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Children War Casualties during the 1991-1995 Wars in Croatia and Bosnia and Herzegovina

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Aim. To analyze clinical course of war-related injuries in children treated at the Split University Hospital during the wars in Croatia (1991-1995) and Bosnia and Herzegovina (1992-1995).

Methods. Medical records of 94 treated children were analyzed. The severity of wounds was scored according to the Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS) evaluation systems.

Results. Most children were wounded during shelling/bombing (n=28, 10 boys and 18 girls) and by leftover explosive devices (n=26). Children injured by leftover explosive devices were predominantly boys (23/26 children), aged 10 to 16 years (19/26 children). Extremities were the most frequently wounded body regions (43% of all wounded regions). The wounds to the head/neck (median AIS=5.0, range 1-6) and abdomen (median AIS=4.5, range 3-5) were the most severe. Abdominal wounds required surgical procedures ($p<0.001$) and antibiotic treatment ($p<0.05$) most frequently, as well as patients with greater AIS and ISS scores ($p<0.05$). According to the treatment outcome, more patients wounded to the abdomen and extremities showed improvement than no change or complete recovery ($p<0.05$). Permanent disability remained in 37 (39.4%) children and three (3.3%) children died.

Conclusion. Boys in upper elementary grades and high school were at greater risk of being wounded by fragments of leftover explosive devices than younger boys or girls. The most severe wounds were to the head/neck and the abdomen and inflicted during the shelling or bombing. This should be taken into account in organization of surgical care for the children with war-related injuries.

Key words: *Bosnia and Herzegovina; child behavior; children; Croatia; explosives; trauma; war; wounds and injuries; wounds, multiple*

In recent wars, civilians have become the major targets, accounting for more than 80% of all killed and wounded (1). Unfortunately, there is a large proportion of children among the civilian victims (2). Also, recent wars are marked by an increase in the proportion of explosive wounds (3,4), in contrast to earlier wars where bullet wounds were predominant (1). In the wars in Croatia and Bosnia and Herzegovina (1991-1995), the civilians were particularly exposed to wounding by explosive weapons, especially bombs, because they were confined in large numbers to shelters, hospitals, towns, or villages under siege (5-7). The increase in firepower and lethality of modern explosives has increased the number of victims of explosive devices (8,9).

The aim of this study was to analyze the manner of wounding, characteristics of wounds, and the parameters and treatment outcome of children with war-related wounds treated at the Split University Hospital during the 1991-1995 wars in Croatia and Bosnia and Herzegovina. Before the outbreak of war in Croatia and neighboring Bosnia and Herzegovina, the University Hospital in Split, Croatia, with its 293 physicians, served a population of approximately 500,000 inhabitants. During the war, that population quickly increased to more than a million. The communications with medical institutions in Zagreb (Croatia) and Sarajevo (Bosnia and Herzegovina) were cut off (10). The Split University Hospital thus became the key medical institution for the sick and the wounded from large territories of southern Croatia and western Bosnia and Herzegovina. We analyzed children casualties treated in the Split University Hospital in hope that the analysis would provide information that could prove useful in treating war and post-war casualties.

Patients and Methods

Data Collection

From August 1991 to December 1995, 94 children from 3 to 16 years of age with war-related injuries were treated at the Department of Pediatric Surgery of the Split University Hospital. The data were collected from the patients' charts using especially created forms to record the sex, age, nationality and citizenship of the patients, circumstances and the site of the accident, number and localization of injuries, and severity of injuries. The data sheets were divided into 4 major sections, each including detailed information on: (a) general demographic data on the patient; (b) circumstances of the accident; (c) diagnosis, treatment in the hospital, and the injury scores; and (d) outcome.

Missing Data

Some children were treated in other medical facilities before the arrival to our hospital and some data, except for the sex, wounded body region, and the AIS and ISS scores, were incomplete or inadequately collected. Data about the circumstances of the accident were complete for 73 children, duration of the hospitalization was known for 90 children, number of surgeries performed for 89 children, number of taken antibiotics for 82 children, duration of the antibiotic therapy for 80 children, and the treatment outcome for 87 children.

Assessment of the Severity of Injuries

The severity of injuries was scored according to the Abbreviated Injury Scale (AIS) and the Injury Severity Score (ISS) system (11,12). The AIS score (scale from 1 to 6) was assessed according to the condensed chart for clinical use with a detailed list of diagnosis, which was proposed by Civil et al in 1985 (11). The ISS takes into account 3 the most severely wounded regions, and is calculated as a sum of squares of the AIS scores for each of those regions (12).

