Multiple Organ Dysfunction Syndrome

Karim Rafaat, MD
Favorite Quotes from my Lit Search

- “The Triad of Death”
- “When good cytokines go bad”
- “The Fas death pathway in MODS: not so fast.”
- “Sepsis and hypovolemia: two bad.”
- “Tempering the temptation to treat with tempol.”
- “The goal of therapy may not be to restore order but, rather, to restore fractal, multiple scale variability.”
Limitations of Term MODS

- MODS is a wastebasket diagnosis...
  - It can mean a lot of different things
- MODS has many historical synonyms ...
  - Multiple / Remote Organ System Failure
  - Sequential / Progressive System Failure
  - Systemic Inflammatory Response Syndrome (SIRS)
- MODS is a final common pathway...
  - like “cardiorespiratory failure”
- MODS is heterogeneous clinically...
  - varies by organ systems affected, severity, etc.
ACHIEVEMENT

You can do anything you set your mind to when you have vision, determination, and an endless supply of expendable labor.
MODS: General Concepts

MODS is comprised of the activation and dysregulation of multiple complex overlapping physiologic systems.

Overall: hormonal, cytokine, and immunologic changes leading to systemic inflammation, a procoagulant state, & organ dysfunction.
MODS: General Concepts

- Increases Stress Hormones
  - catecholamines
  - cortisol
  - growth hormone
  - glucagon
  - insulin
MODS: General Concepts

- Immune System Activation
  - complement activation
  - neutrophil & macrophage activation
  - free radical liberation
  - toxic oxygen metabolites
  - immune-mediated proinflammatory...
    - peptides
    - cytokines
    - bioactive lipids
MODS: General Concepts

- Inflammatory Cytokines
  - many involved, major players listed...
  - tumor necrosis factors (TNF)
  - interleukins (IL-1β, IL-6, IL-8, IL-4, IL-10)
  - interferons
  - cytokine receptors & receptor antagonists
MODS: General Concepts

- Procoagulant State
  - shift in tendency of coagulation system
  - endothelial injury and dysfunction
  - fibrinolysis inhibited
  - protein C depletion
MODS: General Concepts

- Increased Metabolic Demands
  - increased oxygen consumption
  - increased gluconeogenesis
  - increased protein catabolism
MODS: General Concepts

- Feed-Forward Cycle
  - metabolic/inflammatory/immunologic responses become generalized & persistent (even in absence of original stimulus)
  - increased demand on organ function promotes failure (CO, ventilation, oxygenation, nutrition, fluids, excretion of waste)

- Organ Failure
  - causes metabolic/inflammatory/immunologic responses
  - hypoxia → ischemia → cell death → inflammation
LIMITATIONS

Until you spread your wings,
you’ll have no idea how far you can walk.
Major Cytokine Mediators

- TNF-\(\alpha\) (1)
  - produced mainly by macrophages & neutrophils
  - response to many stimuli
  - very early expression in almost any major inflammatory response
  - sustained increased levels in many conditions (trauma, burns, severe sepsis)
  - levels correlate with mortality
Major Cytokine Mediators

- TNF-α (2)
  - amplifies inflammatory response
  - stimulates release of other proinflammatory cytokines / lipids
    - IL-1, IL-6, eicosanoids, PAF
  - upregulates adhesion molecules on endothelial cells & PMNs
  - enhances a number of neutrophil functions
    - phagocytosis, degranulation, chemotaxis, free radical formation
  - upregulates enzymes in parallel inflammatory cascades
    - phospholipase A2, COX, and nitric oxide synthase
  - upregulates coagulation inhibitors
  - endothelial cell alteration (incr. vascular permeability → edema)
  - myocardial depression
  - fever
  - vasodilatation (nitric oxide) → hypotension
IL-1β
- produced by a variety of cell types
- increased release of proinflammatory cytokines / lipids
  - TNF, IL-6, and PAF
- endothelial cell activation & pro-thrombotic stimulus (TF)
- increased adhesion molecule expression
  - ICAM, VCAM, selectins
- myocardial depression
- fever
- vasodilatation (nitric oxide) $\rightarrow$ hypotension
Major Cytokine Mediators

- **Proinflammatory Cytokines**
  - e.g., IL-6, IL-8 & interferon-γ
  - promote immune cell-mediated killing

