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Outcome of isolated gastroschisis; an international study, systematic review and meta-analysis

Chiara C.M.M. Lap [a,*], Maria L. Brizot [b], Lourens R. Pistorius [a,v], William L.M. Kramer [c], Ivo B. Teeuwen [d], Marinus J. Eijkemans [e], Hens A.A. Brouwers [f], Eva Pajkrt [g], Anton H. van Kaam [h], Phebe N. Adama van Scheltema [i], Alex J. Eggink [j,w], Arno F. van Heijst [k], Monique C. Haak [i,l], Mirjam M. van Weissenbruch [m], Christien Sleeboom [n], Christine Willekes [o], Mark A. van der Hoeven [p], Ernst L. van Heurn [q,x], Catherina M. Bilardo [r], Peter H. Dijk [s], Robertine van Baren [t], Rossana P.V. Francisco [b], Ana C.A. Tannuri [u], Gerard H.A. Visser [a], Gwendolyn T.R. Manten [a]

[a] University Medical Center Utrecht, Division Woman and Baby, Department of Obstetrics, Utrecht, The Netherlands.
[b] Department of Obstetrics and Gynaecology, Hospital das Clínicas, São Paulo University Medical School, São Paulo, SP, Brazil.
[c] University Medical Center Utrecht, Department of Paediatric Surgery, Utrecht, The Netherlands.
[d] Maastricht University Medical Center +, Department of Anesthesiology, Maastricht, The Netherlands.
[e] University Medical Center Utrecht, Biostatistics and Research Support, Julius Center for Health Sciences and Primary Care, Utrecht, The Netherlands.
[f] University Medical Center Utrecht, Division Woman and Baby, Department of Neonatology, Utrecht, The Netherlands.
[g] Academic Medical Center Amsterdam, Department of Obstetrics and Gynaecology, Amsterdam, The Netherlands.
[h] Emma Children's Hospital, Academic Medical Center Amsterdam, Department of Neonatology, Amsterdam, The Netherlands.
[i] Leiden University Medical Center, Department of Obstetrics and Gynaecology, Leiden, The Netherlands.
[j] Radboud University Medical Center, Department of Obstetrics and Gynaecology, Nijmegen, The Netherlands.
[k] Radboud University Medical Center, Department of Neonatology, Nijmegen, The Netherlands.
[l] VU University Medical Center Amsterdam, Department of Obstetrics and Gynaecology, Amsterdam, The Netherlands.
[m] VU University Medical Center Amsterdam, Department of Neonatology, Amsterdam, The Netherlands.
[n] Pediatric Surgical Center of Amsterdam, Emma Children's Hospital University Medical Center and VU Medical Center, Amsterdam, the Netherlands.
[o] Maastricht University Medical Center +, Department of Obstetrics and Gynaecology, Maastricht, The Netherlands.
[p] Maastricht University Medical Center +, Department of Neonatology, Maastricht, The Netherlands.
[q] Maastricht University Medical Center +, Department of Paediatric Surgery, Maastricht, The Netherlands.
[r] University Medical Center Groningen, Department of Obstetrics and Gynaecology, Groningen, The Netherlands.
[s] University Medical Center Groningen, University of Groningen, Department of Neonatology Beatrix Children's Hospital, Groningen, The Netherlands.
[t] University Medical Center Groningen, University of Groningen, Department of Paediatric Surgery, Groningen, The Netherlands.
[u] Department of Pediatric, Pediatric Surgery Division, São Paulo University Medical School, São Paulo, SP, Brazil.
[v] University of Stellenbosch, Department of Obstetrics and Gynaecology, Stellenbosch, South Africa.
[w] Erasmus MC University Medical Centre Rotterdam, Department of Obstetrics and Gynaecology, Rotterdam, The Netherlands.
[x] Pediatric Surgical Center of Amsterdam, Emma Children's Hospital University Medical Center and VU Medical Center, Amsterdam, The Netherlands.

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ABSTRACT

Objective: To determine outcome of children born with isolated gastroschisis (no extra-gastrointestinal congenital abnormalities).
Study design: International cohort study and meta-analysis. Primary outcome: time to full enteral feeding (TFEF); secondary outcomes: Duration of mechanical ventilation, length of stay (LOS), mortality and differences in outcome between simple and complex gastroschisis (complex; born with bowel atresia, volvulus, perforation or necrosis).
To compare the cohort study results with literature three databases were searched. Studies were eligible for inclusion if cases were born in developed countries with isolated gastroschisis after 1990, number of cases >20 and TFEF was reported.

