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National trends in pediatric blunt spleen and liver injury management and potential benefits of an abbreviated bed rest protocol

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ABSTRACT

Purpose: Recent reports suggest that an abbreviated bed rest protocol (ABRP) may safely reduce length of stay (LOS) and resource utilization in pediatric blunt spleen and liver injury (BSLI) patients. This study evaluates national temporal trends in BLSI management and estimates national reduction in LOS using an ABRP.

Methods: Pediatric patients (<18 years old) sustaining BLSI were identified in the Kids' Inpatient Database from 2000 to 2009. Yearly rates of injury and operative intervention were examined and stratified by type of injury. APSA guidelines and the reported ABRP were applied based on abbreviated injury score (AIS) and compared with actual LOS.

Results: 22,153 patients were identified. Over the study period, operative rates for spleen and liver injuries and overall mortality significantly declined: LOS = 3.1 days (±1.6) and 2.7 days (±1.9) for spleen and liver, respectively. If APSA guidelines were followed, the rates were LOS = 3.7 days (±1.1) and 3.4 days (±0.7), respectively. Application of the ABRP would result in LOS = 1.3 days (±0.5) for all BSLI patients. An ABRP could potentially save 1.7 hospital days/patient or 36,964 patient hospital days nationally.

Conclusion: Our study confirms a significant national decrease in operative intervention and overall mortality in patients with BSLI. Additionally, it appears that a shorter observation period than the APSA guidelines is being utilized. The implementation of ABRP holds potential in further reducing LOS and resource utilization.

Approximately 10%–15% of pediatric trauma patients suffer abdominal injuries, with blunt injuries to the spleen and liver (BSLI) being the most frequent. Over the last two decades there has been a definitive trend towards non-operative management of BSLI [1,2]. In 2000, the American Pediatric Surgical Association (APSA) published guidelines for non-operative management in this patient population, recommending a period of bed rest equal to the grade of injury plus one, in days, prior to clearance for discharge [3]. Since their release, an abbreviated bed rest protocol (ABRP) of one-day bedrest for grade I–II injuries and a two-day bedrest for injuries grade III or higher has been reported which safely reduced duration of hospitalization [4,5]. An abbreviated protocol has not been evaluated on a national level. We reviewed national trends in BSLI non-operative management in the pediatric trauma population using the Kid's Inpatient Database and examined the influence of an ABRP.

1. Methods

1.1. Data sources

Data from the Agency for Healthcare Research and Quality (AHRQ) sponsored Healthcare cost and Utilization Project (HCUP) Kid's Inpatient Database (KID) 2000, 2003, 2006, 2009 were used for analysis. Records in the KID are a sample of all pediatric discharges from community, non-rehabilitation hospitals from 27, 36, 38 and 44 states, respectively based on year of report. Each record was coded for max Abbreviated Injury Scale (AIS) by diagnosis using ICDPIC-trauma [6] and Injury Severity Score (ISS) using ICDMAP-90 [7].

1.2. Cohort

The study cohort includes only those KID discharges <18 years of age with trauma ICD-9 codes (800–959) as the primary diagnosis. We excluded those with a primary diagnosis of 905–909.x, 910–924.x, and 930–939.x, which represent injury late effects, superficial injuries and foreign bodies [8]. We further defined the cohort by selecting only those patients with a liver (864.x) or spleen (865.x) injury in any diagnosis field. Operative intervention was determined

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by ICD-9 procedure codes for splenectomy (41.42, 41.43, 41.5), splenorrhaphy (41.95, 41.99), hepatorrhaphy (50.61, 50.69, 50.99) or partial hepatectomy (50.22, 50.3). Discharges were excluded if they were missing injury severity scores (ISS), or where the ISS could not be calculated. Patients who sustained penetrating injuries were identified by ICD-9 external cause of injury codes and excluded from our analysis. Length of stay (LOS) analysis for all comparisons was limited to only those patients who did not undergo operative intervention.

1.3. Statistical analysis

Procedure specific operative rates were calculated for both liver and spleen injuries. Temporal relationships in procedure-specific rates, LOS and time to operative intervention were analyzed using Mantel–Haenszel chi-square test for trend, accounting for clustering of patients within hospital.

Hospitals were categorized according experience with pediatric patients based on the yearly volume of pediatric trauma discharges (high > =200, medium 100–200, and low <100) and by the yearly percentage of hospital discharges of patients 20 years old or younger.

