European Journal of Trauma and Emergency Surgery (2019) 45:857–864
https://doi.org/10.1007/s00068-018-0901-3

ORIGINAL ARTICLE

Severe casualties from Bastille Day Attack in Nice, France

Federico Solla[1] · Joseph Carboni[1,2] · Arnaud Fernandez[2,3] · Audrey Dupont[4] · Nathalie Chivoret[1] · Gilles Brézac[5] · Virginie Rampal[1] · Jean Bréaud[1,2]

Received: 9 October 2017 / Accepted: 2 January 2018 / Published online: 9 January 2018

Abstract

Purpose To describe the most severe casualties from the July 14th, 2016 terror attack in Nice that were treated at the Lenval University Children's Hospital (LUCH) of Nice (France).

Methods Retrospective study about casualties treated at LUCH from Bastille Day Attack with injuries resulting in the need for surgery, resuscitation, or death. The type of lesions and surgery, duration of hospitalizations, complications, psychological status, and outcome at discharge were collected.

Results Eleven patients presented severe traumas including three adults. They were triaged and managed first by the Critical Care Physician on duty and by emergency room nurses with no additional staff. Six pediatric casualties needed surgery; seven patients were hospitalized in Pediatric Intensive Care Unit (PICU). Five deaths were reported. The most relevant injuries were: pelvic disjunction, lower limb fracture, vascular injuries, and head or trunk crush. As soon as it was possible, two surgeons attended the emergency room (ER) to help carry out the triage. Overall we performed twenty-eight surgeries, including two neurological, one vascular, and five orthopedic. We performed closed reduction and internal fixation (CRIF) in three cases of limb fractures. A compartment syndrome was observed. Stress disorders were observed in three patients, which merited psychiatric support and treatment.

Conclusion We faced uncommon situations with severe casualties without pre-hospital management. The presence of adult patients and unusual lesions increased the complexity. The presence of surgeons in the ER seemed useful for effective clinical decision-making. CRIF has been a valid option for damage control. Competence in vascular, neurological, major trauma surgery and psychic trauma should be available in any pediatric trauma center.

Keywords Terror attack · Mass casualty incident · Children · Trauma · Pediatric hospital

Introduction

On July 14th, 2016 (Bastille Day), a terror attack by a lorry against the crowd occurred in Nice (France) at 10.33 p.m. [1] near to *Lenval University Children's Hospital* (LUCH), which is a level 1 trauma center for children with a surgery department including five operating rooms. Pediatric surgeons of each specialty (general, urologic, ENT, trauma-orthopedic and neurological) and operating room nurses are on call at home after 8 p.m.

Due to its position close to the scene, LUCH received both adult and child casualties prior to any pre-hospital medical management [2, 3].

Once Mass Casualties Incident (MCI) was confirmed by unofficial sources, the disaster plan was triggered, recalling staff and releasing beds. Ten minutes later, four severe casualties arrived without pre-hospital management and were

✉ Federico Solla
fedesolla@hotmail.com

[1] Pediatric Surgery Department, Lenval University Children's Hospital, 57, Avenue de la Californie, 06200 Nice, France

[2] Medical School, University of Nice, 28 Avenue de Valombrose, 06107 Nice, France

[3] Child Psychiatry, Lenval University Children's Hospital, 06200 Nice, France

[4] Pediatric Intensive Care Unit, Lenval University Children's Hospital, 06200 Nice, France

[5] Pediatric Anesthesiology, Lenval University Children's Hospital, 06200 Nice, France

treated by on-duty staff led by the critical care physician (CCP). Two operating rooms were immediately made available. Most of the victims arrived at the hospital without any prior information or pre-hospital management and without any extra medical or paramedical staff. The highest influx of casualties ($n = 18$) was between 10.40 p.m. and midnight. After midnight, with reinforcement of medical staff, a surgeon and a CCP triaged all patients for the priority in which each patient would go to the Operating Room (OR) and/or CT scanner and/or Pediatric Intensive Care Unit (PICU). The CT scanner performed 13 CT body scans between midnight and 5 a.m.

