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Clinical Spectrum of Sepsis in Children

Microbes have been abused by us every now and then. We always think them as our enemies.

If we look at them without prejudice,we find them indispensible.

Microbes Are Useful to Humans in Numerous Ways

1. Microbial biomass is 100 times the human biomass. Thus we are wrong in saying microbes invade us. Infact we invaded them.
2. Our protection against infectious agents is done by microbes (commensals). So with prophylactic antibiotics we destroy them and make ourselves prone to infections.
3. These synthesise vitamin K.
4. Fix nitrogen for plants hence support plant life (and subsequently human life) which can not exist without microbes
5. Aroma and flavor to wine is also due to them!

Microbes Are More Intelligent / Democratic than Humans

1. Humans take decades to find new class of antimicrobial while microbes take less than 24 hours to develop resistance.
2. Penicillin was put to clinical use in1945,while penicillinase was discovered in 1943.
3. They are a step ahead of humans – when we had only penicillin,there was penicillin resistant staphylococci. When we discovered cloxacillin, there was cloxacillin resistant staphylococci. With advent of methicillin there was MRSA. and now when we have vancomycin, there are VRSA.
4. Humans rarely share with other's power or money, but microbes are not so selfish.They share their power (drug resistance trait) with their fraternity immediately.

We always say that microbes are responsible for great morbidity and mortality. But we forget that we abuse them by indiscriminate use of antibiotics and in response to our offence they become vindictive and develop resistance to antibiotics.

When an infectious agent enters human body it can lead to various types of manifestations (provided it escapes immune system of body and causes infection) (Fig 36.1):

Infectious agent can enter body through integument/gastrointestinal tract/genitourinary tract/ respiratory system.

Knowing the portal of entry can give idea about pathogen involved.

Infectious agents are: (i) Bacteria, (ii) Viruses, (iii) Fungi, (iv) Protozoa.

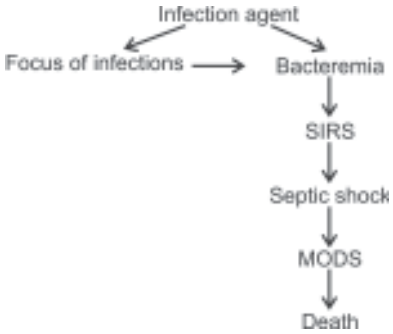

Fig. 36.1: Clinical spectrum of sepsis

SIRS – Systemic inflammatory response syndrome.
MODS – Multiorgan dysfunction syndrome.

Most commonly infectious agent leads to some focal infection in body e.g., pharyngitis, meningitis, UTI, etc.

Infectious agent directly or after causing focal infection can lead to bacteremia.

Fate of Bacteremia

1. Spontaneous resolution (30 – 40% in pneumococcal, 5% in case of Hib bacteremia).
2. Form metastatic foci of infection e.g., osteomyelitis/meningitis.
3. Leads to SIRS (Systemic inflammatory response syndrome).

Role of Clinician in Bacteremia

Most confusing–When confronted with febrile child without focus of infection where one has to identify those 20% [5% bacteremia + 15% serious bacterial infection (SBI)] who needs proper treatment.

At this time clinician has to answer following questions:

a. Should I do diagnostic tests?
b. Which ones?
c. Should I treat in OPD/indoor?

Most crucial–If you underplay and miss some cases of bacteremia, it leads to increase in morbidity and mortality.

While if you overplay and give antibacterials to those who don't need, it will lead to:

a. Bacterial resistance.
b. Increases cost.
c. Side effects of drugs.
d. Inconvenience.

The physicians have to kept in mind that no combination of laboratory tests and clinical assessment is completely accurate in predicting presence of occult bacteremia.

Approach to Fever

Fig. 36.2 shows categorisation of fever to identify and treat.

