

Termination of Resuscitation (TOR)

Using the literature to write a protocol

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The Problem

- Lights and sirens may be a risk to the public
- Survivability from arrest is dismal

National Guideline

Medical

- Baily ED, et al. Termination of resuscitation in the prehospital setting for adult patients suffering non-traumatic cardiac arrest. Prehospital emergency care. 2000; 4 (2): 190-5
 - Unwitnessed arrest with delayed CPR beyond 6 min and delayed defibrillation beyond 8 min has poor prognosis
 - In absence of DNR, full efforts for at least 20 min
 - Resuscitate VFib or pulseless VTACH
 - Consider TOR if PEA or asystole
 - In addition protocol should address
 - Logistics
 - On-line medical direction
 - Social services
 - QI

National Guideline

Trauma

- Hopson LR, et al. Guidelines for withholding or termination of resuscitation in prehospital traumatic cardiopulmonary arrest. *PEC*. 2003; 7 (1): 141-6
 - Blunt: Apnea, pulseless, without organized activity on ECG
 - Penetrating: Blunt criteria + other signs of life (i.e. pupillary reflex)
 - Signs incompatible with life (i.e. rigor mortis, decapitation, etc.)
 - TOR considered for witnessed arrest but > 15 min of unsuccessful resus
 - TOR considered with > 15 min transport
 - Special considerations for drowning, lightning, hypothermia
 - Notify law enforcement and medical examiner
 - Social services

Ambulance Crashes



San Francisco Ambulance

Ambulances Crashes

- Ray AM, Kupas DF. Comparison of crashes involving ambulances with those of similar-sized vehicles. PEC. 2005; 9 (4): 412-5.
- Retrospective review of the Penn DOT database on ambulance crashes: 1997 - 2001
- Results
 - 2038 ambulances vs. 23,155 control
 - More likely to involve 4-way intersection (43% vs. 23% $p = 0.001$)
 - Collisions at traffic signals (37% vs. 18% $p = 0.001$)
 - More common to have injuries (76% vs. 61% $p = 0.001$)

Ambulance Crashes

- Ray AM, Kupas DF. Comparison of rural and urban ambulance crashes in Pennsylvania. PEC. 2007; 11 (4): 416-20
 - Retrospective review of the Penn DOT database: 1997 - 2001
 - Compared rural to urban crashes
 - Results
 - Urban crashes
 - Intersections (67% vs. 26%)
 - Stop sign or other signal (53% vs. 14%)

Ambulance Crashes

- Becker LR, et al. Relative risk of injury and death in ambulances and other emergency vehicles. *Accid Anal Prev.* 2003; 35 (6): 941-8.
- Analysis of the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) and the General Estimates System (GES): 1988 -97
- Comparison of Emergency vs. Non-emergency Call
- Results
 - Analysis of 35,966 crashes
 - Incapacitating or fatal injury for unrestrained occupant in the back
 - (71.8% vs. 28.2%)
 - Total incapacitating or fatal injury (front or back and restrained or unrestrained)
 - (56% vs. 44%)

Ambulance Crashes

- Kahn CA, et al. Characteristics of fatal ambulance crashes in the United States: an 11year retrospective analysis. PEC. 2001; 5 (3): 261-9.
- Analysis of data from FARS: 1987 - 97
- Results
 - 339 ambulance crashes caused 405 fatalities and 838 injuries
 - During emergency use
 - $202/339 = 59.6\%$ crashes
 - $233/405 = 57.55\%$ fatalities
 - Intersections ($p < 0.001$)
 - In the rear vs. the front (OR 2.7)
 - Improperly restrained vs. restrained (OR 2.5)

Ambulance Crashes

- Saunders CD, Heye CJ. Ambulance collisions in an urban environment. Prehospital Disaster Medicine. 1994; 9 (2): 118-24.
- Retrospective analysis of ambulance collisions in paramedic division of San Francisco Dept. of Public Health during 27 month period
- Results
 - Collision rate lights and sirens vs. non-lights and sirens
 - 45.9 per 100,000 vs. 27.0 per 100,000 (95% CI 30 - 62 vs. 18 - 36)
 - Injury rate for collisions lights and sirens vs. non-lights and sirens
 - 22.2 per 100,000 vs. 1.5 per 100,000 (95% CI 11 - 34 vs. 0.6 - 4)

Ambulance Crashes

- What do we know?
 - Ambulance crashes occur at intersections and signals
 - More common while running lights & sirens
 - Injuries while running lights & sirens more severe
 - More injuries while unrestrained and/or in back

Medical



Medical

- Lloyd-Jones D, et al. Heart Disease and Stroke Statistics 2010 Update. A report from the American Heart Association. Circulation. 2010; 121: e1 - e170.
- Out-of-hospital cardiac arrest ~ 295,000 EMS assessed arrests per year
 - 23% initial rhythm VFib
 - 31% bystander CPR
 - If no bystander CPR survivability decreases by 10% for every minute delay until defibrillation
 - Survival rate if VFib 21%
 - Overall median survival rate 7%

