Post “ROSC”

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And they ask you, [O Muhammad], about the soul. Say, The soul is of the affair of my Lord. And mankind have not been given of knowledge except a little.” (Al Izbaa, 55)
1. Brain Injury
2. Myocardial Dysfunction
3. Systemic ischemic response
4. Systemic reperfusion Response
5. Persistent Pathology
Inhospital Deaths

➢ 1st 3 days most deaths will result from Cardiovascular failure
Brain injury will kill 2/3 of out of hospital arrests & ¼ of inhospital arrests.

Brain injury
- starts within 4-6 minutes
- continues from hours to days
- can be re-triggered by new ischemia
- may be exacerbated by metabolic turmoil:
  - Microcirculatory failure,
  - Impaired autoregulation,
  - Hypotension,
  - Hypercarbia,
  - Hypoxemia,
  - Hyperoxemia,
  - Pyrexia,
  - Hypoglycemia,
  - Hyperglycemia
  - Seizures
The most frequent cause of death:
Withdrawal of life-sustaining therapy (WLST)

- 80% mortality rate
- 50% leaving the hospital have neurological injury.
A couple of days before death, our body starts secreting chemicals like putrescine & cadaverine. Our subconscious picks up these subliminal smells & it knows that it's time.

This is Oscar the therapy cat who lives in a nursing home in Rhode Island. He has predicted the death of over 50 patients, and is so accurate nurses notify patients families when Oscar has been sleeping in their room. Scientists believe he can smell biochemicals released by dying cells.

Just before “Death”
An unexplained electric surge runs through the brain. Our brains are stimulated like never before in our whole life...

2–20 seconds after the heart and lung have stopped, the cerebral cortex still has perception of the outside world.

For about 10 minutes after the heart stops and just before shutting down, the memory center sends out electroencephalographic recordings that are different and unique for each and every one of us.
## TABLE 10

**Survival Time of Different Nerve Tissues Completely Deprived of Blood**

<table>
<thead>
<tr>
<th>Tissue</th>
<th>Survival Time (Minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum, small pyramidal cells</td>
<td>8</td>
</tr>
<tr>
<td>Cerebellum, Purkinje’s cells</td>
<td>13</td>
</tr>
<tr>
<td>Medullary centers</td>
<td>20–30</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>45–60</td>
</tr>
<tr>
<td>Sympathetic ganglia</td>
<td>60</td>
</tr>
<tr>
<td><strong>Myenteric plexus</strong></td>
<td><strong>180</strong></td>
</tr>
</tbody>
</table>


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**Gut feelings: the emerging biology of gut–brain communication**

Eranman A. Mayer

The concept that the gut and the brain are closely connected, and that this interaction plays an important part not only in gastrointestinal function but also in certain feeling states and in intuitive decision making, is deeply rooted in our language. Recent neurobiological insights into this gut–brain crosstalk have revealed a complex, bidirectional communication system that not only ensures the proper maintenance of gastrointestinal homeostasis and digestion but is likely to have multiple effects on affect, motivation and higher cognitive functions, including intuitive decision making. Moreover, disturbances of this system have been implicated in a wide range of disorders, including functional and inflammatory gastrointestinal disorders, obesity and eating disorders.
Two Days After Death

Resurrection of > 2000 embryonic genes involved with the stimulation of inflammation & the immune system; counteracting stress.

Some of these genes promote cancer growth…
Reperfusion Injury & Inflammatory Response

- Increased vascular permeability: edema
- Activation of coagulation
- Cellular hyperactivity
- Disruption of Blood-brain barrier
- Microthrombi formation
- Increased temperature in the brain
The post-cardiac arrest syndrome has many common features with sepsis, including:

- intravascular volume depletion,
- vasodilation,
- endothelial injury
- microcirculation abnormalities
Unconscious patient?

Doesn’t follow commands?

Intubate

- pharyngeal
- nasogastric also serves to decompress the stomach from bag-mask ventilation
Sedate

*Common practice: for at least 24 hours post-ROSC¹
- decrease O₂ consumption
- reduce patient/ventilator dysynchrony & barotrauma
- prevent shivering & pain

*Opioids & short-acting hypnotics are used e.g. propofol, alfentanil, remifentanil
to allow for more reliable & earlier neurological assessment & prognostication

*Followed up by sedation scales eg Ramsay scale
(1-patient is anxious and agitated + restless, 2-patient is cooperative, oriented & tranquil, 3-patient responds to commands only, 4-patient exhibits a brisk response to light glabellar tap, or loud auditory stimulus, 5-patient exhibits a sluggish response to light glabellar or loud auditory stimulus, 6-patient exhibits no response)

