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A comparison of the management of blunt splenic injury in children and young people—A New South Wales, population-based, retrospective study

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ABSTRACT

The importance and safety of non-operative management (NOM) of Blunt Splenic Injury (BSI) has been established in children and adults over recent decades. However, studies have shown higher operation rates in adults. There is international evidence that when children are managed in adult centres, operation rates are higher while adolescents in paediatric centres, are operated on in line with paediatric guidelines. This difference between children and young adults, and the factors responsible, have not been examined in New South Wales (NSW).

Objective: To use NSW hospital and mortality data to compare the characteristics of BSI in patients aged 0–16 to those aged 17–25, and determine factors related to operative management (OM) and splenic salvage in each group.

Methods: Patients age 0–25 between July 2000 and December 2011, with a diagnosis of BSI, were identified in the NSW Admitted Patient Data Collection, and linked to deaths data from Registry of Births Deaths and Marriages and Bureau of Statistics. Operation rate was compared between the two groups. Univariable analysis was used to determine factors associated with OM. Multivariable logistic regression with stepwise elimination was then performed to determine likelihood of OM according to age group, adjusting for potential confounders.

Results: 1986 cases were identified, with 422 (21.2%) managed operatively – 101/907 children (11.1%) and321/1079 (29.7%)young adults($p < 0.001$). Of these, 59 (58%) children underwent splenectomy compared with 233 (73%) young adults ($p < 0.001$). OM increased significantly after the age of 12 ($p = 0.03$), and the percentage almost tripled in the teenage years, coinciding with a higher proportion admitted to adult centres. OM doubled again in young adults($p < 0.001$), all of whom were managed away from paediatric centres. On multivariable analysis, factors significantly associated with operation included age over 16 (OR 2.82, 95%CI 2.10-3.81), splenic injury severity, associated thoracic, liver, pancreatic and hollow viscus injury, and blood transfusion.

Conclusion: While Paediatric Surgeons have wholeheartedly adopted non-operative management, away from paediatric centres, it is possible children and young people in NSW are undergoing operation unnecessarily. Further evaluation of the surgeon attitudes and institutional factors involved in the management of injured children and young people within the broad NSW trauma system is required.

Introduction

The spleen is the most commonly injured intra-abdominal organ. The importance and safety of non-operative management (NOM) of Blunt Splenic Injury (BSI) has been established in children and adults over the last few decades. This is founded in the recognised link between asplenia and overwhelming sepsis, with

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its associated mortality, particularly when the spleen is removed in children [1]. Other contributing factors include the observation that the injured spleen can stop bleeding spontaneously and rarely restarts, reduced complications, lower transfusion rates and lower injury related mortality in both adults and children [1–4].

These benefits in paediatric trauma management were highlighted in the first published series in 1968 [5]. Further reports followed, culminating in the American Paediatric Surgical Association (APSA) guidelines in 2000 [6] which confirmed the place of NOM of splenic injury in paediatric trauma care. While initial recommendations were based on spleen injury grade, it is now recognised that haemodynamic instability should be the sole indicator for laparotomy [7]. The original guidelines set a NOM benchmark of 97% in isolated BSI and 89–95% overall [6,8]. These benchmarks are met in the vast majority of Paediatric Trauma Centres (TCs) in both North America and Australia [4,9,10] and splenic salvage approaches 100% in some [11].

The proven success of NOM in children soon drew the attention of adult trauma surgeons. In fact, the first case report of deliberate NOM was that of a 19-year-old male [12]. Other reports followed, culminating in publication of various adult guidelines [13,14]. The Eastern Association for the Surgery of Trauma (EAST) guidelines cite high level evidence that, as in children, the need for operation should be based purely on haemodynamic stability, except when there are other indications to operate such as hollow viscus injury [14].

While the last 15–20 years have seen a safe upward trend in splenic conservation in adults, whether by NOM or splenic preserving procedures [15,16], rates of NOM have been much lower than in children and there remains considerable variation in practice [17,18]. Most adult series report “selective” NOM, excluding up to 35% of cases who undergo immediate laparotomy, usually for haemodynamic instability [19]. When “failed” NOM cases are added, up to 50% of adults end up being managed operatively [19–21]. A recent Victorian state-wide series quoted a NOM rate of 64% and a splenectomy rate of 30% in seriously injured adults [22].