Statistical Analysis

The frequencies of the wounds in different circumstances of the accident according to the age and gender of children, as well as the treatment outcome for different parameters of the wounding were compared using the Pearson's chi-square test. Kruskal-Wallis ANOVA test was used to compare the AIS and ISS scores for body regions and the circumstances of the accident, as well as the treatment parameters.

Table 1. Demographic and clinical data on 94 children wounded in 1991-1995 wars in Croatia and Bosnia and Herzegovina treated at the Split University Hospital

Characteristic		No. (%) of patients
Year of the accident	1991	4 (4.3)
	1992	21 (22.3)
	1993	43 (45.7)
	1994	15 (16.0)
	1995	11 (11.7)
Citizenship	Bosnia and Herzegovina	76 (80.9)
	Croatia	16 (17.0)
	Missing data	2 (2.1)
Nationality	Croat	61 (64.9)
	Bosniak (Muslim)	25 (26.6)
	Serb	4 (4.3)
	Missing data	4 (4.3)
Age (years)	3-4	6 (6.4)
	5-6	8 (8.5)
	7-8	11 (11.7)
	9-10	17 (18.1)
	11-12	18 (19.1)
	13-14	28 (29.8)
	15-16	5 (5.3)
	Missing data	1 (1.1)
Sex	Boys	62 (66.0)
	Girls	32 (34.0)
Circumstances of the accident	Shelling/bombing	28 (38.4)
	Leftover explosive device	26 (35.6)
	Other	19 (26.0)
	Missing data	21 (28.8)
Permanent disability	Present	37 (39.4)
	Absent	50 (56.4)
	Missing data	4 (4.3)

Results

We analyzed data for 62 boys (66%) and 32 girls (34%) (Table 1). The children were the citizens of Bosnia and Herzegovina (76/92) or Croatia (16/92) (data missing for 2 children), mostly Croats by nationality. Children from other two entities in BH were also treated (30.9% of all children). The largest number of children was in the age group of 13-14 years. Most children were wounded in 1993 (43/94 or 45.7%) and, considering the circumstances of the accident, most children were wounded during shelling and/or bombing (n=28) or by the leftover explosive devices (n=26). Permanent disability remained in 37 (39.4%) children and 3 children (3.3%) died in the hospital.

Most children injured by leftover explosive devices were boys (23 out of 26 or 88%; Table 2) in the older age group (19 or 73%). Girls were more frequently wounded during the shelling/bombing than by leftover explosive devices. There was a significant difference with regard to the circumstances of the accident between the two age groups of boys ($p=0.013$), and of total number of children ($p=0.032$).

Out of 94 children, 53 had only one body region wounded, 26 had two body regions, and 15 had three body regions wounded, with the total number of 150 wounded regions (Table 3). There were more patients with the wounds to the head/neck, thorax, and abdomen in the shelling/bombing group than in other two groups. Also, for the leftover explosive devices, wounds to the extremities were significantly more frequent than to the other regions ($p=0.036$).

The most frequently wounded body region were extremities, making 43% of all wounded regions (65 out of 150). The wounds to the extremities were also frequent as the third most severe wounds, whereas the abdomen and the thorax had the similar frequency as the first and the second most severely wounded body regions, respectively (Table 3). The most severe wounds were caused by the shelling/bombing (median 4, range 2-5; $p<0.001$) (Table 4) and the most severely wounded body regions were head/neck (median 5, range 1-6) and the abdomen (median 4.5, range 3-5; $p<0.001$). Both the AIS and ISS scores analysis showed similar results in scoring the wound severity for the circumstances of the accident and for the wounded body regions.

The duration of treatment was similar in all patient groups with regard to the circumstances of the accident, most severely wounded body region, number of wounded body regions, and severity of wound (Table 5). The highest number of surgeries was performed on the patients wounded during the shelling/bombing (median 3, range 1-14; $p=0.0498$) and those with abdominal wounds (median 4.5, range 1-14; $p<0.001$). Also, more surgeries were performed on the patients with greater AIS ($p<0.001$) and ISS ($p=0.001$) score.