¹ no high level data available to support a defined period

Ventilate

* Tidal volume 6-8 ml/kg ideal body weight
* PEEP 4-8 cm H₂O
Blood Pressure
*Target unknown
*Aim from observational studies: achieve an adequate urinary output of 1 ml/kg/hr & a normal or decreasing plasma lactate values

Potassium
*Hyperkalemia, followed by hypokalemia

Glucose
*Increased mortality & poor neurological outcome with
  - Post-ROSC hyperglycemia,
  - intensive glucose control, & hypoglycemia
  - glucose variability, irrespective of value

*Observational data: optimal level ~10mmol/L (180mg/dl)

Temperature

*Hyperthermia
- maybe a sign of severe brain injury & destroys quantum features.
- It could be immediate, in the 1st 24 hours post-ROSC, or rebound after a period of induced hypothermia

*Targeted Temperature Management (TTM)
- Observational data on comatose patients: mild induced hypothermia at 36 °C is neuroprotective
Methods

- Induction:
  30 ml/kg of 4°C saline will decrease core temperature by 1.0-1.5°C

  observational studies: Do not recommend pre-hospital TTM, increases risk of pulmonary edema & re-arrest during transport.

- Other cooling methods: non prove superiority
  > simple ice packs/wet towels: more time consuming, greater temperature fluctuations
  > cooling blankets / pads
  > water/air circulating blankets
  > water circulating gel-coated pads
  > transnasal evaporative cooling even before ROSC: under investigation in a large multicenter randomised controlled trial
  > intravascular heat exchanger: usually in the femoral or subclavian veins
  > extracorporeal circulation eq cardiopulmonary bypass, ECMO
*Monitoring: core thermistor placed in the bladder / esophagus / rectum

*Rewarming: 0.25-0.5°C / hour to avoid rapid alterations in plasma electrolyte concentrations & rebound hyperthermia

*contraindications to TTM
- severe systemic infection
- pre-existing medical coagulopathy

**However, fibrinolytic therapy is not a contraindication to mild hypothermia

ECG
*STEMI/LBBB
- Observational studies: recommend a combination of TTM & PCI

*NON-STEMI
- Observational studies: suggest that even in the absence of STEMI there may be an ACS situation.

*Bradycardia: retrospective studies found it beneficial: Even <40
CXR
* confirm position of tubings & CV line
* assess for pulmonary edema
* detect CPR complications: pneumothorax, fractured ribs...

Echo
Early echo in ALL patients

* Detect & quantify degree of myocardial dysfunction & need for inotropic support:
  - Fluids
  - Epinephrine
  - Dobutamine

* Treatment maybe guided by:
  - Blood Pressure: arterial/intra-arterial
    - Heart Rate
    - Urinary output
    - Plasma lactate clearance rate
    - Central venous oxygen saturation
  - Serial echo especially in hemodynamic instability

N.B. IABP: IABP-SHOCK II Trial showed no improvement in 30 day
CT brain & chest: Needed on hospital admission before or after coronary angio according to presenting picture

Seizures

May present

- Clinically: in 1/3 of post ROSC comatose patients
  - valproate
  - levetiracetam
  - benzodiazepines
  - propofol
  - barbiturates
  - phenytoin: often ineffective

- Subclinically: there are no recommendations for routine prophylaxis.
*Involves multiple tests for brain injury & neuro consultation
*Obscured by TTM, sedatives, & neuromuscular blockers
*Do not prognosticate before 72 hours…. Results may translate into an unplug situation.

Prognostication

* Long-term cognitive impairments are present in half of survivors.
  * Memory is most frequently affected, followed by problems in attention and executive functioning (planning and organisation)
  * Emotional problems, including depression, anxiety and post-traumatic stress

Rehabilitation
Organ Donation

*Non-randomised studies*: 1 year organ survival ~ in post-CPR & non-CPR specimens.

*Organ donation is currently considered after CIRCULATORY death occurs.

Organ Donation

Ethicality?
**Hydrocortisone, Vitamin C, and Thiamine for the Treatment of Severe Sepsis and Septic Shock: A Retrospective Before-After Study.**

**Abstract**

**BACKGROUND:** The global burden of sepsis is estimated as 15 to 45 million cases annually, with a mortality rate approaching 60% in low-income countries.

**METHODS:** In this retrospective before-after clinical study, we compared the outcome and clinical course of consecutive septic patients treated with intravenous vitamin C, hydrocortisone, and thiamine during a 7-month period (treatment group) with a control group treated in our ICU during the preceding 7 months. The primary outcome was hospital survival. A propensity score was generated to adjust the primary outcome.