According to the degree of emergency, two patients were operated during the night (patient 1 and 2, Table 1), whereas others were delayed. Twelve OR nurses were contacted by phone and joined the surgical team on duty to free the five operating rooms. That night, three general pediatric surgeons, four orthopedic surgeons, one neurosurgeon, one ENT surgeon and five anesthetists were available. Psychologists and psychiatrists were quickly mobilized to assist victims and families. The following day, all scheduled surgeries were postponed and the emergencies were operated on by surgeons who had not worked during the night. During the following days (July 15th up to 18th), the on-call system was informally upgraded up to three surgeons available in less than 30′ of each specialty.

This unique situation needed reactivity to assure a good quality of care for both children and adults. It is well-known that the unique attributes of children make them particularly vulnerable in disasters, both physically and psychologically [4–10]. On the other side, adults treated in a pediatric hospital are possibly at risk of suboptimal diagnosis and treatment. Literature about pediatric injuries and/or pediatric surgery related to terror attack is limited.

This article reports the severe injuries that were treated in the LUCH, including both adults and children following the Bastille Day Attack.

Methods

This is a retrospective descriptive study from the medical records of LUCH about casualties from the Bastille Day Attack with injuries resulting in the need for surgery, resuscitation, hospitalization in pediatric intensive care unit (PICU) or death. Minor injuries were excluded. The type of lesions and surgery, deaths, duration of hospitalizations, complications, psychological status, and outcomes at discharge and final follow-up were collected.

Results (Tables 1, 2, 3, 4, 5; Figs. 1, 2, 3, 4)

Among the 47 patients treated in our center, 11 presented severe somatic injuries (7 from Nice, 4 from elsewhere). Five patients died, of which one during surgery, two in PICU and two in Emergency Department. Causes of death were vascular lesion ($n = 2$), head trauma ($n = 2$) and chest crush ($n = 1$).

In total, seven patients needed transfusion of 14 red cells units and 7 plasma units. Overall, six casualties required surgery (Tables 4, 5; Figs. 1, 2, 3, 4). Head trauma was present in 63% of casualties, lower limb injuries in 36%. We performed closed reduction and internal fixation (CRIF) in three cases of closed limb fracture, resulting in average blood loss < 100 cc and surgery duration < 1 h. In one case of femoral fracture, we had to change the elastic nails due to a 20° varus.

According to their condition, adult victims were released or hospitalized in LUCH or adult hospitals for specialized treatment.

Physical complications include one case of leg compartment syndrome with foot ischemia due to a lesion of the anterior tibial artery, which required ligature of the artery and large fasciotomy of the leg; the patient developed superficial necrosis and infection of leg wounds; hence, he had negative pressure treatment for 20 days, repeated surgeries and intravenous antibiotics for 7 days, and then skin grafts; at discharge (October 20th), skin and fractures were correctly healed, anterior tibial muscle palsy was progressively recovering and the patient was able to walk with crutches (patient 2, Table 1).

Psychological data are summarized in Table 2. Two acute stress and one post-traumatic stress disorder were observed, needing psychotropic treatments and psychological support (Table 2). Some parents presented significantly worse psychiatric symptoms than their children, needing two transfers to the adult psychiatric department of Nice for acute stress disorder.

Discussion

A dramatically unexpected situation occurred with multiple potentially severe casualties arriving without pre-hospital management, which needed atypical management. This possibly increased in-hospital mortality. In fact, most deaths occurred during the first hour after arrival at the hospital.

Moreover, the presence of adult patients in a pediatric hospital without experience in adult care increased the stress and, possibly, the risk of suboptimal healthcare.

