



Outcomes of infants with abdominal wall defects over 18 years



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ABSTRACT

Background/Purpose: Infants with abdominal wall defects (AWD) are at risk of poor outcomes including prolonged hospitalization, infections and mortality. Our objective was to describe and compare the outcomes of infants admitted with gastroschisis and omphalocele over 18 years.

Methods: Population-based study of clinical data and outcomes of live-born infants with AWD admitted to all tertiary-level neonatal intensive care units in New South Wales and Australian Capital Territory from 1992 to 2009. **Result:** There were 502 infants with AWD – 336 gastroschisis, 166 omphalocele. Infants with gastroschisis required a longer duration of total parenteral nutrition (19 vs 4 days, $p < 0.05$), longer hospitalization (28 vs 15 days, $p < 0.05$) and had a higher rate of systemic infection [23.5% vs 13.3%, OR 1.77 (1.15–2.74), $p < 0.05$] compared to infants with omphalocele. Overall, omphalocele infants had higher mortality rate compared to gastroschisis infants [OR 2.77 (1.53, 5.04), $p < 0.05$]. Gastroschisis mortality rates increased from epoch 1 to epoch 3 (4.2% to 8.8%).

Conclusion: Compared to infants with omphalocele, infants with gastroschisis required significantly longer hospitalization and parenteral nutrition with higher rates of infection. Infants with omphalocele had higher overall mortality rates. However, there has been an increase in the gastroschisis mortality rates but the cause for this is unclear.

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Gastroschisis (GS) and omphalocele (OM) are the most common congenital abdominal wall defects (AWD). Both conditions may be diagnosed prenatally by a combination of maternal serum screening and fetal ultrasound [1–5]. While the incidence varies between countries, the overall global incidence of GS has been increasing (1–5 per 10,000) [6–10], while OM rates have remained stable (1–3 per 10,000) [7,11,12].

Children with AWD are at risk of prolonged hospitalization, feeding intolerance, infections and mortality [13–16]. Single center reports

Abbreviations: AWD, abdominal wall defect; ACT, Australian Capital Territory; ART, assisted reproductive technology; BW, birth weight; CLD, chronic lung disease; OM, omphalocele; GS, gastroschisis; ICD-9, International Classification of Diseases Ninth Revision; IUGR, intrauterine growth restriction; NEC, necrotizing enterocolitis; NICU, neonatal intensive care unit; NSW, New South Wales; ROM, rupture of membranes; SGA, small for gestational age; TPN, total parenteral nutrition.

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suggest that advances in perinatal management, nutrition and surgical techniques have improved outcomes, particularly for GS infants [6,17–19]. Whether this is true on a population level remains uncertain but important, as factors associated with short and long-term outcomes guide management and decision-making.

In this study, we aimed to describe and compare the outcomes of infants admitted with GS and OM to neonatal intensive care units (NICU) in New South Wales (NSW) and the Australian Central Territory (ACT) more than an 18-year period (1992–2009). We also aimed to identify risk factors associated with adverse short term outcomes and mortality. We hypothesized that the outcomes and survival of these infants have improved as a result of changes and improvement in neonatal and surgical practice over the 18-year period.

1. Methods

This study included all infants with AWD who survived to be admitted to one of the ten NICUs and were born over an 18 year period

between 1 January 1992 and 31 December 2009. The following information were extracted for the purposes of this study including maternal demographic data (maternal age, aboriginal status), perinatal information (maternal antenatal issues, provision of antenatal steroids, delivery information), neonatal data (gender, birthweight, gestational age), details of AWD management (surgical management, length of parenteral nutrition) and selected outcomes of AWD (length of stay, necrotizing enterocolitis, systemic infections, mortality).

1.1. Data source

This study was a retrospective review of data extracted from the neonatal intensive care units' (NICUS) data collection, which is a population-based, prospective state-wide audit of infants admitted to all ten NICUs (eight perinatal centers and two children's hospitals) within NSW and the ACT in Australia. The NICUS database commenced in 1992 and collects data on all neonatal patients who are admitted to a NICU during the neonatal period for one of the following reasons: (1) gestation age < 32 weeks, (2) birth weight ≤ 1500 g, (3) assisted ventilation (mechanical ventilation or continuous positive airways pressure) for 4 h or more commenced during the first 28 days of life, or (4) major surgery (opening of a body cavity first performed in the first 28 days of life), (5) insertion of a central line (6) therapeutic hypothermia. Neonatal, maternal and perinatal data were prospectively collected and collated within each NICU by a designated clinical nurse specialist. Standard definitions were used across the entire network. Data were compiled into a central database located at the NSW Pregnancy and Newborn Services Network, Sydney and were subjected to rigorous quality control measures. The definitions and accuracy of this database has been previously documented [20].

