KEBUTUHAN CAIRAN DAN ELEKTROLIT PADA ANAK

DR. NIA NURUL AZIZA SPA

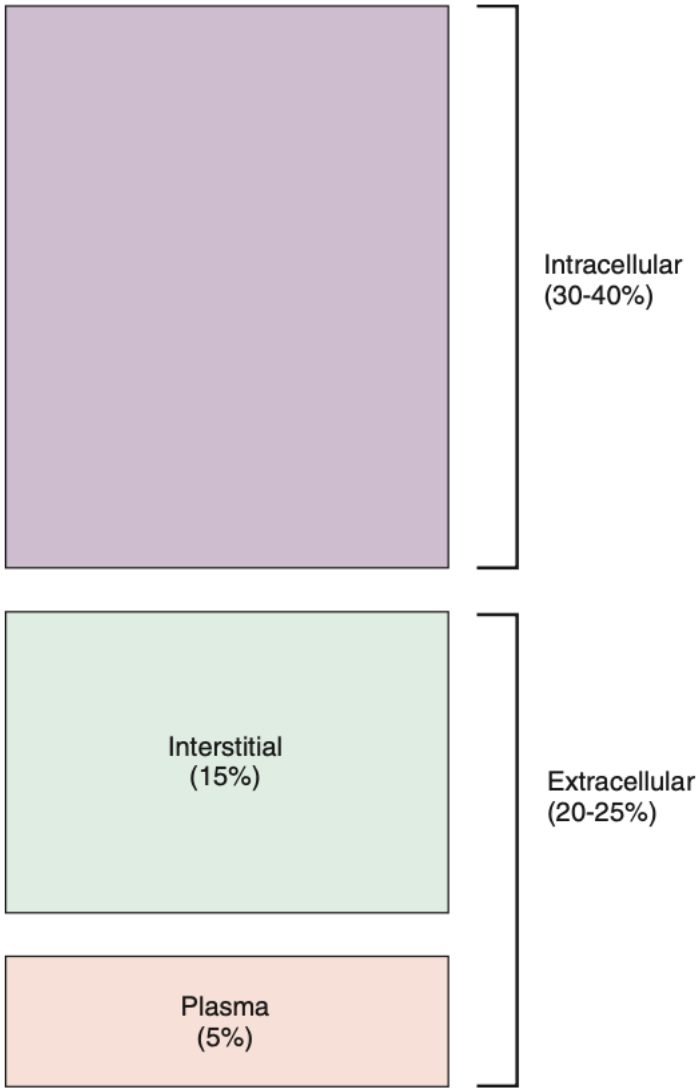

FIGURE 32.1 Compartments of total body water, expressed as percentage of body weight, in an older child or adult. (From Greenbaum LA. Pathophysiology of body fluids and fluid therapy. In Kliegman RM, St Geme JW, eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia: Elsevier, 2020:390.)