Table 1 Somatic injuries and treatments

Patient		Lesions		CT	Intensive care				Surgery			
Nb	Sex-age (years old)	Main injury	Other lesions		GSC	Shock	PICU	Medical treatment	Number of surgeries	Number of anesthesias	Duration of hospitalization (days)	Somatic outcome
1	F-4	Abdominal crush with left iliac vein rupture	Pelvic fracture	N	?	Y	N	Vascular filling, vasoactive amines	2: pelvic fixation + laparotomy	1	0	Deceased (cardiac failure during surgery)
2	M-9	Head and lower limb trauma	Abdominal crush: compartment syndrome	Y	12	N	Y	Intubation ventilation norepinephrine renal protection analgesia	4 (+16 repair dressing)	2 (+16 for repair dressing)	70	Progressive recovery of anterior muscles of the leg; skin healed
3	F-5	Head trauma	Lower limb trauma	Y	15	N	Y	Analgesia	2 (skull + tibia)	1	7	Good
4	M-7	Lower limb and chest crush	Head trauma	Y	8	N	Y	Neuroprotection analgesia	2 (tibia + chest drain)	1	26	Good
5	F-13	Head trauma	–	Y	4	N	Y	Monitoring	0	0	12	Good
6	Adult-M	Head trauma	Trunk crush	Y	3	N	Y	Intubation norepinephrine	0	0	0	Deceased (brain trauma)
7	M-40	Abdominal crush	–	N	15	Y	N	–	–	–	0	Deceased (aortic dissection ?)
8	M-3	Head trauma	Chest crush—Eye hypertony	Y	14	N	Y	Analgesia neuroprotection	1 (eye)	1	11	Good
9	F-10	Lower limb trauma	Head trauma	Y	15	N	N	Analgesia	1 (tibia)	1	10	Good but PTSD
10	M-79	Head trauma	Chest crush, Spine trauma	Y	?	N	Y	Cardiopulmonary resuscitation	–	–	0	Deceased
11	F-13	Chest crush	–	N	3	Y	N	Cardiopulmonary resuscitation, vascular filling	–	–	0	Deceased

Nb progressive number, *CT* CT scan, *Y* Yes, *N* No, *GCS* Glasgow score, *PICU* hospitalization in PICU

Table 2 Psychological and social characteristics

Patient Number	Sex–age	Beginning of psychiatric care (days after admission)	Early clinical manifestations	Psychotropic treatment during hospitalization	Family and social context	Language	PTSD (yes/no)	Outcome at 6 months
2	9-M	10	Motor inhibition, selective mutism, Depressive mood	Anxiolytic: Hydroxyzine, Hypnotic: Alimemazine, Antipsychotic: Cyamemazine	Mother hospitalized for spinal trauma; Father: absent: Grandparents and sister: daily presence	French	No	Good outcome, Isolated sleep disturbance
3	5-F	5	Acute anxiety crisis, Separation anxiety, Anorexia	Anxiolytic: Hydroxyzine	Father: hospitalized Mother: presented intense distress Grandmother: psychic asthenia but daily presence Cousin: daily presence	French	No	Family psychiatric consultations once a week Separation anxiety No sleep or eating disturbances No repetitive play
4	7-M	10	Confusion, amnesia, separation anxiety, motor and verbal inhibition	No	Father deceased, mother hospitalized in a different hospital, grandmother came from Austria, good help from Romanian community of Nice	Romanian, German, no French. Need for translator for psychiatric care	No	Good outcome
5	13-F	4	Alteration in cognition (dissociative amnesia) Motor inhibition	No	Twin Brother: deceased Best friend and aunt: deceased Parents and large family: daily presence	French	?	Lost to follow-up
8	3-M	Parents: 3rd day Child: 8th day	Early tantrum, separation anxiety, no sleep or eating disturbances J10: Motor inhibition, "silent child"	No	Two parents, daily presence	French	No	Residual Motor inhibition Spontaneous decrease of separation anxiety Normal behavior No repetitive play
9	10-F	7	Alteration in cognition (dissociative amnesia) Persistent avoidance of stimuli associated with the trauma	No	Mother: daily presence (with the little brother)	French	Yes	Sleep disturbance with traumatic nightmares Avoidance of distressing trauma-related stimuli ("promenade des Anglais") Fear Constrictive affect Amnesia Slight improving…

Table 3 Repartition of injuries on 11 patients

Site of trauma	Number of injuries	Proportion (number of injuries/11) (%)
Head trauma	7	63.6
Spine trauma	3	27.3
Lower limb fracture	4	36.4
Upper limb fracture	1	9.1
Pelvic fracture	2	18.2
Chest crush	4	36.4
Abdominal crush	4	36.4

Fortunately, all medical and nursing staff had acquired the basic tools to perform triage and assess adult patients during their training. Naturally, the surgeons with most experience in trauma surgery managed the adult patients that night.