Table 2. Distribution of circumstances of the accident by age and sex of 73 children wounded in 1991-1995 wars in Croatia and Bosnia and Herzegovina and treated at the Split University Hospital[a]

	Circumstances of the accident (No., %)				
Age groups (years)[b]	shelling/bombing	leftover explosive devices	other	total	p[c]
Boys	10 (20.9)	23 (47.9)	15 (31.3)	48 (100.0)	
3-9	7 (14.6)	4 (8.3)	5 (10.5)	16 (33.3)	0.013
10-16	3 (6.3)	19 (39.6)	10 (20.8)	32 (66.7)	
Girls	18 (72.0)	3 (12.0)	4 (16.0)	25 (100.0)	
3-9	8 (32.0)	1 (4.0)	3 (12.0)	12 (48.0)	
10-16	10 (40.0)	2 (8.0)	1 (4.0)	13 (52.0)	N.A.
Total	28 (38.4)	26 (35.7)	19 (26.1)	73 (100.0)	
3-9	15 (20.6)	5 (6.9)	8 (11.0)	28 (38.4)	0.032
10-16	13 (17.8)	21 (28.8)	11 (15.1)	45 (61.6)	

[a]For 21 of 94 analyzed patients, the data on circumstances of the accident were missing.
[b]Analyzed by age and sex.
[c]Pearson's chi-square test; N.A. – not analyzed.

The highest number of antibiotics was used in the group of patients most severely wounded to the abdomen (median 4, range 1-5; p=0.003).

Considering the most severely wounded body region only, there were more children with improved condition than cured or with no change in the health status in the group of children wounded to the abdomen (12 out of 18 or 67%) and the extremities (31 out of 50 or 62%) than in the group of those wounded to the head/neck and thorax (p=0.004). The treatment outcome analysis showed that most children were in the "improved" category in all analyzed parameters of wounding. The significantly large number of children with less severe wounds according to the AIS (p<0.001) and ISS (p=0.007) score was cured.

Discussion

Our study showed that the major cause of wounds in children with war injuries were either shelling/bombing or a leftover explosive device. This is in line with other studies reporting that recent wars are marked by an increase in the frequency of explosive wounds (1,3,4), and supports the observation that the increase in firepower of modern explosives increases the number of victims of explosive devices (8,9).

The most important finding of our study was that the largest number of children wounded by fragments of leftover explosive devices were older boys (10-16 years of age – in upper elementary grades or first two high school grades). Since the similar pattern was observed earlier (13), it was suggested that additional educational efforts aimed at this high-risk children group and their parents should be undertaken (14).

Contrary to the mechanism of wounding, the anatomical localization of wounds has not changed in recent wars (1,8). The anatomical localization of wounds in our study was similar to previous reports, with injuries to the extremities being the most common (1). However, the incidence of abdominal wounds in children in this study was higher than that reported in the previous studies, where abdomen was the least often wounded body region (9,15,16). Compared to bullets, fragments of the explosive devices produce a higher proportion of soft-tissue injuries (19), which could explain the higher proportion of the wounds to the abdomen in our study.

Our study was based on retrospective analysis of hospital data in surgical departments (3,17,18). Since some of the wounded children were treated in other medical facilities before the arrival to our hospital, some data were incomplete or inadequately collected. Due to the war circumstances in Croatia and Bosnia and

Table 3. Number and severity of body region wounds in 94 patients treated at the Split University Hospital[a]

	Body region				
Parameter	head/neck	thorax	abdomen	extremities	total
Circumstances of the accident (No. of patients):[b]					
Shelling/bombing	8	4	8	8	28
Leftover explosive device	4	2	1	19	26
Other	4	1	2	12	19
Total	16	7	11	39	73
Severity of wounds (No. of body regions):[c]					
Most severe	17	9	18	50	94
Second most severe	8	11	17	5	41
Third most severe	2	0	3	10	15
Total	27	20	38	65	150

[a]There were 53 children with one, 26 with two, and 15 with three body regions wounded.
[b]p=0.036 (Pearson's chi-square test).
[c]The severity of wounding according to the AIS ranked as the most severe wound, the second most severe, and the third most severe wound. The differences among regions were not significant (Pearson's chi-square test).

Table 4. Assessment of the severity of wounds according to AIS and ISS scoring systems in 94 children wounded in 1991-1995 wars in Croatia and Bosnia and Herzegovina and treated at the Split University Hospital

Variable	Severity of wounding (median, range)[a] AIS	ISS
Circumstances of the accident[b]:		
Shelling/bombing (n=28)	4 (2-5)	17.5 (4-41)
Leftover explosive devices (n=26)	3 (1-5)	9 (1-34)
Other (n=19)	3 (1-6)	9 (1-75)
p[c]	<0.001	0.002
Most severely wounded body region:		
Head/neck (n=17)	5.00 (1-6)	25 (1-75)
Thorax (n=9)	3.00 (1-5)	10 (1-32)
Abdomen (n=18)	4.50 (3-5)	22 (9-35)
Extremities (n=50)	3.00 (1-4)	9 (1-17)
p	<0.001	<0.001

[a]AIS score is determined for single most severely wounded body region and ISS is calculated as a sum of squared AIS scores for three most severely wounded body regions (11).
[b]Missing data for 21 patients.
[c]Kruskal-Walis ANOVA test.

