations of cardiovascular-, gastrointestinal and respiratory system	1
hygroma colli	1
syndromes	*5 (6.8)*
noonan syndrome	1
charge syndrome	1
jeune syndrome	1
poland syndrome	1
osteogenesis imperfecta type 2c	1
gastrointestinal tract	*4 (5.5)*
esophageals atresia	2
gastroschisis	1
anal atresia	1
central nervous system	*4 (5.5)*
holoprosencephaly	1
porencephaly	1
ventriculomegaly	1
multiple cerebral anomalies	1
respiratory tract	*4 (5.5)*
congenital diaphragmatic hernia	2
congenital cystic adenomatoid malformation	1
congenital laryngomalacia and tracheomalacia	1
chromosomal abnormality	*3 (4.1)*
trisomy 21	1
monosomy X	1
46,XY/47,XY+ 22	1

MALF fetuses (17.1 %). The mean birth weight was therefore significantly lower in the MALF group than in all other groups. Furthermore, we observed a higher incidence of small infants (< 10th percentile) in the MALF group. Regarding the mode of delivery, we found higher rates of elective (22.9 % and 21.2 %) and overall cesarean sections (42.9 % and 39.7 %) in the MALF and DIAB groups. There was no significant difference in the presence of neonatal acidosis (arterial pH < 7.20). However, severe acidosis

Table 3 Perinatal outcome of fetuses with polyhydramnios according to the respective study group including cases with infections (TORCH), fetal malformations (MALF), maternal diabetes (DIAB) and without detectable pathology (IDIOP). SGA, small for gestational age; LGA, large for gestational age; pHart, arterial pH.

perinatal outcome (n = 807)	TORCH (n = 24)		MALF (n = 70)		DIAB (n = 156)		IDIOP (n = 557)	
	n mean	% range	n mean	% range	n mean	% range	n mean	% range
maternal characteristics								
age (years)	28.9	17 – 39	30.3	18 – 40	30.7	16 – 44	29.6	14 – 44
pregnancy characteristics								
gestational age at delivery (weeks)	40	35 – 41	38	24 – 41	39	32 – 42	40	32 – 42
birth weight (grams)	3563	2370 – 4530	3177	660 – 4466	3542	1790 – 5190	3513	1800 – 4870
SGA (< 10th percentile)	1	4.2	12	17.1	13	8.3	38	6.8
LGA (> 90th percentile)	5	20.8	11	15.7	25	16.0	72	12.9
perinatal complications								
cesarean section	5	20.8	30	42.9	62	39.7	184	33.0
elective cesarean section	2	8.3	16	22.9	33	21.2	68	12.2
preterm delivery (< 37 weeks)	1	4.2	12	17.1	10	6.4	21	3.8
moderately acidosis (pHart 7.0 – 7.19)	2	8.3	12	17.1	28	17.9	84	15.1
severe acidosis (pHart < 7.0)	0	0	1	1.4	0	0	4	0.7
5-min Apgar score ≤ 3	0	0	2	2.9	0	0	0	0

(arterial pH < 7.0) only occurred in the MALF group (1.4 %) and in the IDIOP group (0.7 %). A 5-min Apgar score ≤ 3 was only observed in the MALF group (n = 2). Intrauterine fetal death occurred in one case of osteogenesis imperfecta and feticide was performed on parents' request in one case of porencephaly. One newborn died on the second day of life due to severe acidosis in the presence of pulmonary atresia with ventricular septal defect. We classified 193 (25.4 %) cases as severe (≥ 10 cm) and 568 (74.6 %) cases as mild (< 10 cm) polyhydramnios. In pregnancies with severe polyhydramnios, there was a higher proportion of fetal malformations (15.5 %) compared with those with less amniotic fluid (6.7 %). Fetuses with severe polyhydramnios were born more often preterm (8.3 % vs. 3.5 %) and by elective cesarean section (19.7 % vs. 12.3 %) than those with a mild case.

Comment

We performed a retrospective study on the etiology and perinatal outcome of polyhydramnios to gain profound information for counseling patients and potentially improve the management of affected pregnancies. It is remarkable that the majority of cases (68.8 %) were idiopathic with no evidence for fetal or maternal pathology which seems important to communicate during informed consent. However, in the remaining 31.2 % we identified maternal diabetes (19.8 %), fetal structural or genetic anomalies (8.5 %) as well as TORCH infections (2.9 %) being underlying causes for the condition. Our findings correspond well with earlier reports on polyhydramnios and the respective etiology [1, 2, 18, 27, 28]. It is well known that polyhydramnios is commonly present in pregnancies complicated by maternal gestational and pregestational diabetes, being observed in 8 – 20 % of cases [19 – 21]. In our study population maternal diabetes was the most common etiology for polyhydramnios. In Austria oGTT is implemented in routine pregnancy care and is therefore obligatory between 24 and 28 weeks of gestation. In women with polyhydramnios and a missing oGTT, this should be performed as soon as possible. However, in late pregnancy maternal glucose metabolism may be influenced by fetoplacental glucose steal phenomenon [29]. To identify such occult cases of gestational diabetes, routine cord blood insulin analysis is performed at our institution in all cases with an infant birth weight above 4000 g. Based on the latter, we could identify 6 cases in our study population as occult manifestations of diabetes.