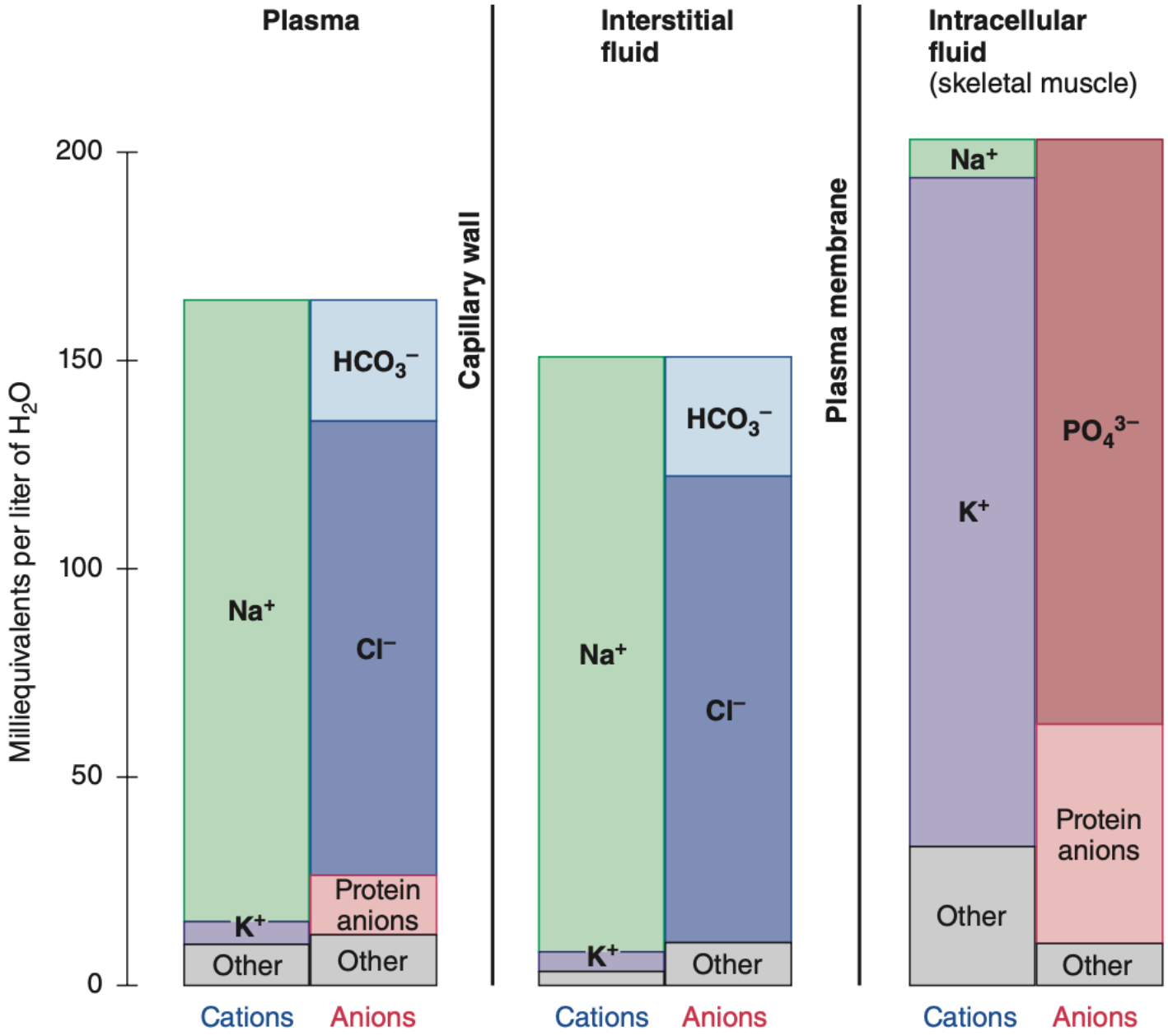

Figure 15-2 Ionic composition of the major body-fluid compartments.

TABLE 32.1 Body Weight Method for Calculating Maintenance Fluid Volume and Rate

BODY WEIGHT (kg)	VOLUME PER DAY	HOURLY RATE
0–10	100 mL/kg	4 mL/kg/hr
11–20	1,000 mL + 50 mL/kg for each 1 kg >10 kg	40 mL/hr + 2 mL/kg/hr × (wt–10)
>20	1,500 mL + 20 mL/kg for each 1 kg >20 kg*	60 mL/hr + 1 mL/kg/hr × (wt–20)†

The maximum total fluid per day is normally 2,400 mL.
†*The maximum fluid rate is normally 100 mL/hr.*

TABLE 33.1	Components of Maintenance Water
Urine	60%
Insensible losses (skin and lungs)	35%
Stool	5%

TABLE 33.2	Adjustments in Maintenance Water	
SOURCE	**CAUSES OF INCREASED WATER NEEDS**	**CAUSES OF DECREASED WATER NEEDS**
Skin	Radiant warmer Phototherapy Fever Sweat Burns Extensive exfoliative dermatitis*	Incubator (premature infants)
Lungs	Tachypnea Tracheostomy	Humidified ventilator
Gastrointestinal	Diarrhea Emesis Nasogastric suction	
Renal	Polyuria	Oliguria/anuria
Miscellaneous	Surgical drain Third space losses	Hypothyroidism

Epidermolysis bullosa, toxic epidermal necrolysis.