For isolated BSLI patients an ABRP of one day for grade I–II (AIS < =2) injuries and two days for any higher grade of injury (AIS > =3) was applied to available data and an estimated difference in LOS was calculated compared with suggested APSA guidelines and with actual patient LOS. Overall patient days saved were calculated using a 66% rate of prolonged hospital stay secondary to bedrest seen in a previous prospective observational study [5]. Weighted frequencies were used to provide a national estimate of days saved. The Healthcare Cost and Utilization Project

Table 1
Characteristics of BSLI Patients.

PATIENT CHARACTERISTICS	All		Spleen		Liver		Both	
	22,153	(100%)	14,365	(64.8%)	9453	(42.7%)	1665	(7.5%)
	N	(%)	N	(%)	N	(%)	N	(%)
Age								
Mean (SD)	12.0	(4.7)	12.5	(14.2)	11.3	(5.2)	12.6	(4.8)
<1	533	(2.4)	289	(2.0)	290	(3.1)	46	(2.8)
1 to 4	1982	(9.0)	863	(6.0)	1272	(13.5)	153	(9.2)
5 to 9	3924	(17.7)	2371	(16.5)	1789	(18.9)	236	(14.2)
10 to 14	6551	(29.6)	4603	(32.0)	2330	(24.7)	382	(22.9)
15 to 17	9163	(41.4)	6239	(43.4)	3772	(39.9)	848	(50.9)
Gender								
Male	14,841	(67.0)	10,117	(70.4)	5681	(60.1)	957	(57.5)
Female	6947	(31.4)	3982	(27.7)	3667	(38.8)	702	(42.2)
Race/Ethnicity								
Caucasian	11,470	(51.8)	8060	(56.1)	4244	(44.9)	834	(50.1)
Black	1785	(8.1)	838	(5.8)	1091	(11.5)	144	(8.7)
Hispanic	2354	(10.6)	1204	(8.4)	1360	(14.4)	210	(12.6)
Asian/Pacific Islander	234	(1.1)	128	(0.9)	128	(1.4)	22	(1.3)
Native American	121	(0.6)	66	(0.5)	66	(0.7)	11	(0.7)
Injury Severity Score								
Mean (SD)	16	(11.5)	16	(12.1)	16	(11.3)	24	(13.5)
<5	5372	(24.3)	3846	(26.8)	1645	(17.4)	119	(7.2)
5–14	6318	(28.5)	3159	(22.0)	3520	(37.2)	361	(21.7)
15–22	5118	(23.1)	3316	(23.1)	2219	(23.5)	417	(25.1)
>22	5345	(24.1)	4044	(28.2)	2069	(21.9)	768	(46.1)
Abbreviated Injury Score								
Mean(SD)	2.6	(1.0)	2.8	(1.1)	2.3	(0.7)	2.8	(1.1)
<=2	15,271	(68.9)	9478	(66.0)	7295	(77.2)	972	(58.4)
3	1388	(6.3)	264	(1.8)	1208	(12.8)	112	(6.7)
4	3575	(16.1)	2704	(18.8)	950	(10.1)	405	(24.3)
5	1919	(8.7)	1919	(13.4)			176	(10.6)
Length of Stay								
0–2	5691	(25.7)	3257	(22.7)	2738	(29.0)	304	(18.3)
3–4	6739	(30.4)	4607	(32.1)	2438	(25.8)	306	(18.4)
5–7	5303	(23.9)	3731	(26.0)	1898	(20.1)	326	(19.6)
8–12	2340	(10.6)	1533	(10.7)	1119	(11.8)	312	(18.7)
>13	2080	(9.4)	1237	(8.6)	1260	(13.3)	417	(25.1)
HOSPITAL CHARGES								
Total Hospital Charges								
1–10,000	5042	(22.8)	3314	(23.1)	1848	(19.6)	120	(7.2)
10,001–20,000	5613	(25.3)	3732	(26.0)	2126	(22.5)	245	(14.7)
20,001–45,000	5689	(25.7)	3672	(25.6)	2443	(25.8)	426	(25.6)
>45,000	5208	(23.5)	3253	(22.7)	2784	(29.5)	829	(49.8)
Total Hospital Cost[a]								
<$4690	3370	(23.6)	2217	(24.0)	1232	(20.0)	79	(7.1)
$4690–$8335	3642	(25.5)	2366	(25.6)	1420	(23.1)	144	(13.0)
$8335–$16,520	3642	(25.5)	2406	(26.0)	1511	(24.6)	275	(24.8)
>$16,520	3642	(25.5)	2267	(24.5)	1987	(32.3)	612	(55.1)

[a] Costs available for years 2003, 2006 and 2009.