Fluid and Electrolytes in Pediatric Patients Before and After Surgery

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Example-1

- 10 y/o boy; 30 Kg
- Abdominal pain for 1 day (at the right lower quadrant)
- TPR = 36.5°C/80/20; 110/60 mmHg
- Tenderness at right lower quadrant
- WBC 11,000 (S74/L15/); CRP 11 mg/l
- BUN13/creatinine0.9; Na137; K3.8
- Echo: fixed tubular lesion, about 1.2 cm in diameter, at the right lower quadrant; compatible with the appendix

Diagnosis

1. Acute appendicitis without perforation

Example-2

- 10 y/o boy; 30 Kg
- Abdominal pain for 3-4 days (initially at the right lower quadrant; then became diffuse abdominal pain)
- TPR = 39.5°C/150/35; 90/60 mmHg
- Lip dry, tired looking
- Diffuse muscle guarding, especially at right lower quadrant
- WBC 23,000 (S88/L5/B5); CRP 230 mg/l
- BUN33/creatinine0.9; Na125; K3.3
- Echo: dilated bowel loops with much turbid ascites

Diagnosis

1. Acute appendicitis with perforation
2. Sepsis
3. Dehydration
4. Electrolyte imbalance

Step 1: how much water

- IVF = Basic maintenance + Loss + Deficit
- Basic maintenance : 100-50-20 rule
- Loss : present and future
- Deficit : past
- Understanding the basic cardiac, pulmonary and renal condition

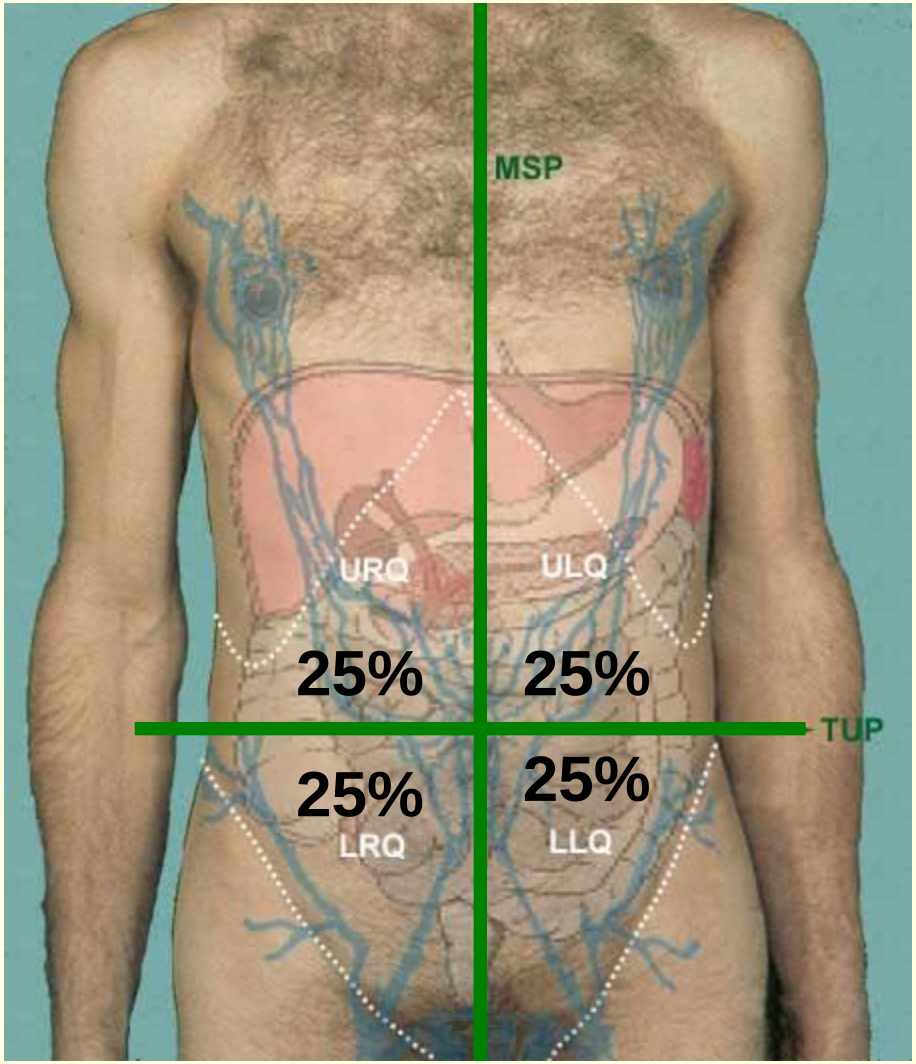
Step 1: how much water

- Basic maintenance : 100-50-20 rule
  - First 10Kg: 100cc/Kg
  - 2nd 10Kg: 50cc/Kg
  - After 3rd 10Kg: 20cc/kg
- The basic requirement for a 30 Kg patient = $100 \times 10 + 50 \times 10 + 20 \times 10 = 1{,}700$ cc/day