- **Anti-inflammatory Cytokines**
  - e.g., soluble TNF receptor, IL-1 receptor antagonist protein, IL-4, and IL-10
  - turn off the immune response when infection/stimulus has been cleared
Major Cytokine Mediators

- Cytokines out of control...
- Peroxynitrite (ONOO−) can cause DNA damage
  - Cell program and function deranged
- Activation of poly ADP-ribose synthetase
  - depletes cells of NAD+ & ATP
  - leads to secondary energy failure
- overactivated immune cells release Fas & Fas ligand
  - prevents activated immune cell apoptosis
  - promotes ongoing inflammation
- ineffective and unresolving inflammation
  - leads to systemic organ failure
MODS: Genomics Research

- Genomic Micro-Arrays
  - Models
    - Animal models of ALI / ARDS / Sepsis
  - Function
    - To determine gene expression patterns
    - Disease attributes:
      - Variance in cytokine expression patterns between MODS subsets
    - Host attributes:
      - Impact of cytokine polymorphisms in the same MODS subset
MODS: Genomics Research

- Genomic Micro Array Results – Some Examples...
  - TNFβ-2 homozygotes:
    - greater amounts of TNF in septic shock and have significantly higher mortality
  - TNF-α promoter polymorphism + TNFβ-2 allele:
    - higher incidence of septic shock & mortality
  - PAI-1 polymorphisms:
    - worse outcome with purpura fulminans; susceptibility to meningococcal sepsis
  - IL-1 receptor antagonist polymorphism:
    - Increased risk of developing septic shock
  - Fc receptor genetic polymorphism:
    - decreased clearance of bacterial infections & poorer outcomes
  - Toll-like receptor 2 polymorphism:
    - susceptibility to severe staphylococcal infections
MODS: Genomics Research

- Identification of pre-cytokine control
  - Finding ways to turn on heat shock proteins (viral vectors with HSP promoters proven to be protective in ALI models)
  - Identification of transcription factors and gene expression modulators that control intracellular & humoral cytokines
Example of a signal further upstream
- NF-κB promoter pathway linked to ARDS and is associated with the expression of...

<table>
<thead>
<tr>
<th>Cytokines</th>
<th>Adhesion molecules</th>
<th>Growth factors</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNF-α</td>
<td>ICAM-1</td>
<td>GM-CSF</td>
<td>Inducible NO synthase</td>
</tr>
<tr>
<td>IL-1, -2, -3, -6, -8, -12</td>
<td>VCAM-1</td>
<td>G-CSF</td>
<td>CRP</td>
</tr>
<tr>
<td>Eotaxin</td>
<td>E-selectin</td>
<td>M-CSF</td>
<td>5-lipoxygenase</td>
</tr>
<tr>
<td>Gro-α, -β, and -γ</td>
<td></td>
<td></td>
<td>Inducible COX-2</td>
</tr>
<tr>
<td>MIP-1α</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MCP-1</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
MOTIVATION

If a Pretty Poster and a Cute Saying are All it Takes to Motivate You, You Probably have a Very Easy Job. The Kind Robots Will be Doing Soon.
SIRS-Sepsis-MODS Spectrum

- Epidemiology suggests there is a general progression of pathologic states...
  - SIRS
  - Sepsis
  - Severe Sepsis
  - Septic Shock
  - MODS
SI RS-Sepsis-MODS Spectrum

- **SIRS**
  - Defined as $\geq 2$ of the following:
    - Temperature abnormality
      - $>38^\circ C$ or $<36^\circ C$
    - Hemodynamic distress
      - tachycardia
    - Respiratory distress
      - tachypnea, hypercarbia, or hypoxia
    - Inflammatory marker
      - WBC $>12k$, $<4k$, bands $>10\%$, CRP $>2$ SD high
SIRS-Sepsis-MODS Spectrum

- **Sepsis**
  - SIRS plus...
    - confirmed infectious process
    - or strongly suspected infection

- **Severe Sepsis**
  - Sepsis plus...
    - organ dysfunction
      - various organ-failure scores exist
Septic shock
- Definition: sepsis plus ≥1 of the following:
  - decreased peripheral pulses (compared to central pulses)
  - capillary refill:
    - >2 seconds (cold shock)
    - mottled or cool extremities (cold shock)
    - flash capillary refill (vasodilated / warm shock)
  - decreased urine output (< 1 mL/kg/hr)
- Other shock notes:
  - Hypotension observed in late decompensated shock
  - Shock in children also classified by response to therapy
    - fluid responsive / refractory
    - dopamine responsive / resistant
    - catecholamine responsive / resistant
    - refractory shock
SI RS-Sepsis-MODS Spectrum