The triage was initially performed on basic criteria, namely on the need for immediate resuscitation. Then, once the healthcare team has been reinforced, triage was efficiently performed following the usual methods by a team of senior doctors including a surgeon to prioritize the interventions and imaging; the presence of senior surgeons in ER seemed useful for the correct and quick orientation of most

Table 4 Surgical procedures during first 24 hours for a total of six casualties

Surgical specialty	Number of surgeries
Neurosurgery	1 (reduction of depressed skull fracture)
Orthopedic surgery	6 (3 internal fixations, 1 external fixation , 1 closed reduction and casting, 1 fasciotomy)
General surgery	1 (exploratory laparotomy)
ENT surgery	1 (cavum packing)
Ophthalmologic surgery	1 (lateral inferior and superior cantholysis for ocular hypertension)
Other procedures	3 (1 thoracic drain + 2 monitoring of intracranial pressure)

Table 5 Repartition of surgeries, general anesthesia and duration of hospitalization

	Number	Average per patient	Less and most	Median
Surgery	12 (28)[a]	2.4 (5.6)[a]	1–4 (20)[a]	2
Anesthesia	6 (22)[a]	1.2 (4.4)[a]	1–2 (18)[a]	1
Days of hospitalization (excluding patients deceased before 24 h)	71 (141)[a]	11 (22.6)[a]	7–26 (70)[a]	12

[a]Parenthesis include 16 repair dressing for a patient who needed fasciotomy for compartmental syndrome