Step 1: how much water

- Loss : present and future
  - Third space
  - Drain
  - Estimated by I/O record and rule of the quadrant

Rule of the quadrant



- Easy calculation of the third space fluid in the abdomen
- The IVF should increase 25% for each quadrant involved

Step 1: how much water

- 30 Kg third space
  - Basic = 1,700 cc
  - Each quadrant is about 25% of the 1,700 cc
  - If the third space involved one quadrant, the IVF needed = 1,700 x 1.25 (125%)
  - If the third space involved two quadrants, the IVF needed = 1,700 x 1.5 (150%)
  - If the third space involved the whole abdomen, the IVF needed = 1,700 x 2.0 (200%)
  - If you apply high volume IVF, always monitor the *urine output* as a guide

IVF – step 2: how much salt

- The need of the salt:
  - Na: 2-4 mEq/Kg/day (young infant)
  - Na: 1 mEq/Kg/day (adult)
  - Average: 1-2 mEq/Kg/day (for all patients)
- Understanding the renal condition

IVF – step 3: understanding the IVF

- The simplest IVF
  - Normal saline (N/S) = 0.9% NaCl
  - 5% glucose water = 5% G/W
  - The most important content of the IVF: glucose, Na, Cl (K, Ca)
- Serum Na: 135 ~ 145 mEq/L
- Serum K: 3.5 ~ 4.5 mEq/L
- Serum Cl: 105-115 mEq/L

IVF – step 3: understanding the IVF

- Concentratin of Na (Cl) in different saline
  - 0.9% NaCl = 153.8 mEq/L (how to calculate)
  - 0.45% NaCl = 77 mEq/L
  - 0.225% NaCL = 38.5 mEq/L
- Lactate Ringer ?
- TPN ?
- Always understand the IVF content before prescription

IVF – step 3: understanding the IVF

- A 30 Kg patient needs 1,700cc/day = 1.7L/day
- A 30 Kg patients needs 30×(1~2 mEq Na/day) = 30~60 mEq Na/day
- The ideal IVF contains 30 ~ 60 mEq Na/1.7 L = 18 ~ 35 mEq/L (D5 0.225S is the ideal IVF)
- What if a 10 Kg patient?
- What if a 60 Kg adult patient?

IVF – step 4: adjusting the IVF

- What is the electrolyte content of the third space fluid?
  - Serum
  - Gastric juice
  - Intestinal content
  - Colon
  - Ascites
  - Pleural effusion
- What is the ideal IVF to replace the third space fluid?

IVF – step 4: adjusting the IVF

- The salt concentration of the third space fluid was close to the serum.
- In patient with significant third space shifting, the salt content of the IVF should increase.
- D50.225S ➔ D2.50.45S ➔ D5S
- The electrolyte data should be followed up to keep a stable and normal serum electrolyte level.

IVF – step 4: adjusting the IVF

- Deficit : past
  - Dehydration before admission
  - Estimated by vital signs (BW loss, heart rate, PE findings)
  - Fever: 10% of basic requirement if BT> 2℃

Estimation of the dehydration

% Weight loss	H2O cc/kg	Na mEq/kg	Cl mEq/kg	K mEq/kg
5	50	4	3	3
10	100	8	6	6
15	150	12	9	9

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IVF needed

- Basic requirement = 1700 cc/day
- Loss: minimal (or 25% third space)
- Deficit: minimal
- D5 0.225S (+ KCl 5 mEq) run 560cc/q8h

Example-2

- 10 y/o boy; 30 Kg
- Abdominal pain for 3-4 days (initially at the right lower quadrant; then became diffuse abdominal pain)
- TPR = 39.5°C/150/35; 90/60 mmHg
- Lip dry, tired looking
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IVF needed

- Basic requirement = 1700 cc/day
- Loss: 50 ~ 100% third space loss
- Deficit: hard to estimate
- D2.5 0.225S + KCl 5 mEq run 850 cc/q8h or
- D2.5 0.225S + KCl 5 mEq run 1100 cc/q8h x 8 hours; then tapered to 850cc/q8h if adequate urine output (>2 cc/Kg/hr)
- Replace drain loss (NG, penrose drain, J-P drain…) by lactate Ringer q8h

Conclusion

The fluid and electrolyte changes in patients is under a ***dynamic*** status. Always think about what is the best for the HOMEOSTASIS for your patients.