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


• 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


• 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, lightening, hypothermia

• Notify law enforcement and medical examiner

• Social services
Ambulance Crashes
Ambulances Crashes


• 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

- 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


- 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


• 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


• 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


- 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%

• 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

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%
What do we know?

- Survival rate low ~ 7%
- TOR has high sensitivity/specificity
- No shock
- No ROSC
- Unwitnessed
Trauma
Trauma


• 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


• 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
• 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

- 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


- 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 \( \frac{4}{497} = 0.8\% \)
    - 3/4 functionally intact; 1/4 with minimal functional deficit
  - Blunt Survival \( \frac{5}{382} = 1.3\% \)
    - 0/5 with good neurological outcome
  - All survivors in penetrating group with PEA sinus or sinus tach
Trauma

  - 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

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


• 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 then when they did not $p < 0.0001$
Social Aspects


- 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


• 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


- 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 low
  - 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