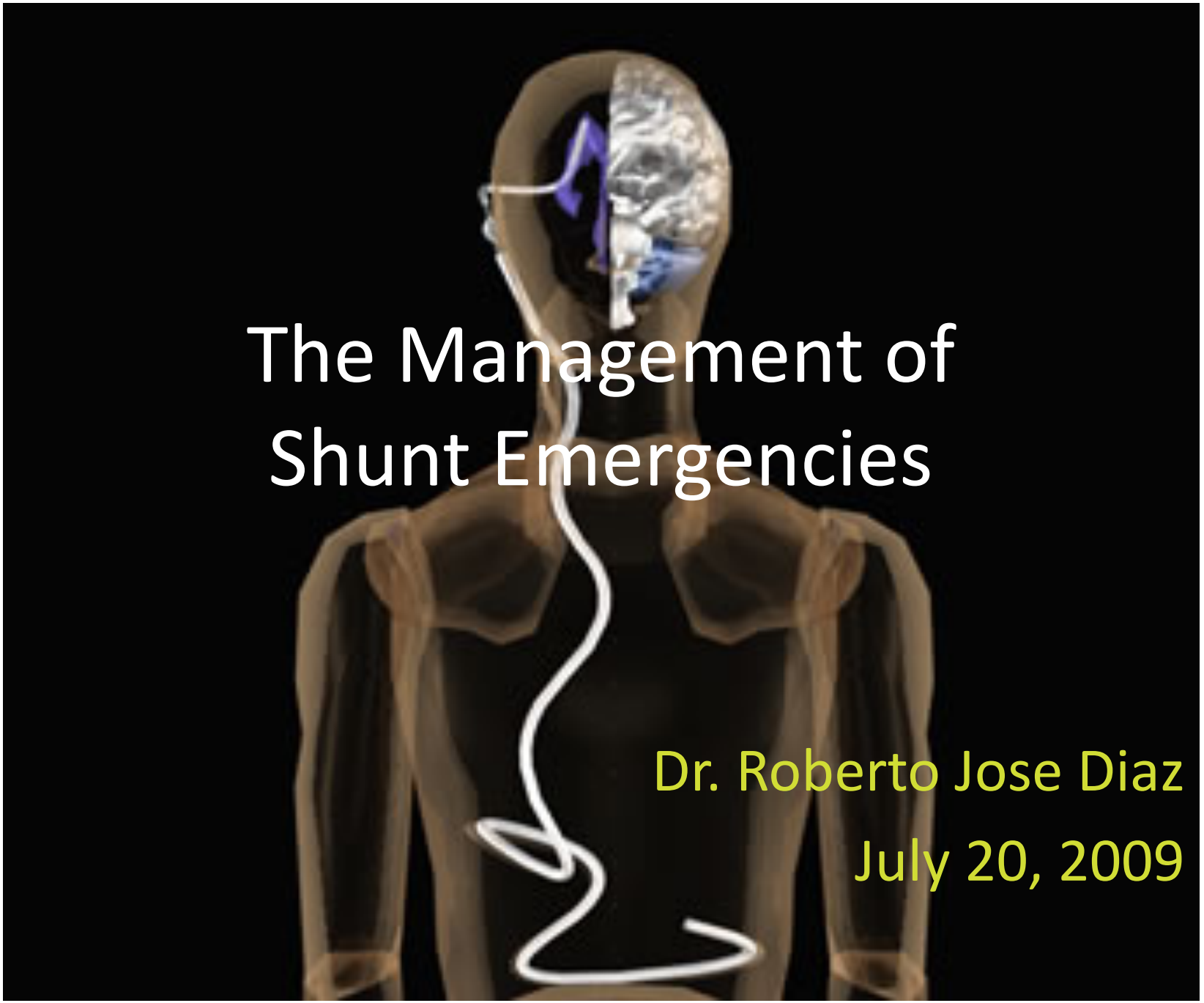

The Management of Shunt Emergencies

Dr. Roberto Jose Diaz

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Incidence of VP Shunt Complications

- Obstruction or Malfunction 30-40%
- Infection 5-10%

Shunt Malfunction

- The most common cause of shunt malfunction is mechanical obstruction.

