What is resuscitation science?

Simply the science of resuscitation:

- Pre arrest
- Arrest care
  - Medical care
  - Technology
  - Team behaviors
- Post Arrest syndrome and care
- Predictors of outcomes

Credit: Ashley Gilbertson for The New York Times
Objectives today

Historical perspective
Sudden Cardiac Death
Pre arrest detection and management
  • Hemorrhagic shock
  • Perfusion monitoring
  • Pump failure / cardiogenic shock
Resuscitation of
  • Primary cardiac death
  • Secondary cardiac death
  • Traumatic death
Post Resuscitation Care
  • What are the goals in goal directed care today?
Scientific horizons in resuscitation

Terms

Primary Cardiac Arrest or Sudden Cardiac Arrest (SCA)
Secondary Cardiac Arrest
ROSC
NDE / OBE
In hospital Cardiac Arrest

- 1.5 events per 1000 hospital admissions
- Respiratory arrest survivals 75% compared to 25% for cardiac arrest

2015 Highlights in Conventional Resuscitation

- National Early Warning Score
- Quality chest compressions matter
- Early defibrillation still critical
  - 62% increase in odd of surv to discharge is lay public AED administered
- Best airway is still debatable
- Mechanical compression is as good as good CPR, and better than bad CPR
- Adrenaline may not impact survival, but hypotension is bad

- Targeted Temperature 33 vs 36?
- Tools to provide goal directed resuscitation and prognostication of survival are still being studied
It takes a team

Clinical Paper

NASCAR pit-stop model improves delivery room and admission efficiency and outcomes for infants <27 weeks’ gestation


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Resuscitation team characteristics

- Checklists
- Team huddle & debriefs
- Clear and defined roles based by tasks

A team knows how to improve

Clinical paper

Analysis and classification of errors made by teams during neonatal resuscitation

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Audiovisual recordings of 250 real neonatal resuscitations were obtained between April 2003 and May 2004. Of these, 23 complex resuscitations were analyzed for adherence to the contemporaneous NRP algorithm and scored using a novel classification tool

Seven hundred eighty algorithm-driven tasks were observed. One hundred ninety-four tasks were completed incorrectly, for an average error rate of 23%. Forty-two were errors of omission (28% of all errors) and 107 were errors of commission (72% of all errors). Many errors were repetitive and potentially clinically significant: failure to assess heart rate and/or breath sounds, improper rate of positive pressure ventilation, inadequate peak inspiratory and end expiratory pressures during ventilation, improper chest compression technique, and asynchronous PPV and CC.
The CHEER trial
• Mechanical CPR
• Hypothermia
• ECMO
• Early Reperfusion
• The CHEER protocol was developed for selected patients with refractory in-hospital and out-of-hospital cardiac arrest and involves mechanical CPR, rapid intravenous administration of 30 mL/kg of ice-cold saline to induce intra-arrest therapeutic hypothermia, percutaneous cannulation of the femoral artery and vein by two critical care physicians and commencement of veno-arterial ECMO. Subsequently, patients with suspected coronary artery occlusion are transferred to the cardiac catheterization laboratory for coronary angiography.

CHEER trial
There were 26 patients eligible for the CHEER protocol (11 with OHCA, 15 with IHCA). The median age was 52 (IQR 38–60) years. ECMO was established in 24 (92%), with a median time from collapse until initiation of ECMO of 56 (IQR 40–85) min. Percutaneous coronary intervention was performed on 11 (42%) and pulmonary embolectomy on 1 patient.

Return of spontaneous circulation was achieved in 25 (96%) patients. Median duration of ECMO support was 2 (IQR 1–5) days, with 13/24 (54%) of patients successfully weaned from ECMO support. Survival to hospital discharge with full neurological recovery (CPC score 1) occurred in 14/26 (54%) patients.
Hyperoxia: how could oxygen be bad?