Fig 36.2: Categorisation of fever to identify and treat

Approach to Fever Without Focus

Approach to fever without focus is different for various age group because of follwing reasons:

1. Organisms are different for age group < 3 months and 3 to 36 months.
2. Fever as a response to infection is less common at younger age.
3. Sensitivity of clinical evaluation in diagnosing serious illness is 78% for < 3 months age and 90% for >3 months.
4. Sepsis mimicked by nonbacterial illnesses like inborn errors of metabolism,CAH, hypoglycemia are more likely at < 3 months of age.

Approach to Fever without Focus in < 1 Month

Hospitalisation + Full sepsis screen + Empiric antibiotic therapy.

Approach to Fever without Focus in 1-3 Months

a. Well appearing, previously healthy.
b. TLC – Between 5,000-15,000/cmm.

c. Absolute band count < 1,500/cmm.
d. Normal urinalysis.

In presence of all above 4 features a child is unlikely to have serious bacterial infection/ bacteremia with negative predictive value of >98%.

Hence, if a child satisfies all the above 4 criteria, he can be followed up in OPD. If child do not fulfil any of the above criteria then he will need hospitalisation, sepsis screen and IV antibiotics.

Approach to fever without focus is seen in Fig 36.3. (in 3 to 36 months of age)

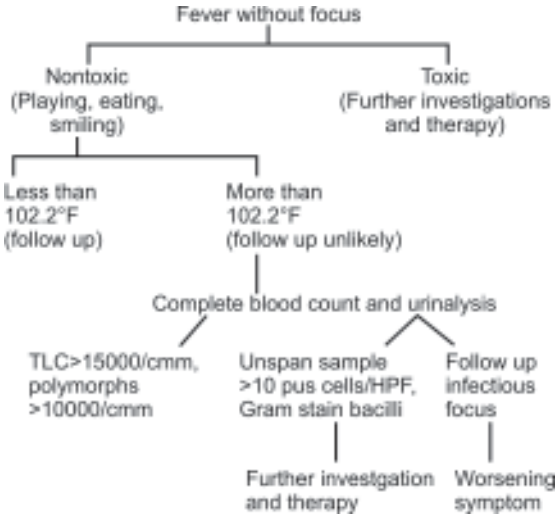

Fig. 36.3: Approach to fever without focus in the age group of 3 to 36 months

Three Other Groups at High Risk of Bacteremia

1. Fever with peteche.
2. Hyperpyrexia > 105.8° F.
3. Immunocompromised: SCA, Nephrotic syndrome, etc.

So these patients always need full evaluation hospitalization and antimicrobials.

SIRS (SYSTEMIC INFLAMMATORY RESPONSE SYNDROME)

Fig 36.4 shows steps of systemic inflammatory response syndrome (SIRS).

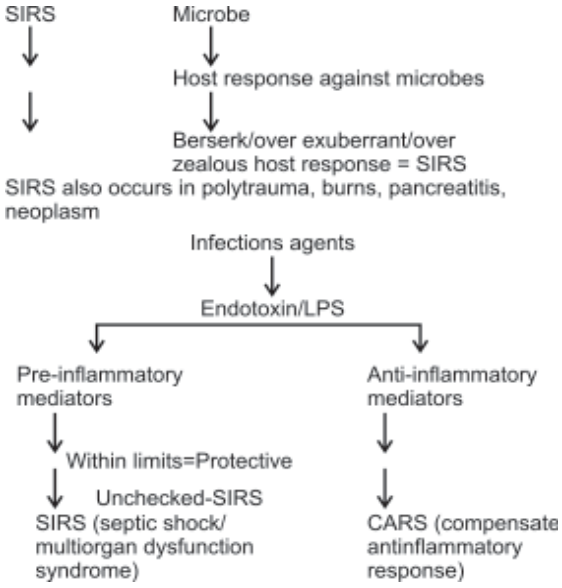

Fig 36.4: Systemic inflammatory response syndrome (SIRS)

Role of Immunomodulators in SIRS

i. Impossible to fine tune between SIRS and compensated antiinflammatory responses (CARS).
ii. Immunomodulators in sepsis – Anti TNF antibody, sol.TNF receptor,anti IL-1, antibody steroids, IV gamma globulin useless / experimental.
iii. Some uniformly fatal – TNF albumin binding protein+IL-1 receptor antagonist (PCNA).