- Location of obstruction:

  36% ventricular end

  34% peritoneal end

  23% at both ends

Shunt Malfunction

Other causes:

- Debris from shunt infection
- Retraction of the distal catheter from the peritoneal cavity due to linear growth
- Disconnection of components
- Catheter kinking
- Valve invagination or leakage of valve reservoir
- Inadequate decompression due to mismatching patient need and valve flow characteristics

CASE #1

30 y/o Male with history of multiple prior shunt revisions, developmental delay. Presents with 3 day history of poor appetite, decreased activity, increased drowsiness in the last 12 hours

Shunt Malfunction

Symptoms:

- **lethargy**, irritability, drowsiness
- nausea, vomiting, headache
- increase in seizure frequency
- enlarging head in children
- neck pain

Signs:

- May have bradycardia and hypertension (Cushing's Reflex)
- Bulging/Tense fontanelle
- **Shunt site swelling**
- Decreased level of consciousness
- Upward gaze palsy
- Papilledema
- CN VI palsy
- Pyramidal and extrapyramidal deficits,
- Memory disturbances
- Mutism
- Transtentorial or cerebellar herniation (respiratory arrest)

Shunt Malfunction

Evaluation Protocol:

1. Manipulation of the valve reservoir.
   NB. Does NOT rule out shunt malfunction
   may give information on distal or proximal obstruction
2. Plain radiographs of the skull, chest, and abdomen
   Helps to determine type of shunt system,
   rules out disconnection, kinking, malposition

3. Non-contrast CT Head

4. CT abdomen or Abdominal Ultrasound (if suspect intra-abdominal complication)

5. 99mTc pertechnetate clearance study (for non-acute presentation)

Shunt Malfunction

Management:

1. ABC's
   Does the patient need intubation?
   Optimize BP and SaO2, manage dysrrhythmias, manage seizures, standard raised ICP management in the setting of herniation (HOB 45 degrees, hyperventilate, mannitol)

2. Deteriorating patient...
   Emergency Reservoir Puncture
   (will only work in about 1/3 of cases where distal obstruction)

   Emergency External Ventricular Drain

Symptomatic patient with no evidence of acute herniation
   Prepare for urgent revision of VP shunt
   Consider other options: Third Ventriculostomy

Role of ETV in the Management of Shunt Malfunction and Infection

Twenty-three patients (76.7%) experienced successful outcomes, resulting in shunt independence.

Seven failures, three were technical failures at the time of surgery and the remaining four were manifest within a median of 10 days, resulting in shunt revision.

Shunt Infection

- Infections produce much of the morbidity and mortality associated with CSF diversion procedures

- 70-80% of shunt infections occur within 2 months of shunt insertion and 80-90% within 4 months.

Shunt Infection

Causative Organisms:

- *Staphylococcus epidermis* (50% to 60%)
- *Staphylococcus aureus* (15% to 25%)
- Gram-negative bacilli account for (6% to 15%)
  - *Escherichia Coli is the most common*
- *Bacteriodes, Enterobacter, or Enterococci* are unusual and may suggest asymptomatic bowel perforation with retrograde shunt infection

CASE #3

9 month old male with 2 day history of decreased feeding,
lethargy developing over last 8 hours.
Initial vital signs in the ED: Temp 39, HR 180 bpm , BP 60/palp , RR 65, SaO2 99% RA