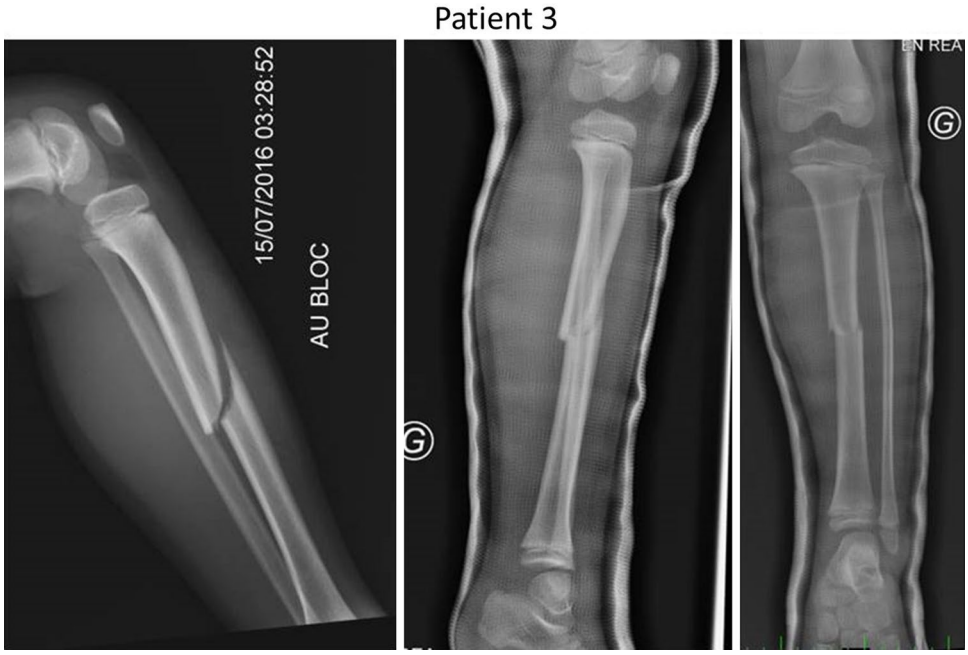

Fig. 1 Patient 3: tibia fracture and cast

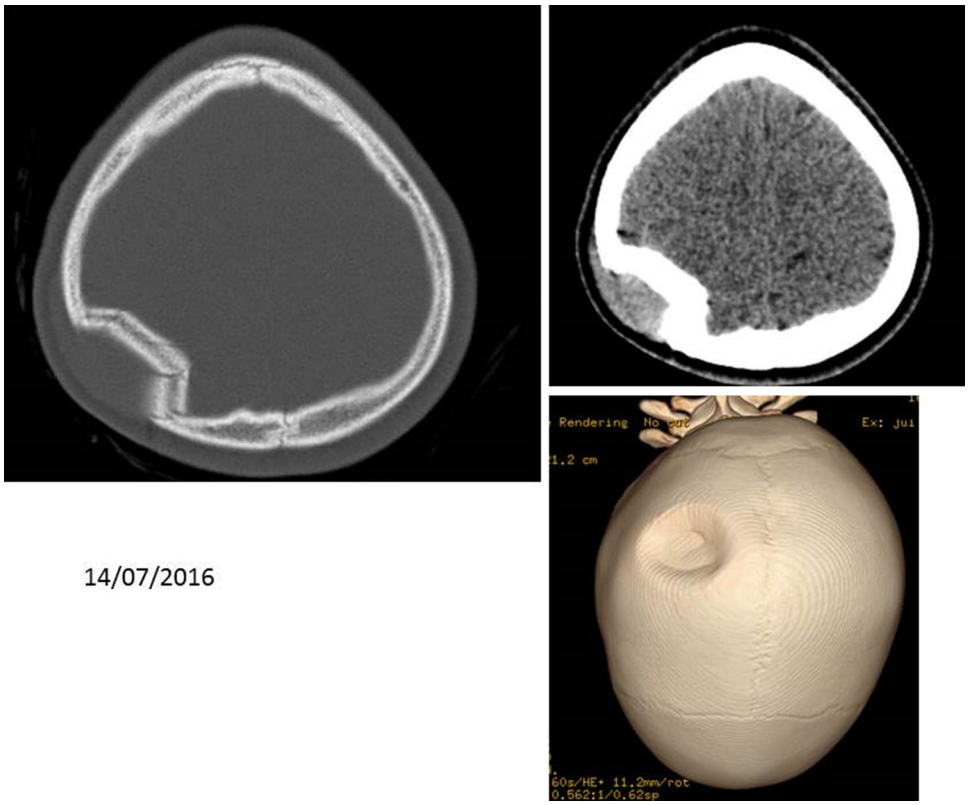

Fig. 2 Patient 3: depressed skull fracture

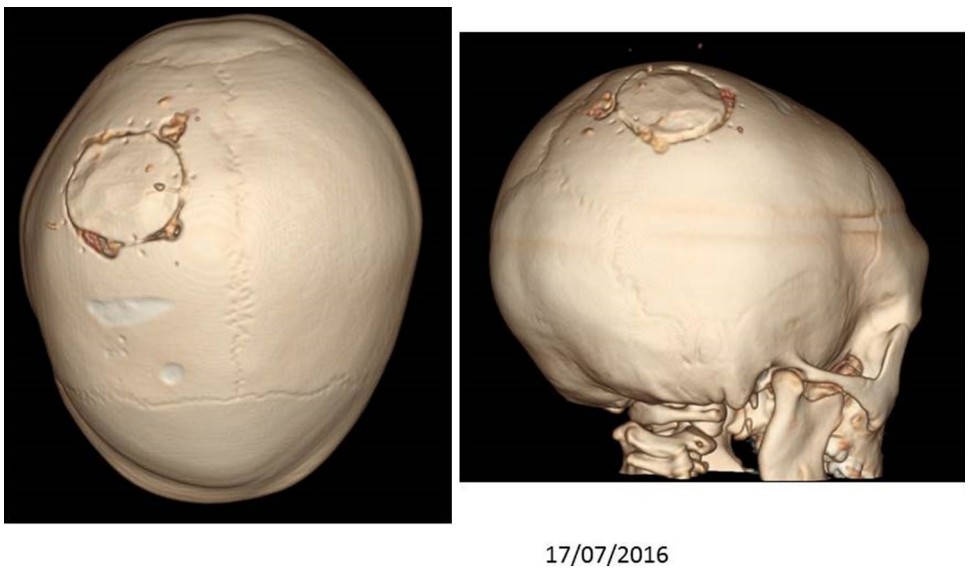

Fig. 3 Patient 3: skull CT Scan after cranioplasty

severe patients. Hence, only two patients needed immediate surgery during the night, and the others, according to their stable status, were operated on during the following day. This allowed reasonable use of operating room during the night.

We had to face injuries which are unusual in our practice in a children's hospital: pelvic disjunction needing external fixation, compartmental syndrome, severe vascular injuries [11–13]. The latter required