Abbreviations: CS, caesarean section; CI, confidence interval; CTG, cardiotocography; GA, gestational age; IQR, inter quartile range; LOS, length of hospital stay; NEC, necrotizing enterocolitis; NICU, neonatal intensive care unit; SD, standard deviation; TFEF, time to full enteral feeding; TPN, total parenteral nutrition.

* Corresponding author: University Medical Center Utrecht, Division Woman and Baby, Department of Obstetrics, Lundlaan 6, 3584 EA, Utrecht, The Netherlands.
E-mail addresses: c.c.m.m.lap@umcutrecht.nl (C.C.M.M. Lap), mlbrizot@uol.com.br (M.L. Brizot), lou@maternalfetal.co.za (L.R. Pistorius), wlm.kramer@solcon.nl (W.L.M. Kramer), i.b.teeuwen@gmail.com (I.B. Teeuwen), M.J.C.Eijkemans@umcutrecht.nl (M.J. Eijkemans), H.A.A.Brouwers@umcutrecht.nl (H.A.A. Brouwers), e.pajkrt@amc.uva.nl (E. Pajkrt), a.h.vankaam@amc.uva.nl (A.H. van Kaam), P.N.Adama_van_Scheltema@lumc.nl (P.N.A. van Scheltema), a.eggink@erasmusmc.nl (A.J. Eggink), arno.vanheijst@erasmusmc.nl (A.F. van Heijst), mc.haak@xs4all.nl (M.C. Haak), M.vanWeissenbruch@vumc.nl (M.M. van Weissenbruch), Chr.Sleeboom@vumc.nl (C. Sleeboom), c.willekes@mumc.nl (C. Willekes), m.vander.hoeven@mumc.nl (M.A. van der Hoeven), e.vanheurn@amc.nl (E.L. van Heurn), c.m.bilardo@umcg.nl (C.M. Bilardo), p.h.dijk@umcg.nl (P.H. Dijk), r.van.baren@chir.umcg.nl (R. van Baren), rossana.francisco@hc.fm.usp.br (R.P.V. Francisco), G.H.A.Visser@umcutrecht.nl (G.H.A. Visser), G.T.R.Manten@umcutrecht.nl (G.T.R. Manten).

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Meta analysis
Systematic review

Results: The cohort study included 204 liveborn cases of isolated gastroschisis. The TFEF, median duration of ventilation and LOS was, 26 days (range 6–515), 2 days (range 0–90) and 33 days (range 11–515), respectively. Overall mortality was 10.8%. TFEF and LOS were significantly longer ($P < 0.0001$) and mortality was fourfold higher in the complex group. Seventeen studies, amongst the current study, were included for further meta-analysis comprising a total of 1652 patients. Mean TFEF was 35.3 ± 4.4 days, length of ventilation was 5.5 ± 2.0 days, LOS was 46.4 ± 5.2 days and mortality risk was 0.06 [0.04–0.07 95%CI].
Outcome of simple and complex gastroschisis was described in five studies. TFEF, ventilation time, LOS were significant longer and mortality rate was 3.64 [1.95–6.83 95%CI] times higher in complex cases.
Conclusions: These results give a good indication of the expected TFEF, ventilation time and LOS and mortality risk in children born with isolated gastroschisis, although ranges remain wide. This study shows the importance of dividing gastroschisis into simple and complex for the prediction of outcome.

1. Introduction

Nowadays, gastroschisis is nearly always diagnosed prenatally during routine first and second trimester ultrasound examinations. However, even with early prenatal diagnosis, a recent meta-analysis has shown that intra-uterine fetal death is still 7-fold higher (4.48%) compared to the general population (0.62%) [1]. Neonatal survival and quality of life of children born with gastroschisis are often expressed as excellent, however, numbers differ widely between studies. This quantitative wide range might be the result of different treatment strategies, or caused by the fact that most studies have included gastroschisis cases with additional extra-intestinal congenital abnormalities [2]. The incidence of associated anomalies in gastroschisis varies from 5 to over 20% between studies [3,4]. Reported associations include cardiac abnormalities and increased prevalence of central nervous system anomalies (amyoplasia), and limb and kidney anomalies [5–7] and may influence the prognosis of the child with gastroschisis significantly [8].