TABLE 33.5 Assessment of Degree of Dehydration

	MILD	MODERATE	SEVERE
Infant	5%	10%	15%
Adolescent	3%	6%	9%
Infants and young children	Thirsty, alert; restless	Thirsty; restless or lethargic; irritable	Drowsy; limp, cold, sweaty, cyanotic extremities; may be comatose
Older children	Thirsty, alert	Thirsty, alert (usually)	Usually conscious (but at reduced level), apprehensive; cold, sweaty, cyanotic extremities; wrinkled skin on fingers and toes; muscle cramps
SIGNS AND SYMPTOMS			
Tachycardia	Absent	Present	Present
Palpable pulses	Present	Present (weak)	Decreased
Blood pressure	Normal	Orthostatic hypotension	Hypotension
Cutaneous perfusion	Normal	Normal	Reduced and mottled
Skin turgor	Normal	Slight reduction	Reduced
Fontanelle	Normal	Slightly depressed	Sunken
Mucous membrane	Moist	Dry	Very dry
Tears	Present	Present or absent	Absent
Respirations	Normal	Deep, may be rapid	Deep and rapid
Urine output	Normal	Oliguria	Anuria and severe oliguria

Data from World Health Organization.

TABLE 33.6 Fluid Management of Dehydration

Restore intravascular volume
Normal saline: 20 mL/kg over 20 min
Repeat as needed
Rapid volume repletion: 20 mL/kg normal saline (maximum = 1 L) over 2 hr
Calculate 24-hr fluid needs: maintenance + deficit volume
Subtract isotonic fluid already administered from 24-hr fluid needs
Administer remaining volume over 24 hr using D5 normal saline + 20 mEq/L KCl
Replace ongoing losses as they occur

TABLE 33.4 Adjusting Fluid Therapy for Altered Renal Output

OLIGURIA/ANURIA	POLYURIA
Place the patient on insensible fluids (~1/3 maintenance)	Place the patient on insensible fluids (~1/3 maintenance)
Replace urine output mL/mL with half normal saline	Measure urine electrolytes
	Replace urine output mL/mL with a solution that is based on the measured urine electrolytes

TABLE 33.3 Adjusting Fluid Therapy for Gastrointestinal Losses

AVERAGE COMPOSITION	APPROACH TO REPLACEMENT
DIARRHEA	REPLACEMENT OF ONGOING STOOL LOSSES
Sodium: 55 mEq/L	Solution: 5% dextrose in ¼ normal saline + 20 mEq/L sodium bicarbonate + 20 mEq/L potassium chloride Replace stool mL/mL every 1–6 hr
Potassium: 25 mEq/L	
Bicarbonate: 15 mEq/L	
GASTRIC FLUID	REPLACEMENT OF ONGOING GASTRIC LOSSES
Sodium: 60 mEq/L	Solution: normal saline + 10 mEq/L potassium chloride Replace output mL/mL every 1–6 hr
Potassium: 10 mEq/L	
Chloride: 90 mEq/L	

TABLE 33.7	Monitoring Therapy
Vital signs	
Pulse	
Blood pressure	
Intake and output	
Fluid balance	
Urine output and specific gravity	
Physical examination	
Weight	
Clinical signs of fluid volume depletion or overload	
Electrolytes	

A4.1. Choice of intravenous fluids

The risk for hyponatraemia may be increased with use of solutions containing very low sodium in paediatric patients, in comparison with fluids with a sodium content of 75–150 mmol/litre. Solutions containing low sodium, such as 0.18% sodium chloride with 4% glucose, or 5% glucose in water, should not be used for rehydration or fluid maintenance. Appropriate sodium-containing IV maintenance fluids should contain glucose to avoid hypoglycaemia and starvation ketosis in children who are unable to feed orally or by nasogastric tube.