Fetal structural anomalies have been reported to be found in 8 – 45 % of pregnancies with polyhydramnios, while fetal aneuploidies, including trisomy 13, 18 and 21, are observed in only 0.4 – 10 % [17 – 19, 30 – 33]. Second trimester screening for fetal anomalies is not part of routine pregnancy care in our country and was therefore not performed in all cases of our study population. 75 % of gastrointestinal and 62.5 % of genitourinary defects were detected prenatally. However, the most frequent anomalies in our cohort were cardiac defects and those had a prenatal detection rate of only 16.7 %. Comparable findings were also reported by other research groups [18, 34 – 36]. However, while 12 of the 21 undiagnosed cardiac anomalies were subtle ones that are commonly detected only postnatally, 8 were major defects (7 ventricular septal defects, 1 transposition of the great arteries) that eventually would have been identified if detailed echocardiography had been performed. We therefore strongly recommend adding fetal echocardiography to the diagnostic workup of cases with polyhydramnios. It is also of interest that esophageal atresia, which is assumed to be a common cause for severe polyhydramnios, was only found in 2 cases of the total population with polyhydramnios (0.2 %) [37]. However, this condition is generally rare with a reported prevalence of 2.17 in 10,000 deliveries according to recent European registry data [38]. A further important observation was the high proportion of fetuses below the 10th percentile of estimated weight in the group with fetal anomalies (17.1 %). We hence recommend screening for fetal malformations, at least in such small fetuses. Some authors [32, 34] additionally reported an association between the severity of polyhydramnios and the frequency of congenital anomalies. We found comparable results in our population with severe polyhydramnios where 30 (15.5 %) infants were affected by congenital anomalies. Additionally, infants with severe

polyhydramnios were born more often preterm and by elective cesarean section than those with a mild case. The same was true for cases with fetal malformations. Additionally, in pregnancies with MALF and DIAB polyhydramnios was diagnosed earlier in gestation as compared to IDIOP ($p < 0.05$). However, this difference was not significant in TORCH cases, probably due to the small number of cases in this group (**Fig. 2**).

The incidence for aneuploidy in infants with polyhydramnios ranges from 0.4 – 10 % [2, 3, 16 – 18, 39]. Brady et al. [17] reported an incidence of 3.2 % and hence advocated performing amniocentesis, whereas others [2, 3, 18, 34] did not recommend routine karyotyping in sonographically isolated polyhydramnios. In our population the prevalence of significant genetic anomalies was only 0.4 %, supporting this conservative approach. In our institution genetic analysis is performed in cases with associated pre- or postnatal anomalies while this is not done in clinically normal fetuses and infants.

TORCH infections may also be associated with polyhydramnios [22, 23]. Still, the relevance of routine TORCH serology in affected pregnancies has been under debate [27, 40, 41]. In our population 2.9 % of patients with polyhydramnios had a recent infection, with the overwhelming number being caused by CMV and parvovirus B19. While screening for toxoplasmosis is well established and implemented in routine pregnancy care in many countries and rubella as well as varicella are usually clinically detectable, the latter two viruses may remain undetected and lead to severe fetal or neonatal complications. Furthermore, prenatal interventions to decrease the likelihood of long-term sequela are available. In case of CMV this would be the administration of immunoglobulins to possibly reduce transfection [42, 43] whereas in parvovirus B19 infection fetal anemia may be treated by intrauterine blood transfusion [44]. Therefore, and due to the noninvasive and affordable testing modality, we recommend the performance of TORCH serology.

In terms of perinatal outcome, we found that fetuses with polyhydramnios and congenital anomalies had a higher risk of perinatal complications. They were born more often preterm (17.1 %) and below the 10th percentile and had a significantly lower mean birth weight. Severe acidosis (arterial pH < 7.0) and 5-min Apgar score ≤ 3 fortunately were rare events, but occurred particularly in the MALF group.

Regarding the mode of delivery, there was a higher rate of elective cesarean sections in the MALF (22.9 %) and DIAB groups (21.2 %). This seems to be attributable to special considerations depending on the underlying etiology. However, the overall cesarean section rate was also higher in these groups, suggesting a higher a-priori risk for intrapartum complications within these groups.

Whether it is preferable to use the SDP or the AFI to identify polyhydramnios is still unclear [45, 46]. Neither technique has been proven to be superior. Both are well applicable to confirm normal amniotic fluid volume, while the recognition of oligohydramnios and polyhydramnios might be less reliable [46]. This matter has been discussed in a recent review. However, the authors finally concluded that it might be preferable to use the SDP, since AFI might overestimate the number of pregnancies with oligohydramnios giving rise to more interventions without improvement in perinatal outcome [45].

Our study was not without limitations, since it was retrospectively designed and reports a single-center experience. In 113 cases there were no congenital malformations, maternal diabetes or other obvious signs of pathology. However, although these were likely to be idiopathic, we retrospectively excluded them due to missing TORCH serology. This may introduce a risk for selection bias. Nonetheless, as we present data from a large cohort our results are important and may be used by clinicians dealing with comparable populations.

To conclude, diagnosis of polyhydramnios should prompt glucose tolerance testing, detailed sonography including fetal echocardiography, and TORCH serology. Especially pregnancies with polyhydramnios and small fetuses as well as such with maternal diabetes should be carefully evaluated for malformations. However, parents should also be reassured by the fact that the vast majority of cases are idiopathic.

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