It is unclear from current literature at what age it is reasonable to expect transition from paediatric to adult modes of practice to occur and what factors may influence that transition. While the factors at play may be multiple, it appears that whether a patient is managed in a paediatric or adult setting has a significant influence on the likelihood of operation. The authors have previously reported that when children are managed in adult centres in New South Wales (NSW), Australia, operation and splenectomy rates are higher [10] and, conversely, it has been reported in North America that when adolescents up to the age of 20 are managed in Paediatric TCs, operation rates are in line with APSA guidelines [23,24]. The differences in management of children, adolescents and young adults with BSI within Australian trauma systems has not previously been described.

This study aimed to characterise blunt splenic injury in patients aged 0–16 compared with adolescents/young adults (AYA) aged 17–25 and determine the factors related to operative management and splenic salvage in each group. It was hypothesised that the operation rate in AYAs would be significantly higher than that in children, and splenic salvage lower, even after controlling for confounding variables.

Methods

The study was a retrospective cohort data linkage study from 1st July 2000 to 31 December 2011, including children and young people aged 0–25 years with a diagnosis of BSI. Cases meeting these inclusion criteria were identified in the NSW Admitted Patient Data Collection (APDC). This database is maintained by the NSW Ministry of Health and uses the International Classification of Diseases version 10–Australian Modification (ICD-10-AM) to code diagnoses, procedures and external causes. Mortality data was obtained from the Registry of Births, Deaths and Marriages (RBDM) and the Australian Bureau of Statistics (ABS) deaths registration. The NSW Centre for Health Record Linkage (CHeReL) undertook the data linkage, and the resulting deidentified records were provided to the researchers. These databases and linkage methods were similar to those described in a previous study by the authors [10].

The data were cleaned to remove records that were duplicates, or where death and APDC admission or discharge dates did not correlate. Cases transferred interstate for management, and those with a penetrating or firearms injury, were excluded.

Outcome and explanatory variables of interest are described in Table 1

Outcomes

The primary outcome was management of BSI, categorised as operative management (OM) or non-operative management (NOM). OM was further sub-grouped in to laparotomy only, splenectomy or spleen preserving procedure such as partial splenectomy or splenorrhaphy. These subgroups were created using ICD-10-AM procedure codes. The secondary outcome was splenic preservation categorised as yes (NOM, laparotomy without splenectomy or laparotomy with a spleen preserving procedure) or no (splenectomy).

Explanatory variables

Explanatory variables were extracted from the three datasets and treated as dichotomous, polycotomous or continuous. They were either obtained directly, or created using pooled date, demographic, facility, diagnostic, external cause and procedure ICD-10-AM codes within the datasets. Extracting and creating the variables was done using methods previously described by the authors [10].

The main explanatory variable was age. This was grouped as less than 17 (children) or greater than 16 (AYA) and further categorised into age sub-groups 0–4, 5–8, 9–12, 13–16, 17–20 and 21–25. Regarding facility categorisation, being manged at a Paediatric TC equates with management by a paediatric surgeon, with no paediatric surgeons providing trauma care at other facility types.

The ABS Socio-economic Index for Advantage and Disadvantage (SEIFAD), organ injury grading and injury severity scores are not specifically coded in the datasets. SEIFAD classifies NSW localities into 10 deciles, from the most socioeconomically disadvantaged and the least advantaged (decile one) to the least disadvantaged and the most advantaged (decile 10). It was allocated according to postcode. Spleen injuries were grouped in to mild, moderate, severe and unspecified and correlated with the American Association for the Surgery of Trauma (AAST) grading system [25].

Injury severity was represented by the compound injury risk ratio (C-IRR) which is the basis of the ICD Injury Severity Score (ICISS). The Injury Risk Ratio (IRR) is calculated as a ratio of all survivors with a particular ICD-10-AM injury code, to all patients with that injury code, including deaths. The C-IRR is the product of all the IRRs for a particular patient’s coded injuries [26]. Both the C-IRR and transfusion were considered proxies for physiological status, as more direct measures are not recorded in the APDC.

Statistical analysis

R statistical software version 3.2.3 was used for all analyses.

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