**RESULTS:** There were 47 patients in both treatment and control groups, with no significant differences in baseline characteristics between the two groups. The hospital mortality was 8.5% (4 of 47) in the treatment group compared with 42.2% (19 of 47) in the control group ($P < 0.001$). The propensity-adjusted odds of mortality in the patients treated with the vitamin C protocol was 0.13 (95% CI, 0.04-0.49, $P = 0.002$). The Sepsis-Related Organ Failure Assessment score decreased in all patients in the treatment group, with none developing progressive organ failure. All patients in the treatment group were weaned off vasopressors, a mean of 16.3 ± 9.8 h after starting treatment with the vitamin C protocol. The mean duration of vasopressor use was 54.9 ± 28.4 h in the control group ($P < 0.001$).

**CONCLUSIONS:** Our results suggest that the early use of intravenous vitamin C, together with corticosteroids and thiamine, are effective in preventing progressive organ dysfunction, including acute kidney injury, and in reducing the mortality of patients with severe sepsis and septic shock. Additional studies are required to confirm these preliminary findings.

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**Medscape**

**Zolpidem Paradox: Why Sleep Med Wakes Brain-Injured Patients**

Pauline Anderson,

November 21, 2010

The observation that zolpidem can have a paradoxical arousal effect on patients with a severe brain injury dates back about 6 years and has been reported by many different groups. For example, Dr. Schiff and his colleagues previously described the case of a 48-year-old woman who had been in a minimally conscious state for 2 years following a suicide attempt. She couldn't move, feed herself, or speak. When given zolpidem to treat insomnia, she could communicate, eat, and move unassisted within 20 minutes.
Sodium-potassium enzyme is the “gate-keeper”. Controlling its functionality could rewrite the guidelines for cardiopulmonary resuscitation & cardiac arrest management.

Enzymes possess quantum tunneling capabilities.

Quantum Mechanics, the branch of physics that describes the behavior of particles in the subatomic realm in which there is:

* Superposition: where a particle can be in 2 places at once, while also occurring in 2 different states; as a particle & a wave

* Quantum Coherence: states that all parts of a wave stick together, the exciton can, as a wave, feel out all possible pathways, find the most efficient one, and take it.

* Quantum Tunneling: where a particle can pass through a solid object like a ghost

* Quantum Entanglement: where 2 particles form a relationship whether an inch apart or light years away
Double slit lamp experiment: They shot just ONE electron from the beam gun and to their surprise, it gave an interference pattern, so next they took their camera and placed it here and looked directly at the electron at which point it behaved like it was supposed to and it bombarded just one spot. Conclusion: deeds are by intention, we literally shape our reality as we go along. Medicine is not about drugs...
Observational Study

All observational studies lack randomization, true assessment of efficacy is not possible. Furthermore, it is not possible to determine what biases may have influenced the results, both from the provider and the patient. Analytically, results from observational studies either cannot be pooled for a meta-analyses or can be done so only with caution.

J Evid Base Dent Pract 2003;3:1-4

Biology can’t explain: our dependency on light for survival

*“light” from the sun is necessary for:
  - photosynthesis in plants
  - sulfated vitamin D3 in humans
*Smell
*Vision

Quantum Biology can

Recently alongside arteries, veins & lymph channels; “light Channels” were discovered. Every living cell emits light. Light receptors have been identified in the spinal cord of rats & in the human kidney. Diphotons have been directly seen in our brains…
Institute for Basic Biomedical Sciences

The Sniffing Kidney
A surprise discovery may expand what is known about the kidney's elaborate physiology.

University of California San Francisco

Surprising New Role for Lungs: Making Blood
Cells in Mouse Lungs Produce Most Blood Platelets and Can Replenish Blood-Making Cells in Bone Marrow, Study Shows
New Life Found That Lives Off Electricity

ELECTRICITY EATERS
Some microbes can survive solely on electricity.

DIRECT UPTAKE
In some cases, the microbe can ingest an electron directly from an electrode.

INDIRECT UPTAKE
Other microbes secrete enzymes that grab an electron from the electrode and pair it with a proton from water. The microbe eats the resulting hydrogen.

https://www.quantamagazine.org/electron-eating-microbes-found-in-odd-places-20160621/
Quantum Biology

'We’re only just learning how to control tunnelling'

Peter Schreiner, University of Giessen

Call to bring quantum tunnelling to the table when trying to understand reactions