surgery in two cases and resulted in death in two cases. Although a pediatric surgeon with competence in vascular surgery was present, an attending vascular surgeon would have been appropriate.

CRIF has been a valid option for damage control of close fractures, allowing quick fixation of limb fractures and minimal blood loss.

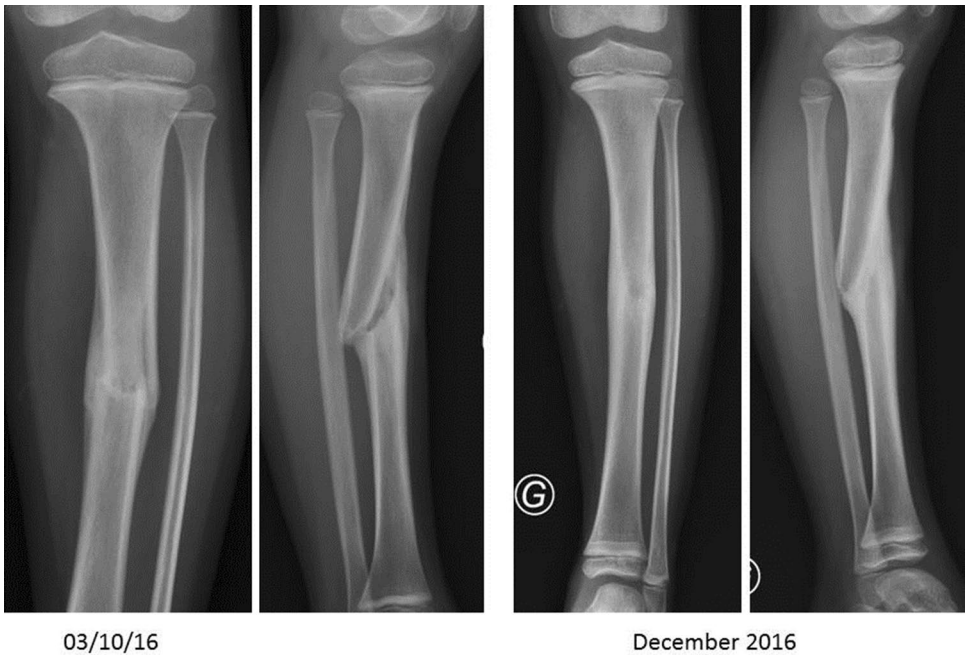

Fig. 4 Patient 3: tibia fracture at 3 months and 5 months follow-up

Beyond medical and psychological care, the hospital staff took into account the overall well-being of victims and paid particular attention to family proximity [8]. Both acute and post-traumatic stress disorders required psychological support and psychotropic treatment [9].