Role of Clinician in SIRS

i. Handicapped to treat SIRS – today.
ii. But one can diagnose SIRS clinically more than 2 criteria out of 4.
   a. Temperature abnormal – >101°/< 96°F
   b. Tachypnea/pCO_2 < 32.
   c. Tachycardia.
   d. TLC=>12,000/<4,000/>10% bands.

Septic Shock

Biggest breakthrough in management of shock has

not come due to any newer gadget or any wonder drug but because of change in definition of shock.

We all have realised that shock is not hypotension but decreased organ perfusion (Fig. 36.5).

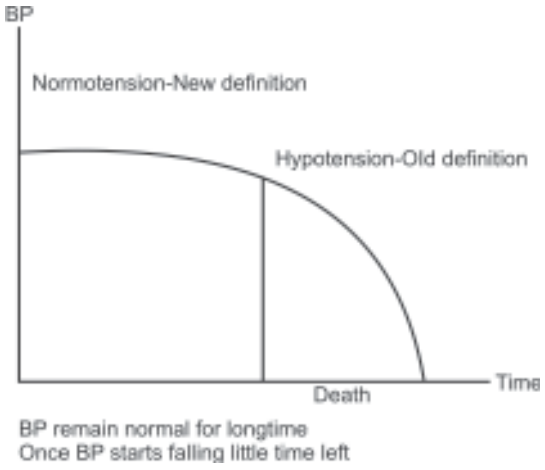

Fig. 36.5: Shock and blood pressure

Early Diagnosis of Any Shock

Early diagnosis of shock is done by decreased organ perfusion and examination of pulse.

1. *Pulse* – Low volume (Decreased pulse pressure), tachycardia. 2. *Decreased skin perfusion* – Cold extremities, prolonged CRT and mottled skin. 3. *Decreased CNS perfusion* – Altered mentation. 4. *Decreased kidney perfusion* – Decreased urine output.

Fig. 36.6 shows mechanism of shock.

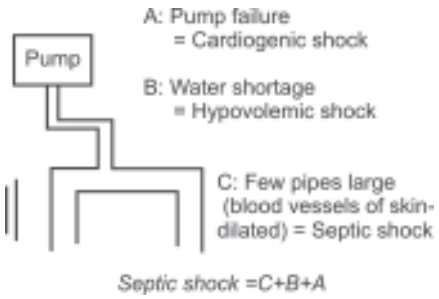

Fig. 36.6: Mechanism of shock

Early Diagnosis of Septic Shock

(Early septic shock = Warm shock/high CO shock/low SVR shock). Let us see how early indicators of shock will behave in early septic shock:

1. *Pulse* – Will not be low volume (Actually pulse is bounding).
2. *Skin* – No cold extremites (Actually warm), CRT not prolonged.
3. *CNS* – Altered mentation (Useful in absence of seizures/meningitis).
4. *Kidney* – Decreased urine output – Very useful.

So features useful for early diagnosis of septic shock are :

1. Urine output = < 1ml/kg/hour–catheterise.
2. Acute change in mentation.
3. ABG: Lactic acidosis.

Management of Septic Shock

Order: A B C D

In spite of often repeated Airway-Breathing-Circulation and then Drugs, we see many cases in practice,where this order is messed up, e.g.,

1. Head on pillow, neck flexed, airway obstructed and patient given O_2 (B before A).
2. IV fluids as recommended given first and then O_2 (C before B).
3. Patient on dopamine drip but volume resuscitation not complete (D before C).

In all patients of shock, 100% O_2 is to be given even SpO_2 is 100.

C-circulation

a. *Vascular access* – Two wide bore IV line and if necessary – intraosseous line.
b. *Fluids* – Septic shock has severe hypovolemia due to reduced vascular tone and increased capillary leak.
c. Hypovolemia in septic shock > Hypovolemia in hypovolemic shock.

