ACTA PÆDIATRICA
NURTURING THE CHILD

Acta Pædiatrica ISSN 0803-5253

BRIEF REPORT

The upper pouch in oesophageal atresia shows proportional growth during late foetal life

Oesophageal atresia with trachea-oesophageal fistula is a rare foregut malformation that requires surgery soon after birth. Prenatal ultrasound diagnosis is based on the presence of polyhydramnios, a small or non-visible foetal stomach and the blind-ending oesophagus, called the upper pouch (1). Neonates present with salivation, coughing, choking and attacks of cyanosis. A diagnosis of oesophageal atresia is confirmed by inserting a nasogastric tube and a thoraco-abdominal X-ray.

The level and size of the upper blind end of the oesophagus is of particular interest to paediatric surgeons, but the mechanism that triggers the growth of the upper pouch remains unknown. It has been assumed that foetal swallowing might have a trophic effect. That is why we studied the size and position of the upper pouch in newborn infants.

Our investigation, which was approved by the ethics committee of the Ruhr University of Bochum, Germany (number 16-5945-2017), revealed some new and important facts regarding the foetal upper pouch. It was based on good quality routine preoperative anterior-posterior X-rays and complete data sets were available for 28/47 cases (61% male) treated between 2006 and 2015.

The level of the dip of the upper pouch in relation to the upper edge of the thoracic vertebra caudal to the pouch was estimated on a digital imaging system: we inserted a radiopaque catheter in nine cases, water-soluble contrast medium in nine cases and aerogramm in seven cases. Furthermore, the ratio of the maximum diameter of the pouch divided by the diameter of the vertebra below was defined as the calibre.

The level of the pouch ranged from 0.5 to 4 thoracic vertebra, with one exception of 6.5, and the calibre ranged from 1.6 to 2.1 (Table S1). There was no correlation between gestational age and the pouch level ($p = 0.44$) or between the birthweight and the pouch level, according to linear correlation and Pearson's coefficient ($p = 0.33$; Fig. 1). Furthermore, the level of the upper pouch did not differ between infants with a birthweight of less than, or more than, 1500 g (mean 2.1 vs 2.9, $p = 0.11$). In addition, there was no difference between premature or mature newborn infants (both 2.3, $p = 0.78$). The levels of the upper pouch were statistically independent from the type of visualisation.

In general, the transverse diameter of the pouch was larger than the diameter of the underlying vertebra and ranged from 1.2 to 3.0. There was no correlation between the calibre and the gestational age ($p = 0.56$) or birthweight ($p = 0.30$). The calibre did not differ between infants based on whether they weighed under or over 1500 g or between premature or mature infants.

It is well accepted that the level of the trachea-oesophageal fistula can be used as a marker for the expected distance between both parts of the interrupted oesophagus. However, there is less information about the role of the upper pouch at surgery.

Our hypothesis was that repeated intrauterine swallowing by the foetus might elongate and enlarge the upper blind pouch in an over-proportional manner. Amniotic fluid and foetal lung secretions are both swallowed by the foetus. It starts, with mouthing and tongue movements between 11 and 20 weeks of gestation and swallowing fluids begins slowly and increase up to 760 mL per day in the third trimester. Single sucks have been noted manometrically at 28 weeks and sucking bursts have been recorded by 31 weeks (2,3).

We were not able to confirm our hypothesis that older and larger newborn infants might have had an over-proportional elongated upper pouch. However, our study was limited by the small sample of patients. In addition, we were not able to eliminate the influence of the posture of the head significantly during routine X-rays. In animal experiments, full flexion of the neck was associated with a 9% reduction in the length of the oesophagus (4). However, posture did not influence the position of the mid-oesophagus in relation to the vertebral column. In addition, the size and position of the upper pouch are influenced by swallowing and breathing (5).

A standardised imaging protocol would be essential to exclude these methodological limits.

In conclusion, our data did not support the hypothesis of an over-proportional growth of the upper pouch and postoperative morbidity in extremely immature infants with oesophageal atresia was not predicted by the limited growth of the upper pouch.

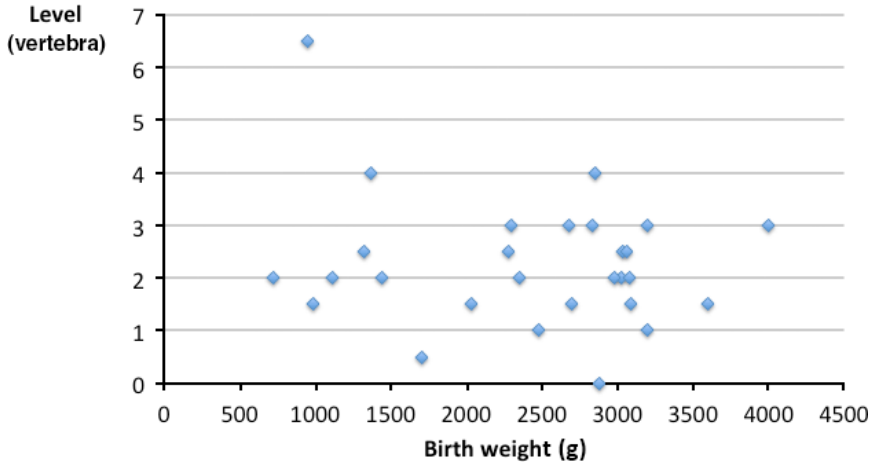

Figure 1 Level of the upper pouch in relation to the birthweight.

CONFLICT OF INTERESTS

The authors have no conflict of interests to declare.

FUNDING

This study received no external funding.

References

1. Garabedian C, Sfeir R, Langlois C, Bonnard A, Khen-Dunlop N, Gelas T, et al. Does prenatal diagnosis modify neonatal treatment and early outcome of children with esophageal atresia? *Am J Obstet Gynecol* 2015; 212: e1–7.
2. Cowart BJ, Beauchamp GK, Mennella JA. Development of taste and smell in the neonate. In Polin RA, Fox WW, Abman SH, editors. *Fetal and neonatal physiology*, 4th ed. volume 2. Philadelphia, PA: WB Saunders, 2011: 1899–1907.
3. Brace RA. Physiology of amniotic fluid volume regulation. *Clin Obstet Gynecol* 1997; 40: 280–9.
4. Lyall P, Bao-Quan Q, Beasley S. The effect of neck flexion on esophageal tension in the pig and its relevance to repair esophageal atresia. *Pediatr Surg Int* 2001; 17: 193–5.
5. Dodds WJ, Steward ET, Hodges D, Zboralske FF. Movement of the feline esophagus associated with respiration and peristalsis. *J Clin Invest* 1973; 52: 1–13.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1 Baseline data (n = 28) and two-sample testing of the upper pouch level and calibre in relation to birthweight and gestational age.

DOI:10.1111/apa.14399

R-B Tröbs (ralf-bodo.troebs@elisabethgruppe.de), M Nissen, J Wald

Department of Pediatric Surgery and Department of Diagnostic and Interventional Radiology, St. Mary's Hospital Herne, St. Elisabeth Group, Ruhr University of Bochum, Herne, Germany

Correspondence

Prof. Dr. med. R-B Tröbs, Department of Pediatric Surgery, Marienhospital Herne, Sankt Elisabeth Gruppe Rhein-Ruhr, Ruhr University Bochum Hospital, Widumer Str. 8, D-44627 Herne, Germany.
Tel: 00 49 2323 499 5400 |
Fax: 00 492 2323 499 3328 |
Email: ralf-bodo.troebs@elisabethgruppe.de