- **Resuscitation:** Children who are severely dehydrated or with signs of shock should be resuscitated with isotonic IV solutions (normal saline 0.9% or Ringer's lactate).
- **Intravenous maintenance fluid:** Children who require IV fluids for maintenance should be managed with Ringer's lactate solution with 5% dextrose or 0.9% normal saline with 5% glucose or half-normal saline (0.45% sodium chloride) with 5% glucose.

KA-EN 3A® AND KA-EN 3B®

Dextrose, Sodium Chloride, Potassium Chloride and Sodium Lactate

KA-EN 3A® and KA-EN 3B® are generally recommended for the supply or replenishment of water and electrolytes which are needed for daily maintenance. The composition is based on the average required amounts of water and electrolytes in normal humans.
These solutions are generally recommended for use post surgery in which patients have difficulties in the oral intake of water and electrolytes, and for hypertonic dehydration with hypokalaemia.
KA-EN 3A® is recommended for use in infants because its lower content of K^+, and KA-EN 3B® in adults as a maintenance solution.

COMPOSITION

The solutions contains the following ingredients.		
Product name	KA-EN 3A®	KA-EN 3B®
Composition	Each 500 mL	Each 500 mL
Dextrose Monohydrate (Equivalent to Anhydrous Dextrose)	14.850 g (13.500 g)	14.850 g (13.500 g)
Sodium chloride	1.170 g	0.875 g
Potassium chloride	0.375 g	0.750 g
Sodium lactate	1.120 g	1.120 g
Water for injection	ad 500 mL	ad 500 mL

	Electrolytes mEq/L				Glucose	kcal/L
	Na^+	K^+	Cl^-	Lactate$^-$	(g/L)	
KA-EN 3A®	60	10	50	20	27	108
KA-EN 3B®	50	20	50	20	27	108

INDICATION
KA-EN 3A® and KA-EN 3B® are indicated for supply or maintenance of water and electrolytes in the case of impossible or insufficient oral intake.

DOSAGE AND ADMINISTRATION
KA-EN 3A®: 50 - 100 mL per hour for children/infant.
The dosage should be adjusted according to the patient's condition, age and body weight.
KA-EN 3B®: The usual adult dosage is 500 - 1000 mL at one time by intravenous drip infusion. The Infusion rate should be 300 - 500 mL per hour (about 80 - 130 drops/minute) for adults, and 50 - 100 mL per hour for children. The dosage should be adjusted according to the patient's condition, age and body weight.

PRECAUTIONS
1. The use of this solution should be carefully supervised in the following cases:
   - Congestive heart failure
   - Renal failure
   - Perifer and pulmonary oedema
   - Pre eclampsia
   - Hypertension
   - Early post-traumatic state
   - Severe sepsis
   - Acidosis
   - Reduced urinary output due to obstructive urinary tract disease
   - Diabetes mellitus
2. Potassium supplements are particularly dangerous in patients who are also receiving potassium sparing diuretic.
3. The infusions should not be mixed with whole blood; haemolysis and clumping has occurred.
4. The electrocardiogram and serum potassium concentration should be monitored frequently and adequate urinary output must be assured.

Especially for KA-EN 3B®:

5. The safety of this solution during pregnancy and lactation has not been assessed, but its use during these periods is not considered to constitute hazard.

PRECAUTION IN USE
During the infusion of the solution, the desirable amount of urea is at least 500 mL per day or 20 mL per hour.

ADVERSE REACTIONS
- Alkalosis
- Cerebral, pulmonary and peripheral edema, water intoxication and hyperkalemia may occur with a large volume and/or over infusion.
- Thrombophlebitis
- Thrombosis of vein chosen.

CONTRA INDICATION
- Lactiacidemia
- Hyperkalemia, oliguria, Addison's disease, severe burn, and azotemia
- Patient's with sodium overload, glucose-galactose malabsorption syndrome, severe hepatic injury, cardiac arrythmic.

DRUG INTERACTION
Since the solution develops precipitates with calcium ion, concomitant use and mixing of solution with calcium preparations should be avoided.