Review

The effect of hyperoxia on survival following adult cardiac arrest: A systematic review and meta-analysis of observational studies

Chih-Hung Wang, Wei-Tien Chang, Chien-Hua Huang, Min-Shan Tsai, Ping-Hsun Yu, An-Yi Wang, Nai-Chuan Chen, Wen-Jeou Chen

PaO2 of greater than 300mmHg correlates with increased in hospital mortality in the post ROSC group

Trauma Resuscitation: Lesson learned of a decade of modern combat

U.S. Army Sgt. Megan Smith, 159th Combat Aviation Brigade medic
Battlefield Trauma Care:  
Now

- Phased care in TCCC
- Aggressive use of tourniquets in CUF
- Combat Gauze as hemostatic agent
- Aggressive needle thoracostomy
- Sit up and lean forward airway positioning
- Surgical airways for maxillofacial trauma
- Hypotensive resuscitation with Hextend
- IVs only when needed/IO access if required
- PO meds, OTFC, ketamine as “Triple Option” for battlefield analgesia
- Hypothermia prevention; avoid NSAIDs
- Battlefield antibiotics
- Tranexamic acid
- Junctional Tourniquets

Fluid Resuscitation from Hemorrhagic Shock

Updated Fluid Resuscitation Plan
Order of precedence for fluid resuscitation of casualties in hemorrhagic shock

1. Whole blood
2. 1:1:1 plasma:RBCs:platelets
3. 1:1 plasma and RBCs
4. (tie) Plasma (liquid, thawed, dried) or RBCs alone
5. Hextend
6. (tie) Lactated Ringers or Plasma-Lyte A
Role of Extra Corporeal Life Support

Types
E-CPR
ECAR : fjord incident
Cardiogenic Shock
Respiratory Failure

Terminal end points in resuscitation

ETCO2
Lactate
- 4.6mmol / L
- Clin Res Cardiol. 2015 Aug 25
Ph
Temperature
Prognostication: Lactate levels

Data from 930 cardiac arrest patients who underwent TH were collected from the KORHN registry. In a total of 443 patients, serum levels of lactate were examined within 1 h of ROSC. In-hospital mortality was 289/443 (65.24%), and 347/443 (78.33%) of the patients had CPCs of 3–5 upon hospital discharge.

The difference in lactate levels between survivors and non-survivors at hospital discharge was statistically significant (9.55 ± 4.33 mmol L⁻¹ in survivors, 11.36 ± 4.58 mmol L⁻¹ in non-survivors);
Prognostication using BIS

A prospective observational study in adult comatose patients treated by therapeutic hypothermia after cardiac arrest we measured bispectral index (BIS) during the first 24 hours of intensive care unit stay. A blinded neurological outcome assessment by cerebral performance category (CPC) was done 6 months after cardiac arrest. Results: Forty-six patients (48%) had a good neurological outcome at 6-month, as defined by a cerebral performance category (CPC) 1-2, and 50 patients (52%) had a poor neurological outcome (CPC 3-5).

Prognostication : Continuous EEG with Exam Score

Use of continuous EEG combined with accurate neurologic exam scoring may assist in prognostication of survival with good neurologic function.
Beyond the bedside
Recall and awareness during resuscitation

Clinical Paper

AWARE—AWArness during REsuscitation—A prospective study

Sam Fornia a,*, Ken Spearpoint a, Gabriele de Vos b, Peter Fennicke c, Diana Goldberg d, Jie Yang e, Jiawen Zhu a, Katie Baker a, Hayley Riltingback e, Paula McLean e, Melanie Wood f, A. Maziar Zafar f, Neal Dietert g, Roland Besteiner h, Fritz Stier b, Michael Berger b, Celia Warloe i, Siobhan Bullock i, Salli Lovett i, Russell McCarthy-Smith McPhee a, Sandra Marini-Navarette a, Porn Cushing i, Paul Wills i, Kayla Harris i, Jenny Stewart i, Anthony Walmsley i, Charles D. Deskins i, Paul Little i, Mark Farber i, Bruce Greyson i, Elinor R. Schoenfeld i

Among 2060 CA events, 140 survivors completed stage 1 interviews, while 101 of 140 patients completed stage 2 interviews. 46% had memories with 7 major cognitive themes: fear; animals/plants; bright light; violence/persecution; deja-vu; family; recalling events post-CA and 9% had NDEs, while 2% described awareness with explicit recall of 'seeing' and 'hearing' actual events related to their resuscitation. One had a verifiable period of conscious awareness during which time cerebral function was not expected.

Experimental: Targets to limit neuronal death

Mild Hypothermia Suppresses Calcium-Sensing Receptor (CaSR) Induction Following Forebrain Ischemia While Increasing GABA-B Receptor 1 (GABA-B-R1) Expression

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Experimental : Argon Gas for Neuroprotection

Early administration of Argon Gas (within one hour) shows neuroprotection benefits in animals undergoing controlled cardiac arrest.