With this study we aimed to determine the outcome of children born with isolated gastroschisis in order to give the prognosis of solely the entity gastroschisis in a cohort of 204 cases and to systematically review the literature to compare our findings with studies describing isolated gastroschisis cases born in other Western countries. Our primary objective was to investigate the time to full enteral feedings (TFEF) in isolated cases of gastroschisis, since this reflects the condition of the child and its bowel, and secondarily to investigate length of mechanical ventilation, length of hospital stay (LOS) and mortality. In addition, we investigated the difference between simple and complex gastroschisis (additional atresia, volvulus, perforation or necrosis of the bowel at birth) [9] on outcome measurements. It was our goal to provide future parents and clinicians with more quantitative data regarding outcome of their child with isolated gastroschisis.

2. Methods

2.1. Retrospective study

We conducted a cohort study of all live born gastroschisis cases, treated between January 2002 and January 2010 in six university hospitals in the Netherlands ('Netherlands') (Academic Medical Center Amsterdam, Maastricht University Medical Center+, Radboud University Medical Center Nijmegen, VU University Medical Center Amsterdam, University Medical Center Groningen, University Medical Center Utrecht) or born and treated at the Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo ('Brazil'), between August 2009 and January 2015.

All women suspected of being pregnant of a fetus with gastroschisis were referred to a university hospital for advanced ultrasound evaluation. If the diagnosis was confirmed, delivery was planned to take place in one of the centers with a pediatric surgery department. If gastroschisis was diagnosed postnatally, the neonate was immediately transferred to one of these pediatric surgery centers. During the study period in the Netherlands there was no uniform policy regarding elective delivery and Caesarean delivery was only performed for obstetric reasons, such as fetal distress or failure to progress in labor. In Brazil an elective Caesarean delivery was planned in all women at 37 weeks of gestation. Signs of fetal distress, such as meconium stained amniotic fluid with premature rupture of membranes, or abnormal CTG were reasons to expedite the Caesarean delivery.

In all pediatric surgery centers a primary operative abdominal wall repair of gastroschisis was attempted in all cases based on the condition of the child, the exteriorized viscera volume and the judgment of the surgeon, neonatologist and anesthetist. If the viscera could not be reduced primarily, a silo bag, either performed or created of a SILASTIC® sheet, was placed [10]. In case of silo placement, mechanical ventilation was continued if indicated and elective closure of the abdominal wall was planned in the subsequent days.

Hospital charts were reviewed for maternal, perinatal and neonatal characteristics. Isolated gastroschisis cases, according to the definition of Mastroiacovo et al. [5], were included. We categorized gastroschisis cases as simple or complex based on the gastrointestinal tract condition at birth. Atresia, antenatal volvulus, perforation or necrosis of the bowel was defined as complex gastroschisis [9,11]. Abdominal compartment syndrome, postnatal necrotizing enterocolitis (NEC) or volvulus were considered to be complications initiated by external factors and were therefore not labeled as complex. The primary outcome measurement was TFEF expressed in days i.e. the complete cessation of total parenteral nutrition (TPN). This primary endpoint was chosen since it reflects both the condition of the bowel as the general health of the child. Secondary outcome measurements were bowel complications, repeated operations after initial closure operation, non-gastrointestinal tract complications, length of mechanical ventilation, LOS and neonatal mortality. Due to the retrospective design not all data were available. If patients were transferred to regional hospitals efforts were made to extract the date of TFEF and date of discharge to home. If these data were not available the discharge date from the regional hospital or the tertiary center was used.

The study protocol was reviewed and approved by the Medical Research Ethics Committee of University Medical Centre Utrecht (no: 13–151/K).

2.2. Systematic review

In addition we performed a systematic search (date: April 22th 2016), to compare our literature with the following study questions: What is the average TFEF in children born with gastroschisis? What is the average duration of ventilation, LOS and mortality rate in children born with gastroschisis. Is there a difference in these outcome parameters between simple and complex gastroschisis?

2.3. Literature search

We conducted an electronic literature search in three databases (Medline, Embase and the Cochrane library) to identify all articles addressing solely the keywords (gastroschisis) OR (laparoschisis). A