Study period was divided into three 6-year epochs: epoch 1 (1992–1997), epoch 2 (1998–2003), and epoch 3 (2004–2009). The study was approved by the NSW Population and Health Services Research Ethics Committee.

1.2. Definitions

The following definitions were used for the purposes of this study:

1. Growth percentiles were derived from Australian population-based growth charts [21].
2. Intrauterine growth restriction (IUGR) was diagnosed by antenatal ultrasounds where the fetus failed to reach its predetermined growth potential.

3. Small for gestational age (SGA) was defined as a birth weight less than 10th percentile for gender and gestation.
4. Out born status denoted neonates who were born in a non-tertiary hospital who required transfer to one of the ten NICUs for specialist treatment.
5. Death before discharge referred to deaths occurring prior to discharge of infants from NICUs, while overall death include any death occurring prior to and after discharge reported to the audit officers.
6. The classification of necrotizing enterocolitis (NEC) was based on published clinical and radiographic definitions [22].
7. To determine the complexity of GS, cases were divided into 'simple' or 'complex' disease based on the dates and types of operations using ICD-9 coding. From 1999 onwards, additional descriptions and code for the GS cases were recorded in the database. GS cases were categorized as 'complex' if there was additional coding for 'resection of atresia', 'bowel resection', 'volvulus', and 'adhesion' on the same day of primary operation. Cases were also categorized as 'primary closure' versus 'delayed closure' based on ICD-9 coding as well as dates of operations.

1.3. Statistical analysis

We utilized χ^2 test and *t* test for categorical and continuous data, where appropriate. One way ANOVA and Kruskal–Wallis test was used for multiple group comparisons. A multiple logistic regression analysis was used to establish the independent influence of AWD on neonatal mortality, after controlling for significant confounding factors identified in the bivariate comparisons. Separate logistic regression analyses were also performed on the subgroups of GS and OM to determine the factors associated with mortality in these groups. Odds ratio (OR) and adjusted odds ratio (AOR) were expressed with 95% confidence intervals (95% CI). A level of significance of $\alpha < 0.05$ using a two-tailed comparison was used in this study. Analysis was performed using SPSS Statistics (IBM Corp., Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp).

2. Results

A total of 36,571 infants were admitted to the 10 NICUs in NSW and ACT during the study period, including 10,052 (27.5%) in epoch 1, 12,038 (32.9%) in epoch 2 and 14,481 (39.6%) in epoch 3. Over the 18-year period, 502 (1.4%) infants with AWD were identified and treated. Of these, 336 (67%) had GS and 166 (23%) had OM. The incidence of

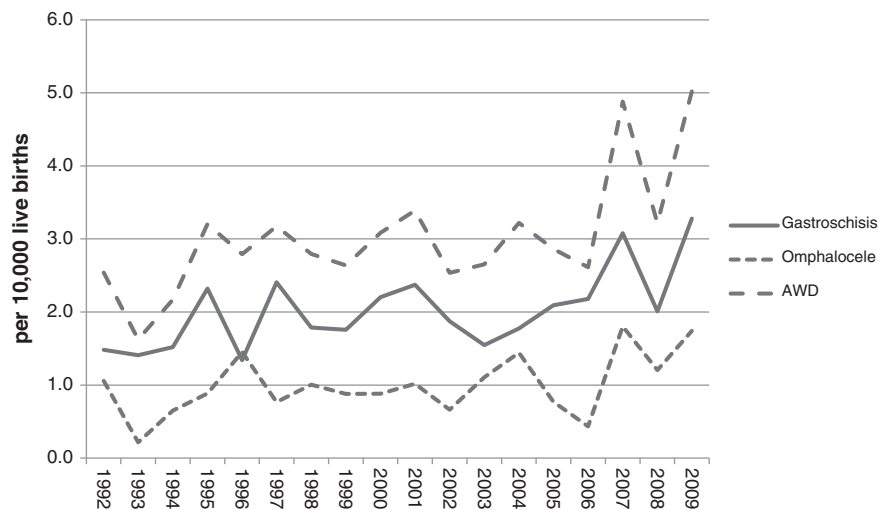


Fig. 1. Incidence of abdominal wall defect cases admitted to NICUs in NSW and ACT from 1992 to 2009. Data expressed as incidence per 10,000 live births (based on live births reported by the Australian Bureau of Statistics for NSW and ACT) [Total livebirths by year – 1992: 94534; 1993: 92393; 1994: 92159; 1995: 90466; 1996: 89517; 1997: 91364; 1998: 89481; 1999: 91037; 2000: 90817; 2001: 88516; 2002: 90695; 2003: 90472; 2004: 90068; 2005: 90795; 2006: 91815; 2007: 94248; 2008: 99488; 2009: 97641]

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