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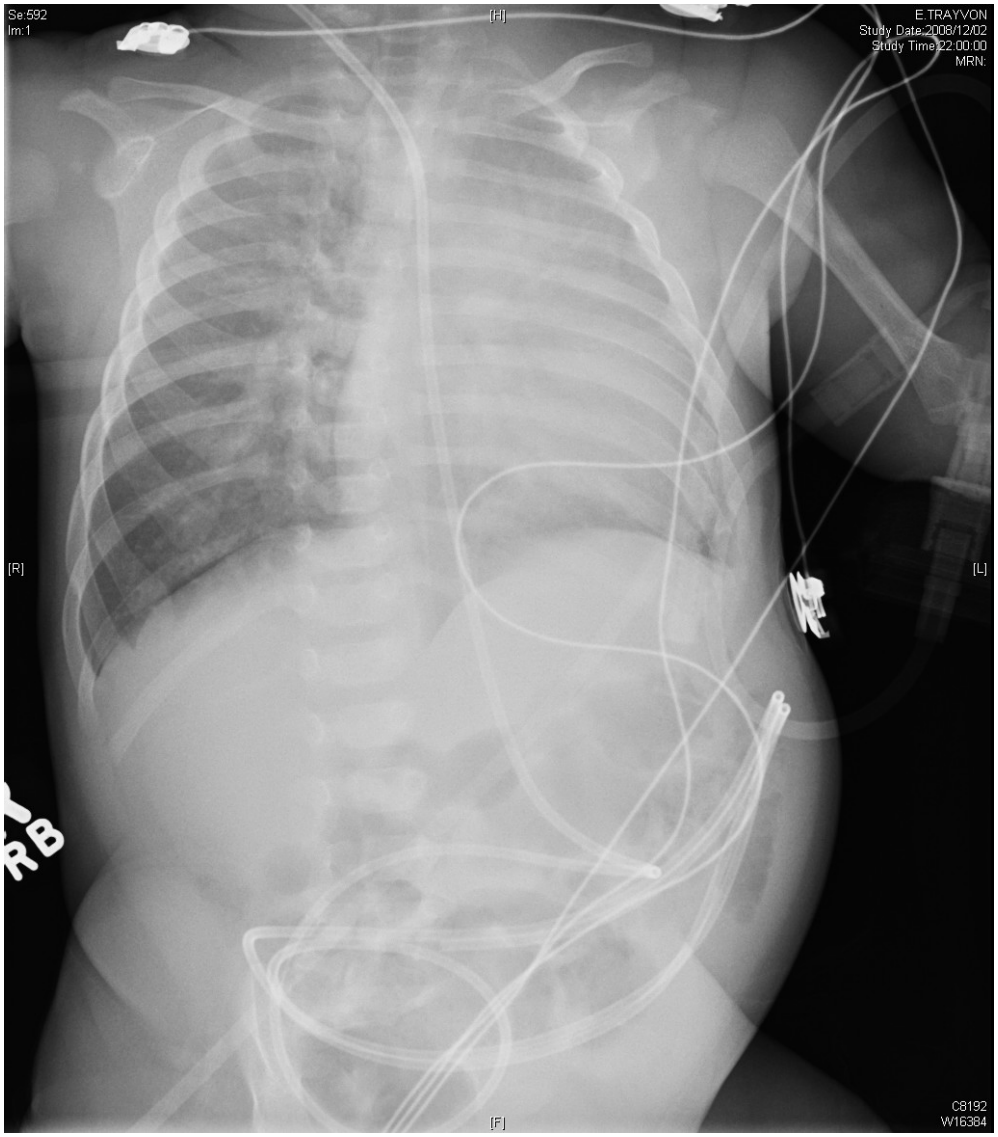
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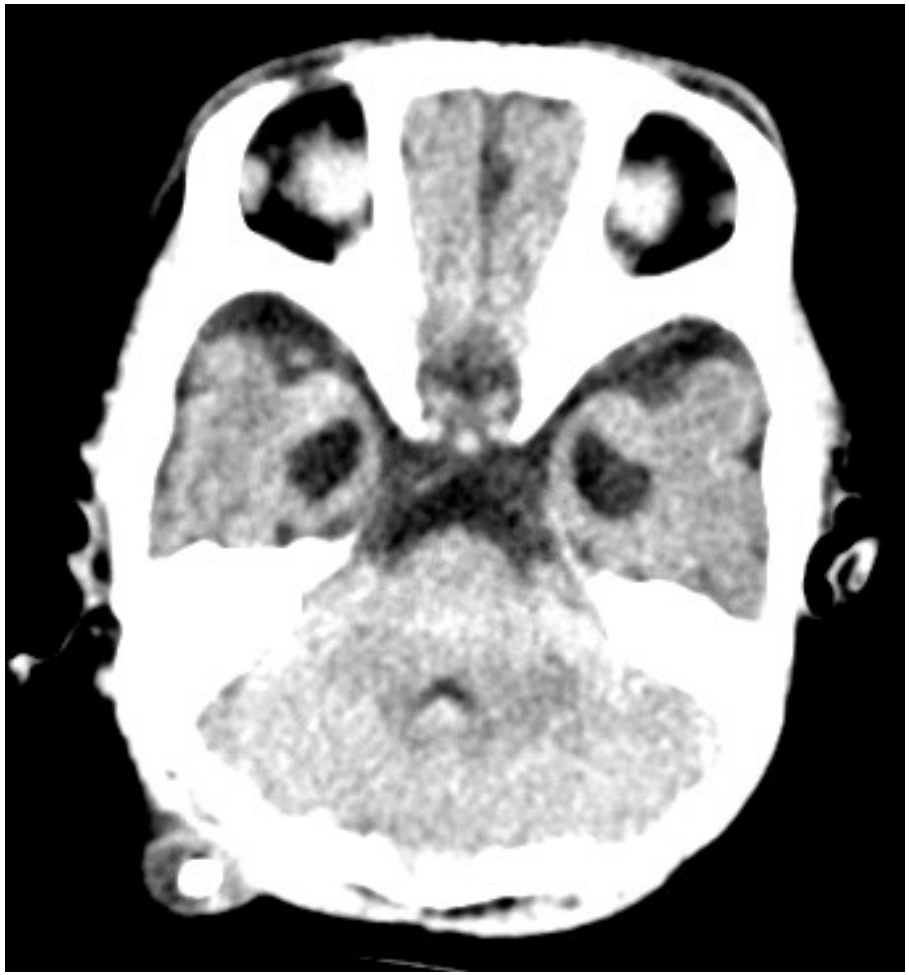