- MODS
  - Definition
    - progressive reversible dysfunction of ≥2 organs from acute disruption of normal homeostasis requiring intervention
  - Primary MODS
    - immediate systemic response to injury or insult
    - <1 week in ICU, better prognosis, ~85% of Peds cases
  - Secondary MODS
    - progressive decompensation from host response & 2nd hits
    - >1 week in ICU, worse prognosis
MODS Progression

- **A Typical Sequence of Organ System Dysfunction…**
  - **Circulatory insufficiency**
    - tachycardia, hypotension, myocardial depression, CHF, arrhythmia
  - **CNS depression**
    - agitation, lethargy, coma
  - **Respiratory failure**
    - tachypnea, hypovent., hypoxia, hypercarbia, pulmonary edema, ALI/ARDS
  - **Renal insufficiency / failure**
    - fluid overload, uremia, electrolyte derangements
  - **Hematologic derangements**
    - anemia, hemolysis, thrombocytopenia, coagulopathy, DIC, consumptive-hemorrhagic complications
  - **Gut/ Hepatic dysfunction**
    - ileus, cholestasis, bacterial translocation, gastritis, malnutrition, poor synthesis
  - **Endocrine dysfunction**
    - insulin resistance, hyperglycemia, adrenal insufficiency
  - **Immune system**
    - cellular and humoral immune suppression
MODS Scoring

- Multiple scoring systems
  - Brussels score, MOD Score, Sepsis-related Organ Failure Assessment, Logistic Organ Dysfunction Score

- MOD Score presented as an example
  - Six organ systems included
  - One physiologic variable is used to describe each organ
  - No consideration of therapy
  - A score of 0 reflects essentially normal function
    - isolated ICU mortality rate of less than 5%
  - A score of 4 represents severe physiologic derangement
    - isolated ICU mortality rate of more than 50%
  - Score range: 0 - 24
## MODS Scoring

<table>
<thead>
<tr>
<th>Organ System Measure</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory (PO\textsubscript{2} /FIO\textsubscript{2} ratio)</td>
<td>&gt; 300</td>
<td>226–300</td>
<td>151–225</td>
<td>76–150</td>
<td>&lt; 75</td>
</tr>
<tr>
<td>Renal (serum creatinine) [umol/L]</td>
<td>&lt; 100</td>
<td>101–200</td>
<td>201–350</td>
<td>351–500</td>
<td>&gt; 500</td>
</tr>
<tr>
<td>Hepatic (serum bilirubin) [umol/L]</td>
<td>&lt; 20</td>
<td>21–60</td>
<td>61–120</td>
<td>121–240</td>
<td>&gt; 240</td>
</tr>
<tr>
<td>Cardiovascular (pressure-adjusted HR) [HR x CVP/MAP]</td>
<td>&lt; 10.0</td>
<td>10.1–15.0</td>
<td>15.1–20.0</td>
<td>20.1–30.0</td>
<td>&gt; 30.0</td>
</tr>
<tr>
<td>Hematologic (platelet count) [x10\textsuperscript{3}/uL]</td>
<td>&gt; 120</td>
<td>81–120</td>
<td>51–80</td>
<td>21–50</td>
<td>&lt; 20</td>
</tr>
<tr>
<td>Neurologic (Glasgow Coma Score)</td>
<td>15</td>
<td>13–14</td>
<td>10–12</td>
<td>7–9</td>
<td>&lt; 6</td>
</tr>
</tbody>
</table>
MODS Subsets

- Thrombocytopenia-associated multiple organ failure or Disseminated intravascular coagulation (DIC)
  - Characterized by
    - Unopposed tissue factor (TF) & plasminogen activator inhibitor type-1 (PAI-1) activity
    - Consumption of coagulant and anticoagulant factors
    - Deficient vWF cleaving protease activity, increased ultra-large vWF multimers
  - Special consideration
    - Plasma Exchange (PE) replaces vWF cleaving protease, removes ultra-large vWF fragments, normalizes PAI-1 activity
    - Kids w/ 3+ organs down + low plt have shown resolution of organ failure & improved outcome w/ prolonged PE
Unresolving multiple organ failure and infection or Prolonged monocyte deactivation