Medical

- Sasson C, et al. Prehospital termination of resuscitation in cases of refractory out-of-hospital cardiac arrest. JAMA. 2008; 300 (12): 1432-38.
 - Validation of termination of resuscitation rules
 - Retrospective cohort using surveillance data
 - BLS criteria
 - Event not witnessed by EMS providers
 - No AED indicated in out of hospital
 - No ROSC out-of-hospital
 - ALS criteria
 - BLS criteria + No bystander CPR

Medical

- Sasson, et al.
 - Results
 - 5505 patients meeting inclusion criteria
 - Overall survival rate $392/5505 = 7.1\%$
 - $5/2592 = 0.2\%$ patients with BLS criteria survived
 - 0/1192 patients with ALS criteria survived
 - BLS rule
 - specificity 0.987
 - PPV 0.998

Medical

- Verbeek PR, et al. Derivation of a termination-of-resuscitation guideline for emergency medical technicians using automated defibrillators. Acad Emerg Med. 2002; 9 (7): 671-78.
- Using 22 month retrospective review of 700 out-of-hospital cardiac arrest patients
- Results
 - 700 cases identified; follow up in 662
 - $36/662 = 5.4\%$ with ROSC prior to transport
 - $2/662 = 0.3\%$ that did not reach ROSC prior to transport survived
 - Shock prior to transport associated with survival OR 6.9
 - Arrest witnessed by EMS providers associated with survival OR 4.4
 - TOR protocol
 - No ROSC, No Shock, Unwitnessed: Sen 100%; NPV 100%

Medical

- What do we know?
 - Survival rate low ~ 7%
 - TOR has high sensitivity/specificity
 - No shock
 - No ROSC
 - Unwitnessed

Trauma



Trauma

- Aprahamian C, et al. Traumatic cardiac arrest: scope of paramedic services. *Ann Emerg Med.* 1985; 14 (6): 583-6.
 - Review of patients from Jan 1, 1981 to Dec 31, 1982
 - Identified patients in traumatic cardiac arrest
 - Results
 - 95 patients in data set
 - Overall survival: $3/95 = 3.2\%$

Trauma

- Rosemurgy AS, et al. Prehospital Traumatic Cardiac Arrest: the cost of futility. Journal of Trauma. 1993; 35 (3): 468-74.
- Review of trauma data Oct 1, 1989 to Mar 31, 1991
- All patients with traumatic arrest
- Results
 - 138 patients in data set
 - $96/138 = 70\%$ blunt
 - $42/138 = 30\%$ penetrating
 - Zero survivors
 - Organ procurement $11/138 = 8\%$ all cornea

Trauma

- Shimazu S, Shatney CH. Outcomes of patients with no vital signs on hospital admission. Journal of trauma. 1983; 23 (3): 213-16
- Review of patients treated at a single institution over 5 year period (Shock Trauma)
- Patients with traumatic cardiopulmonary arrest
- Results
 - 267 patients in data set
 - Overall survival $6/267 = 2.2\%$
 - Functional survival $4/267 = 1.5\%$ (Penetrating 2; Blunt 2)
 - Mechanism of injury did not influence survival
 - ED thoracotomy may influence survival but numbers too small to tell

Trauma

- Esposito TJ, et al. Reappraisal of emergency room thoracotomy in a changing environment. Journal of Trauma. 1991; 31 (7): 881-87
- Retrospective review of charts for ED thoracotomy over 4 year period
- Results
 - 112 patients with ED thoracotomy: 21% penetrating 79% blunt
 - Overall survival 1.8%
 - Penetrating survival 4.2%
 - Blunt survival 1.1%
 - No patients with CPR at scene or through transport survived
 - No survivors with idioventricular or asystole

Trauma

- Stratton SJ, et al. Prehospital pulseless, unconscious penetrating trauma victims: field assessments associated with survival. Journal of Trauma. 1998; 45 (1): 96-100
 - Retrospective review of medical records for penetrating trauma
 - Blunt traumatic arrest patients as control
 - Results
 - 879 patients in data set: penetrating - 497; blunt - 382
 - Penetrating Survival $4/497 = 0.8\%$
 - 3/4 functionally intact; 1/4 with minimal functional deficit
 - Blunt Survival $5/382 = 1.3\%$
 - 0/5 with good neurological outcome
 - All survivors in penetrating group with PEA sinus or sinus tach

Trauma

- Fulton RL, et al. Confusion surrounding the treatment of traumatic cardiac arrest. J am Coll Surg. 1995; 181 (3): 209-14.
 - Retrospective review of trauma registry
 - Results
 - 245 patients in data set
 - $6/245 = 2.4\%$ survival
 - Arrest time longer than 10 minutes associated with mortality

Trauma

- Pasquale MD, et al. Defining “Dead on Arrival”: Impact on a level I trauma center. Journal of Trauma. 1996; 41 (4): 726-30.
 - Review of trauma registry from 1990 to 1994
 - Traumatic arrest and received CPR by certified prehospital personnel
 - Compared those that met their predetermined DOA criteria vs. those that did not meet their criteria
 - Results
 - 106 patients in data set
 - 3/106 = 2.8% survival
 - Mean duration of CPR
 - Non-survivors 23.64 min +/- 12.6 min
 - Survivors 2.33 min +/- 1.53 min
 - $P < 0.001$