Shunt Infection

Symptoms:

- Nausea, vomiting, headache, lethargy, abdominal pain, feeding problems

Signs:

- Fever (42%)
- Signs of meningeal irritation (<33%)
- Erythema over shunt device or external manifestation of infection (30%)
- Signs of isolated shunt malfunction (25%)
- Localized or diffuse peritonitis
- Systemic leukocytosis

Shunt Infection

Management

1. ABC's
   Does the patient need to be intubated?
   Is BP being adequately supported (Management of septic shock)?

2. Empiric Antibiotic Coverage

3. Non-surgical versus Surgical Options

Group 1: intraventricular antibiotics with shunt left in place.

Group 2: shunt removal and immediate replacement combined with systemic and/or intraventricular antibiotics

Group 3: shunt removal with external ventricular drainage (EVE)) with systemic antibiotics and intraventricular antibiotics through the EVD system (Group 3}.

Shunt Infection

A retrospective study comparing these methods found that infection was successfully treated in 36% of Group 1 patients, 84% of Group 2 patients and 94% of Group 3 patients.

Mortality rate of 53% in patients treated with medical therapy alone, as opposed to 17% in patients who had surgical removal of their shunts in addition to antibiotics

VP Shunt Tap

Risks:

Infection, creation of proximal obstruction by drawing debris or choroid into the shunt lumen, CSF leak, Ventricular collapse or SDH if too much CSF is removed

Indications:

1. suspicion of infection
2. symptomatic hydrocephalus to assess for proximal obstruction

Sensitivity:

In a retrospective/prospective pediatric series the etiological agent was recovered in 23 of 25 taps performed prior to or within 24 hours of the institution of appropriate antimicrobial therapy

VP Shunt Tap Procedure

1. Position prone. Restrain as needed.

2. Shave the scalp overlying and surrounding the device, prep, and drape.

3. Anesthetize scalp at puncture site.

4. Nick the scalp with a 18-gauge needle.

5. Puncture the reservoir with a short 25-gauge butterfly or spinal needle.

6. Angle of puncture depends on the type of reservoir: a shallow angle is necessary (<25 °) with the Pudenz, MultiPurpose, or similar device to avoid damaging the pump diaphragm or reservoir base; Rickham-type reservoirs may necessitate a steeper angle to avoid striking the metal cup; the Hakim reservoir may be penetrated at almost any angle.

7. When fluid appears, attach CSF manometer and record pressure.

8. Passively withdraw 4 to 5 mL CSF **Do not aspirate**.

9. Send CSF for appropriate laboratory studies.

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