- Characterized by
  - Monocyte HLA-DR expression <30% for > 5 days
  - Ex vivo TNF-α expression to LPS-stimulation < 200 for > 5 days
  - Can be caused by
    - overwhelming TH2 milieu (e.g., exogenous immunosuppression)
    - free radicals
- Special consideration
  - monocyte function needed to kill infection & clear antigens
  - can be accomplished with
    - rapid weaning of immunosuppression
    - interferon or GM-CSF in patients not receiving immunosuppression
Prolonged lymphopenia, superinfection, and unresolving multiple organ failure

- Characterized by
  - Prolonged absolute lymphocyte count < 1000 for > 7 days
  - Increased incidence of death from secondary infection
  - Associated with prolonged hypoprolactinemia in children

- Special consideration
  - Monitor CD4 count and gamma globulin levels
  - Appropriate prophylaxis for pneumocystis, fungus, and HSV and broader empiric coverage in secondary sepsis
  - IVIG should if hypogammaglobulinemia
  - Prolactin is an antiapoptotic hormone for lymphocytes, but it’s unknown whether prolactin replacement is beneficial
  - Use of drugs associated with hypoprolactinemia or lymphocyte depletion should be stopped when possible (e.g., dopamine)
MODS Subsets

- Sequential multiple organ failure with viral infection or Lymphoproliferative disease
  - Characterized by
    - Association with lymphoma & post-transplant lymphoproliferative disease
    - EBV(+) lymph nodes & serum PCR
    - Lymphocyte Fas ligand–mediated apoptosis contributing to liver failure
  - Special consideration
    - Treatment with monoclonal antibodies to B lymphocytes
MODS Subsets

- Unresolving acute respiratory distress syndrome without infection or Fibroproliferative lung disease
  - Characterized by
    - ARDS at 1 week with no infection by BAL or Bx
    - Increased IL-6 levels
    - Normal lymphocyte count, monocyte HLA-DR expression, and ex vivo whole TNF-α response to LPS
    - Culture-negative bronchoalveolar lavage (BAL) fluid
    - Fibrin deposition
  - Special consideration
    - Treatment with steroids in fibrinoproliferative stage
      - methylprednisolone at asthma dosage
MEETINGS

None of Us is as Dumb as All of Us.
Epidemiology & Mortality

- Mortality of Pediatric Septic Shock*
  - 1963: 97%
  - 1973: “Syndrome” of MOD first described
  - 1985: 57%
  - 1991: 12%
  - 1995: 10%
  - 1999: 5-9% (nearly all dying of MODS)

*about 50% higher in children w/ chronic illness
Epidemiology & Mortality

- MODS has emerged as a consequence of the advances in intensive care, drugs, and technologies.
- Multiple & overlapping definitions have made research and epidemiology difficult.
- Severe sepsis with associated MODS:
  - is the leading cause of death in adult intensive care units
  - has the highest mortality in PICU’s
- Mortality depends largely on definition used for MODS.
- Overall, mortality improving as therapies improve.
MODS mortality increases with:
- advancing age or prematurity
- # of dysfunctional organs
- prolonged organ failure
- delayed diagnosis
- delayed or inadequate resuscitation
- inadequate source-control
  - inadequate nidus removal
  - ineffective antibiotic regimen
Epidemiology & Mortality

- MODS mortality increases with
  - Delay of therapy
    - for every 1 hr w/ hypotension or cap refill > 2 sec, severity-adjusted mortality OR=2.0 in kids w/ community-acquired sepsis
  - Care Model:
    - Managed care gatekeepers and delayed access to care have been associated with poorer outcome from septic shock
Epidemiology & Mortality

- **Adults MODS:**
  - mortality 20-100%
  - # organ systems down:
    - $1 \rightarrow 40\%$, $2 \rightarrow 60\%$, $3 \rightarrow 95\%$, $5 \rightarrow 100\%$
  - sepsis in >70% of cases

- **Peds MODS:**
  - mortality 26-50%
  - accounts for 5-30% of PICU census
  - accounts for ~90% of deaths
  - sepsis in <50% of cases
Epidemiology & Mortality