Golden Hour

1st hour = 60-80ml/kg IV fluids e.g., in a 10 kg child:
10 kg =10X60ml =600ml in 1 hour.
[Drip rate=150 drops/minute (not microdrops].

Hand held syringes/pressure on IV bottles are often necessary as such drip rates are practically difficult.

Volume replacement is often insufficient during initial resuscitation of children with shock (Fig. 36.7).

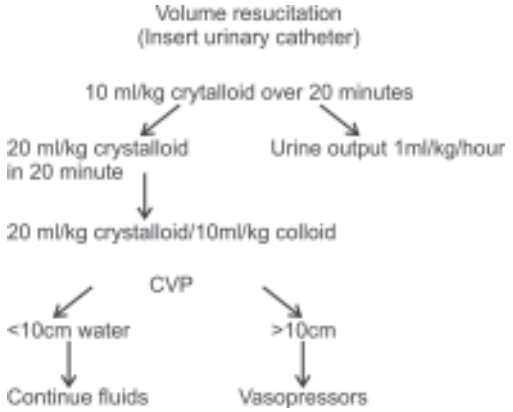

Fig. 36.7: Volume replacement

If CVP not available–Look for signs of fluid overload

a. JVP.
b. Hepatomegaly.
c. Basal crepitations.
d. Chest x ray – cardiomegaly.

Therapy of Metabolic Acidosis

Disadvantages of Metabolic Acidosis

1. Decreases cellular function e.g., myocardial cell so decreases contractility.
2. Tachypnea – Increases work of breathing.
3. Decreases vascular resistance.

Advantage of Metabolic Acidosis

Shifts ODC(oxygen dissociation curve) to right and hence more oxygen for tissues.

How to Treat Metabolic Acidosis of Shock?

Basically it is due to

i. Anerobic metabolism = Increased lactate production.
ii. Decreased liver perfusion = Decreased lactate clearance.

Treatment – (i) Oxygenation, (ii) Perfusion = Fluids + Vasopressors.

Should we use IV $NaHCO_3$? Why ?

Fig. 36.8 shows uses of $NaHCO_3$ in treatment of shock.

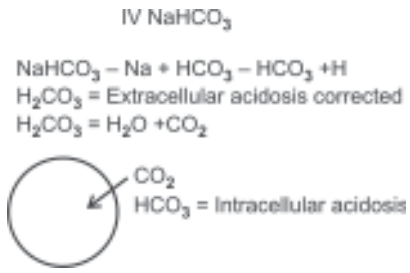

Fig. 36.8: Use of $NaHCO_3$ in treatment of shock

IV. $NaHCO_3$

1. Only after adequate ventillation to washoff CO_2.
2. Only in severe acidosis pH< 7.2.
3. Only half correction.

Other Aspects in Management of Septic Shock

1. Anemia – Hb 10g/dl ($CO_2 = 1.34 \times Hb \times SpO_2$).
2. Hypocalcemia ionic capillary leak–Hypoalbuminemia.
3. Hypoglycemia.
4. Antimicrobials (Acyclovir/antimalarials/antibiotics).
5. Reduce O_2 consumption (Thermoneutral/fever.
6. Seizures/Endotrachent tube intubation).
7. Steroids –No (except Water house Friderichsen).

Take Home Messages

1. *Microbes* – Not always enemy, do not abuse them with indiscriminate antibiotic use or else face antibiotic resistance.
2. *Septic shock* – Can be caused not only by bac-teria but also protozoa/viruses e.g., herpes sim-plex virus, falciparum malaria.
3. *Diagnose shock before hypotension*.
4. *Early diagnosis of septic shock* – ABG/ Urine output – catheterise. Diagnosis and asses res-ponse to therapy.
5. *Shock* – Derangement of "C"but true order for treatment is ABCD.
6. *Volume replacement in septic shock* – High- may be more than hypovolemic shock.
7. Sodabicarbonate may exaggerate intracellular acidosis.