Herzegovina, medical documentation was insufficient at different levels, since the major attention was, naturally, paid more to the adequate medical treatment than to the proper administrative work. The lack of adequate medical documentation limits the use of other, more complex but useful wound scoring methods, such as the Red Cross Classification (18) for the retrospective data analysis. This indicates the need for a standardized form, which could be filled out with all necessary patients' data at the medical facility immediately after patient admission. The forms used in this study would have been of great benefit if applied at the time of hospitalization and not during the retrospective data analysis, when they were created to systematically organize the data.

The existing injury scoring systems, used in scoring the civil trauma, still have to be tested as scoring systems for war-related injuries. Since only 15 of our 94 patients were wounded in three body regions (Table 5), it seems that the AIS scale, which takes into account only the most severely wounded body region, may be more useful in that respect than the Injury Severity Score (ISS), which takes into account the three most severely wounded body regions (11,12). However, both scoring systems appear to be valuable for the analysis of severity

Table 5. Treatment outcome with respect to the severity and circumstances of wounding, and the number of wounded body regions in 94 children wounded in 1991-1995 wars in Croatia and Bosnia and Herzegovina and treated at the Split University Hospital

Parameters of wounding	Treatment parameters; median (range) duration of treatment (days)	No. of surgeries	No. of antibiotics used	Treatment outcome (No. of patients) cured	improved	no change	missing data
Circumstances of the accident:							
Shelling/ bombing	24 (1-79)	3 (1-14)	3 (1-7)	4	18	4	2
Leftover explosive devices	17 (1-39)	2 (1-8)	3 (1-5)	9	15	1	1
Other	16.5 (1-139)	2 (1-7)	2 (1-4)	6	11	2	
p	0.207[d]	0.0498[d]	0.108[d]	0.39[e]			
Most severely wounded body region:[a]							
Head/neck	13.5 (1-79)	1 (1-12)	2 (1-6)	5	7	4	1
Thorax	21 (6-32)	3 (1-8)	3 (1-7)	4	3	2	
Abdomen	22 (8-94)	4.5 (1-14)	4 (1-5)	4	12	1	1
Extremities	17 (1-240)	2 (1-8)	3 (1-5)	13	31	1	5
p	0.338[d]	<0.001[d]	0.003[d]	0.004[e]			
Number of wounded regions:[b]							
One	16.5 (1-240)	2 (1-8)	3 (1-5)	13	32	4	4
Two	15.5 (1-94)	2 (1-9)	3 (1-7)	9	13	3	1
Three	22.5 (1-79)	2 (1-14)	3 (1-6)	4	8	1	2
p	0.788[d]	0.188[d]	0.229[d]	0.864[e]			
Severity of wounding – AIS:[c]							
1-3	16 (1-240)	2 (1-8)	3 (1-5)	22	35	1	5
4-6	23 (1-94)	4 (1-14)	3 (1-7)	4	18	7	2
p	0.101[d]	<0.001[d]	0.036[d]	0.001[e]			
Severity of wounding – ISS:[c]							
<10	16 (2-240)	1 (1-8)	3 (1-5)	19	26	1	4
10	21 (1-94)	3 (1-14)	3 (1-7)	7	27	7	3
p	0.245[d]	0.001[d]	0.037[d]	0.007[e]			

[a]For each patient only the most severely wounded body region according to the AIS scoring system was included.
[b]Patients were divided in groups with one, two, or three wounded body regions.
[c]AIS score is determined for a single most severely wounded body region, whereas ISS is calculated as a sum of squared AIS scores for the three most severely wounded body regions (11).
[d]Kruskal-Wallis ANOVA test.
[e]Pearson's chi-square test.

of wounding in our patients. A proper characterization of injuries according to these scoring systems may be an essential aid in triaging the wounded and a good index of the treatment outcome.

The results of our study indicate that older boys, in upper elementary grades and high school, are under greater risk for being wounded by fragments of explosive devices than younger boys or girls. This risk may greatly outlast the war period, considering the numerous land mines in the previous war zones. Strong efforts should be undertaken in those areas in terms of injury prevention.

Also, the most severe wounds according to the AIS and ISS scoring systems were the wounds to the head/neck and abdominal body regions inflicted during the shelling or bombing. This should be taken into account during organization of surgical care for the children with war-related injuries, as well as in organizing preventive measures to protect children during and after war.

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