- Peds MODS with Severe Sepsis
  - ~50% newborns
    - >50% of those preterm
    - ~50% pediatric
      - >50% of those with chronic illnesses
- More children die in association with severe sepsis / MODS than die from cancer
- Annual health care cost in US ~$4 billion
TEAMWORK
A FEW HARMLESS FLAKES WORKING TOGETHER CAN UNLEASH AN AVALANCHE OF DESTRUCTION.
MODS Rx: General

- No specific effective therapy for all forms of established MODS
- Effective preventive and therapeutic strategies exist in pre-MODS syndromes/pathologies
- Mainstay of non-preventive therapy is supportive care for individual organ failure
  - Optimizing organ function: oxygen delivery, cardiac output, early enteral nutrition
  - Replacement therapies: mechanical ventilation, CVVHD, ECMO, hepatic dialysis (MARS)
- Many models and theories of how to manipulate complex signaling and “cytokine storm” through molecular therapy
MODS Rx: Prevention

- MODS Prevention
  - General:
    - rapidly identify and eliminate of inciting stimulus before host response becomes own feed-forward stimulus
  - Primary MODS:
    - Measures to decrease multisystem injury/trauma/illness through avoidance of 1st hit in a vulnerable demographic
      - e.g., protective gear, child seats, immunizations, etc.
  - Secondary MODS:
    - Measure to forestall progression of SIRS or Sepsis to MODS through avoidance of 2nd hits in a primed system
      - e.g., rapid medical access (EMT), special teams (stroke-team, code-blue), infection control policies (clean units)
MODS Rx: Good Evidence

- **Severe Sepsis in MODS**
  - Appropriate antimicrobials
    - early empiric antimicrobials
    - timely conversion to infection-specific therapy
    - antibiotics with best MIC
  - Early goal-directed hemodynamic & O2-delivery therapy
    - normal BP w/ IVF and SVC O2 sat >70%
    - achieve with oxygen + PRBC + inotropes
  - Activated protein C
  - Adjunctive immune therapy
    - GCSF / GM-CSF for neutropenic patients (esp. newborns)
    - steroids/IVIG/etc in selected cases
  - Pentoxifylline
    - rheologic agent demonstrated benefit in premature infants
MODS Rx: Good Evidence

- Septic Shock in MODS
  - Use of hydrocortisone plus fludrocortisone
    - for patients with a minimal cortisol response to corticotropin stimulation
  - Careful vasopressor selection in patient population
    - e.g., avoidance of alpha agents in neonates
  - ECMO in selected cases
    - benefit greatest in neonates > children > adults
MODS Rx: Good Evidence

- ARDS in MODS
  - Lung-protective ventilation
    - low stretch ventilation (prevent volutrauma)
    - open lung (prevent derecruitment / shearing)
  - Steroids in Proliferative phase
    - criteria:
      - unresolving ARDS (>1 week)
      - culture-negative (by BAL)
    - decreases fibrin deposition
MODS Rx: Good Evidence

- ARF in MODS
  - Renal replacement therapy
    - CVVHD > daily dialysis > intermittent dialysis
    - CVVHD appears to alter cytokines favorably
  - Address abdominal compartment syndrome
    - PD catheter for decompression
MODS Rx: Good Evidence

Other Problems in MODS

- Hyperglycemia
  - insulin therapy
  - normoglycemia improves outcomes in ICU patients

- Hypogammaglobulinemia
  - IVIG
  - broader empiric antimicrobial coverage

- Immunosupression in MODS
  - cessation of immunosuppressants
  - broader empiric antimicrobial selection
MODS Rx: Controversial

- Many Controversial Therapies

- DIC in MODS:
  - Anticoagulants in selected cases
  - Prudent factor / blood product replacement

- Free-Radicals in MODS
  - Scavengers (NAC, procystein, tempol, retinol, tocopherol, and beta carotene, vitamins E & C)
  - Animal models have shown benefit but no proven benefit in hard endpoints in human trials
INCOMPETENCE

When you earnestly believe you can compensate for a lack of skill by doubling your efforts, there's no end to what you can't do.
MODS: The Future

- Attempts to modulate the complex inflammatory responses of SIRS-Seplsis-MODS must address the heterogeneity of the process and the host.

