
Organ Donation, an Unexpected Benefit of Aggressive Resuscitation of Trauma Patients Presenting Dead on Arrival



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BACKGROUND: We sought to determine whether aggressive resuscitation in trauma patients presenting without vital signs, or “dead on arrival,” was futile. We also sought to determine whether organ donation was an unexpected benefit of aggressive resuscitation.

STUDY DESIGN: We conducted a review of adults presenting to our Level I trauma center with no signs of life (pulse = 0 beats/min; systolic blood pressure = 0 mmHg; and no evidence of neurologic activity, Glasgow Coma Scale score = 3). Primary end point was survival to hospital discharge or major organ donation (ie heart, lung, kidney, liver, or pancreas were harvested). We compared our survival rates with those of the National Trauma Data Bank in 2012. Patient demographics, emergency department vital signs, and outcomes were analyzed.

RESULTS: Three hundred and forty patients presented with no signs of life to our emergency department after injury (median Injury Severity Score = 40). There were 7 survivors to discharge, but only 5 (1.5%) were functionally independent (4 were victims of penetrating trauma). Of the 333 nonsurvivors, 12 patients (3.6%) donated major organs (16 kidneys, 2 hearts, 4 livers, and 2 lungs). An analysis of the National Trauma Data Bank yielded a comparable survival rate for those presenting dead on arrival, with an overall survival rate of 1.8% (100 of 5,384); 2.3% for blunt trauma and 1.4% for penetrating trauma.

CONCLUSIONS: Trauma patients presenting dead on arrival rarely (1.5%) achieve functional independence. However, organ donation appears to be an under-recognized outcomes benefit (3.6%) of the resuscitation of injury victims arriving without vital signs. (*J Am Coll Surg* 2017;224: 926–932. Published by Elsevier Inc. on behalf of the American College of Surgeons.)

Traumatic cardiopulmonary arrest is associated with an extremely grim prognosis, with reported survival rates of <2% in victims of blunt trauma and <5% in those suffering penetrating injuries.^{1–8} Patients that do survive are frequently neurologically devastated and experience significant long-term disability. With improvements in prehospital care and reductions in transport times, some patients who would have previously been declared dead in the field are now presenting to the emergency

department (ED) in extremis. This had led some to argue that aggressive resuscitative efforts in patients presenting with no signs of life are not justifiable, primarily due to the lack of proven long-term outcomes benefits, increased use of limited healthcare resources, and unnecessary exposure of healthcare providers to communicable diseases.^{3,9,10}

Alternatively, these individuals represented a pool of organs for donation that might confer added value to resuscitation of individuals in extremis. The gap between the number of patients waiting for a transplant and those receiving an organ has continued to widen.^{11,12} Significant efforts have been made to expand the current donor pool. With improvements in organ preservation techniques, outcomes of deceased organ donors are comparable with living donors for kidneys, lungs, and even livers. Deceased donors from trauma patients, frequently young individuals with healthy organs, are playing an increasingly crucial role in expanding the organ supply.¹² In 2012,

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Abbreviations and Acronyms

DOA	=	dead on arrival
ED	=	emergency department
GCS	=	Glasgow Coma Scale
HR	=	heart rate
MVC	=	motor vehicle collision
RT	=	resuscitative thoracotomy
SBP	=	systolic blood pressure
TBI	=	traumatic brain injury
TCPA	=	traumatic cardiopulmonary arrest

nationwide there were 2,566 deceased donors from trauma patients, accounting for 31.5% of all deceased organ donors.¹¹

The purpose of this study was to evaluate the effects of aggressive management on survival and organ donation in injured patients presenting with no signs of life. We postulated that neurologic survival or donation of major organs for transplantation was a highly unusual event in patients presenting without vital signs (CPR in progress) after injury.

METHODS

We retrospectively reviewed the medical records of all adults presenting to our Level I trauma center with no signs of life (systolic blood pressure = 0 mmHg and no evidence of neurologic activity, Glasgow Coma Scale [GCS] score = 3) between January 1, 2001 and December 31, 2014. Patients who died in the field and those not brought to the trauma center were excluded from analysis.

We reviewed the medical records and trauma registry for patient age, sex, mechanism of injury, injury inventory, time from admission to the operating room, time from admission to time of death (in nonsurvivors), and physiologic parameters, which include GCS score, systolic blood pressure, heart rate (HR), and Injury Severity Score. We also looked at laboratory findings, such as base deficit. We examined overall survival, survival to functional independence, and organ donation rates. We also analyzed the National Trauma Data Bank Research Data Set 2012 using the same metric.

The study protocol was reviewed and approved by the University of Texas Health Science Center at San Antonio IRB and the University Health System Medical Dental Research Committee.

SPSS software, version 22 (SPSS, Inc) was used for all statistical analyses, with $p < 0.05$ considered as significant. Continuous numerical variables were analyzed by a 2-sample *t*-test or 1-way ANOVA. Categorical variables

were analyzed by chi-square test or Fisher's exact test. All numerical data were expressed as mean \pm SD.

RESULTS

A total of 33,988 injured adults presented to our Level I trauma center between 2001 and 2014. Of these, 340 patients presented dead on arrival (DOA) (SBP = 0 mmHg, HR = 0 beats/min, and GCS = 3). Mean age of our sample population was 44.4 years, 75.6% of the patients were male, 28.5% were victims of penetrating trauma, median Injury Severity Score was 40; 65.6% of patients underwent prehospital endotracheal intubation and prehospital CPR was performed in 60.3% of patients. A total of 93 patients (27.4%) underwent resuscitative thoracotomy (RT).

Overall, 7 patients (2.1%) survived to discharge, with only 5 (1.5%) achieving functional independence (Glasgow Outcome Scale = 4 or 5).

Survival from DOA penetrating trauma victims was 4 of 101 and blunt trauma was 3 of 239 (Table 1). Of the 7 patients that survived to discharge, 1 had lost vital signs en route and underwent prehospital endotracheal intubation, the remaining 6 had loss of vital signs on arrival to the ED. Two of the 7 patients underwent ED thoracotomies, and all underwent operative and/or angiographic hemorrhage control on arrival.

Of the 333 nonsurvivors, 12 patients (3.6%) donated major organs (Table 2). All 12 patients had severe traumatic brain injury (TBI), return of spontaneous circulation with a variety of interventions, and were admitted to the ICU. There were a total of 24 organs donated, 16 kidneys, 2 hearts, 4 livers, and 2 pairs of lungs, accruing to, on average, 2 organs per donor.

National Trauma Data Bank data analysis

In analyzing the National Trauma Data Bank Research Data Set 2012, we identified 5,384 patients (18 years and older) who presented with no signs of life (SBP = 0 mmHg, HR = 0 beats/min, and GCS = 3). Most patients were male (81.1%), mean age was 40 years old, and median Injury Severity Score was 25. Blunt trauma accounted for 51.9% of injuries, with the most frequent mechanisms implicated being motor vehicle collisions (MVCs) (43.7%), followed by gunshot wounds (41.8%) and falls (6.4%).

Overall survival rate was 1.8% (100 of 5,384), 2.3% for blunt trauma, and 1.4% for penetrating trauma. Nineteen percent of patients had a prehospital SBP > 0 mmHg; 16.5% had a prehospital SBP = 0 mmHg, but HR > 0 beats/min (ie pulseless electrical activity); and 64.5% had no signs of life in the prehospital setting.

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