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Fluids in General Surgery

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Introduction:

Daily Water balance:

Water is essential for survival, the daily intake and loss is altered according to individual and environmental factors, in general the daily water balance is 2 – 3 L intake and 2 – 3 L output (see tables):

Intake	
Water From Beverage	1200 ml
Water From Solid Food	1000 ml
Water From Oxidation	300 ml

Out put	
Urine	1500 ml
Insensible; water loss from skin and lungs	900 ml
Faeces	100 ml

Water intake

Two sources for intake:

(1) Exogenous.
(2) Endogenous.

Exogenous Water: either drunk or ingested in solid food (2 – 3 L/24h). Nearly half is contained in solid food.
The water Requirements of Infants and children are relatively greater, than those of adult because:

- The large Surface area per unit body weight.
- The greater Metabolic Activity due to growth.
- The poor concentration ability of the immature kidneys in neonates.

Endogenous water: is released during the oxidation of ingested food and the

amount is less than 500 ml/24h. During starvation this amount is supplemented by water released from the break down of body tissue.

Water Output:

Water is lost from all the body by 4 routes:

1- By The Lungs:

about 400 ml of water is lost in expired air /24h in a dry atmosphere and when the respiratory rate is increased, the loss is correspondingly greater.

2- By The skin:

when the body becomes over heated there is visible perspiration. But through life invisible perspiration is always proceeding. The cutanous loss of fluid depend on:

(I) Temp. & Humidity
(II) Muscular Activity
(III) body Temp.

The average losses in a temperature climate is between 600 – 1000 ml / 24h.

3- Faeces:

between 60 – 150 ml / 24h in diarrhea this amount is multiplied not only by the number of stool but according to their fluiding and size.

4- Urine:

The output of the urine is under control by the secretion of the posterior lobe of the pituitary gland (ADH) which controls the tonicity of body fluid, a function that is performed by stimulating the reabsorption of water from the renal tubules, thus varying the amount excreted after the requirement of the first three route have been met.

The normal urinary output is 1500 ml/24 l and provided the kidneys are healthy the specific gravity of the urine bears a direct relation ship to the volume.

A minimum urinary output of 400 ml/ 24 h is required to excrete the end product of protein metabolism

Disorders of water Balance (Imbalance):

Water Depletion:

Causes:

Pure water depletion is usually due to:

1- diminished intake: this may be due to difficulty or inability to swallow because:

(i) Painful condition of the mouth and pharynx.
(ii) Obstruction in the Oesophagus.
(iii) Exhaustion and paresis of the pharyngeal muscle.

2- Loss From the lungs after tracheotomy → 600 ml → so humidification of the inspired air is an important preventive measure.

Clinical Features:

- Weakness and intense thirst (main symptoms)
- Diminished urinary output and increased specific gravity.
- Increased serum osmotic pressure → water leave the cells Intracellular dehydration) → prevent the peripheral circulation failure.

Investigations:

Show an elevated Haematocrit rate, Serum sodium and urea.

Treatment:

1- Increasing the intake initially:

- If swallowing is possible, the nursing staff must ensure a regular half hourly or hourly intake.

- If the swallowing is impossible, give intravenous 5% dextrose or dextrose saline. (water is not isotonic and would haemolyse blood).

2- Careful charting of intake and output.
3- A diuresis signal that must be taken not to overload and cause water intoxication.

Relative Water Depletion:

Is seen following excessive loss of water, by the kidneys in:

- Diabetes insipidus.
- Following head injury
- The Diuretic phase following acute renal faliure.
- Too rapid relief of lower urinary tract obstruction.
- Following renal transplantation.

Management:

- 0.45% Saline.
- Frequent estimation of the serum and urinary Na+

Water Intoxication:

Causes:

- Excessive amount of 5% dextrose or hypotonic solutions are given orally, intravenously, subcutaneously or rectally.
- Colorectal washout with plain water or sodium free solution in patients with Hirscsprung's disease, also when we use water in state of saline during total bowel wash through, prior to colonic surgery
- Excessive uptake of water from irrigation during transurethral resection of the prostate.
- Lung conditions → lobar pneumonia → and empyema.
- ADH-Secreting Tumor, such as Oat-cell carcinoma of the bronchus.

Clinical Features:

- Drowsiness, weakness, some times convulsions and coma.
- The patient appear to be in shock, which is uncorrected because the BP is not low, the pulse is not unduly rapid until the patient is moribund.
- Nausea and vomiting of clear fluid are common.
- The patient usually passes a considerable amount of dilute urine.

Investigations:

- Show low haematocrit and high MCV, serum Na+ and electrolytes may be low, with normal or low urea.

Management:

- Stop water intake.
- If after several days the water-logged patient is still in stupor , then infuse very slowly not more than 200ml of hypertonic saline (5.85%) I.V. → improvement occurs and diuresis begins, the infusion should be stopped, otherwise the circulatory failure from overloading or cardiac arrest is liable to ensue.

Water Loss Assessment:

A- Insensible Fluid loss:

- Hyperventilation increase water loss via the respiratory tract and it depends on humidification of the air.
- Pyrexia increase water loss from the skin by approximately 200ml/day, for each 10C rise in temperature.
- Sweating increase fluid loss considerably by up 2 1L/hour, difficult to quantify (the sweat contain Na+ 20 – 70 mmol/l K+ 10 mmol/l).

B- Effect Of Surgery:

1- The stress Response:

- ADH release conserves water and typically reduces urine volume to 1000 – 1500 ml for 2 – 3 days following major surgery.
- So water administration leads to water excess.
- Aldosterone secretion will conserve Na+ and further contributes to oliguria 30 mmol/ 24h.
- K+ secretion is increased to 120 mmol/day, that's why hypokalemia is the commonest

2- Third-space losses:

- Sequestration of ECF at the site of operation, produces local edema, this fluid contain water, electrolytes and colloid particles.
- As a result third space losses can significantly reduce the circulating volume in the immediate postoperative period.
- The sequestration persists for approx. 48 hours, and may involve up to 4 L of fluids.

Losses from the GIT:

- Vomiting
- Intestinal Obstruction (greater loss from high obstruction).
- Paralytic illeus (increased intestinal secretion with reduced absorption.)
- Intestinal Fistula (high Fistula cause the greatest losses)
- Diarrhea.

Routine Post-Operative Fluid:

The patient requires:

- 2000 – 3000 ml of water/day
- At least 100 mmol of Na+ per day
- About 60 mmol of K+ per day

These requirements are altered by the metabolic response to trauma.

1- During the first 24 hours after surgery:

There is increased secretion of ADH and aldosterone:

- No salt is needed.
- Less water than normal → 2 liters of 5% dextrose is sufficient I.V.

2- During the second 24 hours after surgery:

The metabolic response in trauma diminishes, and the patient need:

- 2 liters of 5% dextrose.
- 1 liter of isotonic saline /day.

3- On the third post-operative day and then after:

- K+ 20 mmol is added to each liter (60 mmol k+/day)

Complications of fluid therapy:

These include pulmonary and tissue edema, the risk of fluid over-load is increased in elderly and those with:

- Heart failure.
- Pulmonary congestion.

Clinical guide for Fluid requirements:

In practice, the measurement of lost fluid is impossible, but this can be estimated by clinical assessment of the patient. Measuring urine output, Central venous pressure and the vital signs can provide a rough guideline for replacement (*giving that the patient has normal renal function.*)