- What’s Needed:
  - Larger multi-center RCT’s to adequately power studies as mortality percentages fall.
  - More refined definitions and consistent usage of the SIRS-Seplsis-MODS spectrum.
  - A better understanding of what is common to all patients and what is associated with host variations (e.g., gene polymorphisms).
<table>
<thead>
<tr>
<th>THEN</th>
<th>NOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not give more than 20 mL/kg.</td>
<td>Give at least 60 mL/kg of fluid</td>
</tr>
<tr>
<td>Do not use epinephrine or norepinephrine.</td>
<td>Use epinephrine or norepinephrine (age-specific dopamine insensitivity)</td>
</tr>
<tr>
<td>Steroids are bad.</td>
<td>Give hydrocortisone for both classic and relative adrenal insufficiency</td>
</tr>
<tr>
<td>Patients have a high CO- low vascular resistance state and die of vascular failure.</td>
<td>Children can have any hemodynamic state, frequently have high vascular resistance, and commonly die of cardiac failure</td>
</tr>
<tr>
<td>Use vasopressors, not inotropes, vasodilators, or inodilators</td>
<td>Vasopressors are required for some, but inotropes, vasodilators and inodilators are required. Pentoxifylline is effective for premature infants</td>
</tr>
</tbody>
</table>
### SIRS-Sepsis-MODS: Then & Now

<table>
<thead>
<tr>
<th>THEN</th>
<th>NOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECMO does not work</td>
<td>ECMO does work</td>
</tr>
<tr>
<td>Do not use inhaled nitric oxide.</td>
<td>Use iNO for PPHN</td>
</tr>
<tr>
<td>Maintain a normal PCO₂.</td>
<td>Use an effective tidal volume of 6 mL/kg and minimize volutrauma</td>
</tr>
<tr>
<td>Hemodialyse/filtrate patients with acute renal failure as infrequently as possible.</td>
<td>Hemodialyse/filtrate patients with acute renal failure daily</td>
</tr>
<tr>
<td>Ignore DIC. It will get better when shock resolves.</td>
<td>Aggressively reverse DIC: thrombosis and bleeding is bad</td>
</tr>
<tr>
<td>O₂ utilization goal-directed therapy isn’t important</td>
<td>Maintain normal perfusion pressure and a SVC O₂ saturation &gt; 70%</td>
</tr>
<tr>
<td>Do not worry about hyperglycemia.</td>
<td>Maintain normoglycemia. Use insulin</td>
</tr>
</tbody>
</table>
## SIRS-Sepsis-MODS: Then & Now

<table>
<thead>
<tr>
<th>THEN</th>
<th>NOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitive means sensitive.</td>
<td>Use antibiotics with MIC &lt; 1</td>
</tr>
<tr>
<td>Children die because they have too much inflammation: white blood cells are bad!</td>
<td>Children die because they cannot kill infection. Stop treatment with immunosuppressives; give GM-CSF for neutropenia, IVIG for hypogammaglobulinemia</td>
</tr>
<tr>
<td>There is not much you can do for septic shock but pray. Nobody understands MOF.</td>
<td>Septic shock is reversible; MOF = untreated thrombotic microangiopathy or uneradicated infection</td>
</tr>
<tr>
<td>TTP is a hematologic disease; not an ICU problem</td>
<td>TTP-like pathology is present in children with TAMOF. Prolonged plasma exchange can reverse pathology</td>
</tr>
<tr>
<td>Secondary infection and unresolving MOF is a mystery.</td>
<td>Monocyte deactivation and lymphoid depletion occur. Rapid tapering of immunosuppressives and use of GM-CSF or interferon can be helpful</td>
</tr>
<tr>
<td>Unresolving ARDS without infection is incurable</td>
<td>Steroids can reverse unresolving ARDS without infection</td>
</tr>
</tbody>
</table>
Multiple Organ Dysfunction Syndrome

Take everything you hear with a grain of salt.

When we look back a decade from now, what will we believe is wrong with what we are doing now?

*Primum non nocere.*
CLUELESSNESS

There are no stupid questions,
but there are a lot of inquisitive idiots.
1. At least how many organ systems need to have dysfunction to count as Multiple Organ Dysfunction Syndrome (MODS)?

A) 1
B) 2
C) 3
D) 4
2. Which of the following statements about MODS is false?

A) Primary MODS (initial insult) has a better prognosis than Secondary MODS (“second-hit”).

B) MODS with sepsis may benefit from CVVHD, even if there is no overt renal failure.

C) MODS is accompanied by infection/sepsis more commonly in children than in adults.

D) Most management in MODS is supportive.
Thank You 😊