Trauma

- What do we know?
 - Overall survivability is low ~2-3%
 - Those that survive
 - Arrest time less than 10 min
 - PEA with sinus or sinus tach
 - Penetrating a bit more successful and better outcome

Social Aspects



Social Aspects

- Morrison LJ, et al. Inter-rater reliability and comfort in the application of a basic life support termination of resuscitation clinical prediction rule for out-of-hospital cardiac arrest. Resuscitation. 2007; 74 (1): 150-7
- Examine the inter-rater reliability and comfort of BLS providers with a TOR rule
 - No ROSC
 - No Shock
 - Unwitnessed arrest
- Providers retrospectively applied rule to 1240 enrolled cases
- Providers rated their comfort with application of rule on 5 point scale
- Compared results for paramedics and EMT drivers

Social Aspects

- Morrison, et al
 - Results
 - Kappa for paramedic and EMT = 0.90
 - Kappa for paramedic and correct interpretation = 0.88
 - Kappa for EMT and correct interpretation = 0.88
 - Comfort in applying the rule was higher when both providers interpreted the rule correctly than when they did not $p < 0.0001$

Social Aspects

- Delbridge TR, et al. Field termination of unsuccessful out-of-hospital cardiac arrest resuscitation: acceptance by family members. Ann Emerg Med. 1996; 27 (5): 649-54
 - Prospective study over 4 month period
 - Interviewed family members present at the scene of an unsuccessful resuscitation attempt
 - Results
 - 140 arrests; follow up on 42 of the 53 cases in family was present
 - TOR in the field
 - 24 (96%) reported satisfaction with TOR decision
 - TOR in the ED
 - 14 (82%) reported satisfaction with TOR decision
 - 13 (76%) indicated my have been satisfied with TOR in the field

Social Aspects

- Edwardsen EA, et al. Family perspective of medical care and grief support after field termination by emergency medical services personnel: a preliminary report. PEC. 2002; 6 (4): 440-4
- Determine acceptance by family members regarding non-transport of patients in cardiac arrest with no ROSC
- Structured telephone interview
- Results
 - 33 follow up telephone interviews completed
 - 32 (97%) expressed satisfaction with EMS
 - 21/33 (64%) not transported
 - 100% of family expressed satisfaction
 - 3/12 that were transported stated would have preferred TOR in field

Social Aspects

- Schmidt TA, Harrahill MA. Family response to out-of-hospital death. Acad Emerg Med. 1995; 2 (6): 513-8.
 - Phone interview over 18 month period
 - Family of out-of-hospital TOR
 - Results
 - No family members believed that the patient should have been transported
 - Most felt that EMS provider informed the family in a
 - Professional manner (81%)
 - Gentle manner (74%)

Putting it Together

- Lights and sirens a danger to the public health
- Overall survival from out-of-hospital arrest is 1%
 - Medical ~ 7%
 - Trauma ~ 2%



Putting it Together

- Determinants of survival
 - Medical
 - Witnessed
 - Shockable rhythm
 - ROSC
 - Trauma
 - Arrest time < 10 min
 - PEA with sinus or sinus tach
 - ??Penetrating??

Putting it Together

- EMS providers are capable to make TOR decisions
- Family members are comfortable with EMS providers making TOR decisions

TOR Protocol

- Initiate patient care
- If any of the following do Not initiate resuscitative efforts
 - Decapitation
 - Rigor mortis
 - Decomposition
 - Dependent lividity
- Otherwise if patient is pulseless and apneic begin CPR
- Determine cause, if any of the following transport
 - Hypothermia
 - Pregnant
 - 14 years of age or less

TOR Protocol

- Trauma
 - Protect c-spine
 - If the patient has any of the following transport
 - Palpable pulses
 - Spontaneous respirations
 - Other signs of life (i.e. pupillary reflexes, spontaneous movement)
 - Otherwise get a rhythm
 - Transport with any of the following: Vfib; pulseless VTACH, PEA with an underlying rate of at least 60
 - If transport time anticipated to be greater than 15 min contact on-line medical control
 - If rhythm is other than above TOR
 - If arrest is witnessed by EMS providers initiate CPR and transport
 - If no ROSC after 15 min consult to TOR

TOR Protocol

- Medical
 - Initiate CPR
 - If AED within 5 min apply AED and shock as indicated
 - If AED after 5 min initiate CPR for 2 min then AED as indicated
 - TOR if
 - Arrest not witnessed
 - NO indication for AED
 - No ROSC after 20 min

TOR Protocol

- ALS providers above protocol without on-line medical direction
- BLS providers above protocol with on-line medical direction
- BLS providers may TOR without medical consult after 30 min
- Also
 - After TOR
 - Medical examiner
 - Law enforcement

Summary

- TOR Protocol
 - Evidence based
 - Safe
 - May reduce lights and sirens and unnecessary transport of a patient that is dead

Rest in Peace