DESCRIPTION
KA-EN 3A® and KA-EN 3B® are clear, colorless or pale yellow liquid.

	pH	Specific gravity (20°C)	Osmolarity
	Average immediately After manufacture		
KA-EN 3A®	About 5.6	1.014	approx. 290 mOsm/L
KA-EN 3B®	About 5.6	1.014	approx. 290 mOsm/L

STORAGE
Store below 30°C

HOW TO SUPPLIED
Plastic bottles 500 mL
Soft bag 500 mL

REG. NO.:	Plastic bottle	Soft bag
KA-EN 3A® :	DKL9218703049A1	DKL9218703049A2
KA-EN 3B® :	DKL9218703149A1	DKL9218703149A2

Do not use if bottle / bag is leaking, solution cloudy and contains foreign matters

ON MEDICAL PRESCRIPTION ONLY
HARUS DENGAN RESEP DOKTER

Otsuka
Manufactured by:
PT. Otsuka Indonesia
Jl. Sumber Waras No. 25,
Lawang, Malang 65216, Indonesia

CILBSPKN37

IV fluid	Composition						
	Na+	K+	Cl−	Ca++	Lactate	Glucose	Calories
	mmol/l	mmol/l	mmol/l	mmol/l	mmol/l	g/l	cal/l
Ringer's lactate (Hartmann's)	130	5.4	112	1.8	27	–	–
Normal saline (0.9% NaCl)	154	–	154	–	–	–	–
10% glucose	–	–	–	–	–	100	400
0.45 NaCl/5% glucose	77	–	77	–	–	50	200
Darrow's solution	121	35	103	–	53	–	–
Half-strength Darrow with 5% glucose[a]	61	17	52	–	27	50	200
Half-strength Ringer's lactate with 5% glucose	65	2.7	56	1	14	50	200
0.18% NaCl/4% glucose[b]	31	–	31	–	–	40	160
5% glucose[b]	–	–	–	–	–	50	200

a Half-strength Darrow's solution often comes without glucose, and glucose must be added before use.

b These fluids can be used mainly in the first few days of life but not in other infants or children.

Chart 8. How to give intravenous fluids to a child in shock with severe malnutrition

Give this treatment only if the child has signs of shock (usually there will also be a *reduced level of consciousness, i.e. lethargy or loss of consciousness)*:

- Insert an IV line (and draw blood for emergency laboratory investigations).
- Weigh the child (or estimate the weight) to calculate the volume of fluid to be given.
- Give IV fluid at 15 ml/kg over 1 h. Use one of the following solutions according to availability:
  - Ringer's lactate with 5% glucose (dextrose);
  - Half-strength Darrow's solution with 5% glucose (dextrose);
  - 0.45% NaCl plus 5% glucose (dextrose).

Weight	Volume of IV fluid Give over 1 h (15 ml/kg)	Weight	Volume of IV fluid Give over 1 h (15 ml/kg)
4 kg	60 ml	12 kg	180 ml
6 kg	90 ml	14 kg	210 ml
8 kg	120 ml	16 kg	240 ml
10 kg	150 ml	18 kg	270 ml

- Measure the pulse rate and volume and breathing rate at the start and every 5–10 min.

If there are signs of improvement (pulse rate falls, pulse volume increases or respiratory rate falls) and no evidence of pulmonary oedema

- repeat IV infusion at 15 ml/kg over 1 h; then
- switch to oral or nasogastric rehydration with ReSoMal at 10 ml/kg per h up to 10 h (see p. 204);
- initiate re-feeding with starter F-75 (see p. 209).

If the child fails to improve after two IV boluses of 15 ml/kg,

- give maintenance IV fluid (4 ml/kg per h) while waiting for blood;
- when blood is available, transfuse fresh whole blood at 10 ml/kg slowly over 3 h (use packed cells if the child is in cardiac failure); then
- initiate re-feeding with starter F-75 (see p. 209);
- start IV antibiotic treatment (see p. 207).

If the child deteriorates during IV rehydration (breathing rate increases by 5/min and pulse rate increases by 15/min, liver enlarges, fine crackles throughout lung fields, jugular venous pressure increases, galloping heart rhythm develops), stop the infusion, because IV fluid can worsen the child's condition by inducing pulmonary oedema.