Conclusion

After the Bastille Day attack, we reviewed our disaster plan to describe the required actions before the arrival of reinforcement: (1) diffusing the alert; (2) keeping the staff on duty; (3) organizing the crisis unit around the administrative director; (4) designation of a chief "organizing" doctor and a chief "triaging" doctor; (5) stopping or achieving all ongoing medical and surgical activities; (6) counting and releasing beds; (7) preparing the trauma bays with resuscitation tools; (8) preparing a second zone for "ordinary" emergencies (not related to MCI); (9) making available paper medical records and identification stickers instead of informatics. Moreover, we upgraded our training program with simulation and conferences. Similarly, every hospital, even small or specialized, should prepare protocols to face Massive Casualties Incidents and receive unusual type of patients of varying age, severity and characteristics of lesions. A periodic training program for MCI seems necessary, at least once per year. A political reflection is required to improve the readiness of healthcare system for MCI, including the possibility of displacing human (e.g. specialized surgeons) and material resources (e.g. external fixators) toward the hospitals that receive MCI victims.

In case of MCI, the triage should be performed by senior doctors with clear leadership and coordination between critical care physicians, anesthetists and surgeons in clinical decisions. Quick psychological support is required for patients and families.

Acknowledgements The authors thank all the healthcare and administrative staff of LCH; Psychiatrists and private doctors Chau, Renaud, Rocher, Picon for clinical support; Doctors Lecompte, Bensaid, Demonchy, Kosok, Boyer, Richelme, Rosello, Oborocianu, Afanetti, Allia, Gastaldi, Muccioli for their hard work during and following the Bastille Day Attack; Mr. Charles Musoff and Mr. Trevor Griffiths for proofreading; and Prof. Askenazy and Dr. Haas for their scientific support.

Funding None.

Compliance with ethical standards

Conflict of interest Federico Solla, Joseph Carboni, Arnaud Fernandez, Audrey Dupont, Nathalie Chivoret, Gilles Brézac, Virginie Rampal, Jean Bréaud declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The Institutional Board Review of Nice, France, declared no opposition and no need for formal review because formal consent is not required for retrospective study.

Informed consent Informed consent was obtained from all individual participants included in the study and their relatives. All data were anonymized.

References

1. Carles M, Levraut J, Gonzalez JF, Valli F, Bornard L. Mass casualty events and health organization: terrorist attack in Nice. Lancet. 2016;388(10058):2349–50.
2. Haas H, Fernandez A, Bréaud J, Dupont A, Tran A, Solla F. Terrorist attack in Nice, France: Central role of a children's hospital. Lancet. 2017;389:1007.
3. Solla F, Carboni J, Bréaud J, et al. 14th of July Terrorist Attack in Nice, France. Academic Pediatrics. 2018 (**in press**).
4. Allen GM, Parrillo SJ, Will J, Mohr JA. Principles of disaster planning for the pediatric population. Prehosp Disaster Med. 2007;22:537–50.
5. Holton CS, Kelley SP. The response of children to trauma. Orthopaedics Trauma. 2015;29:337–49.
6. Harjai MM, Chandrashekhar N, Raju U, Jog SS, Arora P. Terrorism, Trauma and Children. Med J Armed Forces India. 2005;61:330–2.
7. Slone M, Mann S. Effects of war, terrorism and armed conflict on young children: a systematic review. Child Psychiatry Hum Dev. 2016;47:950–65.
8. Chrisman AK, Dougherty JG. Mass trauma: disasters, terrorism, and war. Child Adolesc Psychiatr Clin N Am. 2014;23:257–79 **(viii)**.
9. Sathya C, Alali AS, Wales PW, et al. Mortality among injured children treated at different trauma center types. JAMA Surg. 2015;150:874–81.
10. Trudeau MO, Rothstein DH. Injuries and surgical needs of children in conflict and disaster: From Boston to Haiti and beyond. Semin Pediatr Surg. 2016;25:23–31.
11. Gregory TM, Bihel T, Guigui P, et al. Terrorist attacks in Paris: Surgical trauma experience in a referral center. Injury. 2016;47:2122–6.
12. Tobert D, von Keudell A, Rodriguez EK. Lessons From the Boston Marathon Bombing. J Orthop Trauma 2015;29 Suppl 10:S7–10.
13. Heldenberg E, Givon A, Simon D, Bass A, Almogy G, Peleg K. Terror attacks increase the risk of vascular injuries. Front Public Health. 2014;2:47.