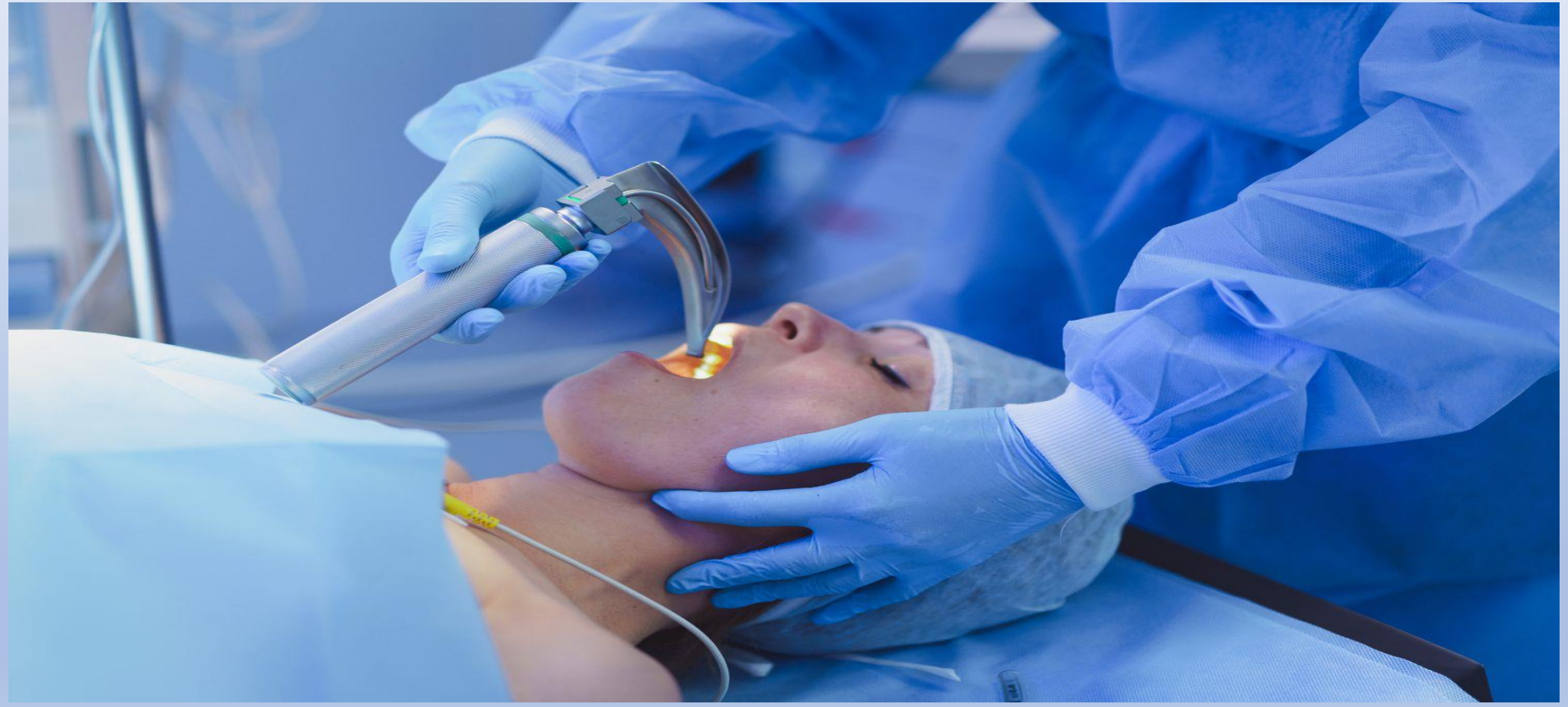
Beyond return of spontaneous circulation: update on post-cardiac arrest management in the intensive care unit


AED
Resuscitation
Care after resuscitation
Rehabilitation

❑ A – AIRWAY



- if there is any doubt about the ability to protect airway such as a depressed conscious level, tracheal intubation and mechanical ventilation should be instituted.

- It is reasonable to consider using a tracheal tube with subglottic secretion drainage to reduce ventilator-associated pneumonia

❑B – BREATHING

❖Oxygenation

- The recommendation, therefore, is to target blood oxygen saturation (SpO2) of 94%–98%.

- avoid using a high level of positive end expiratory pressure (PEEP; e.g. > 10 cmH2O).

❖Ventilation

- Hypocapnia causes cerebral vasoconstriction and reduces cerebral blood flow, contributing to poorer neurological outcomes.

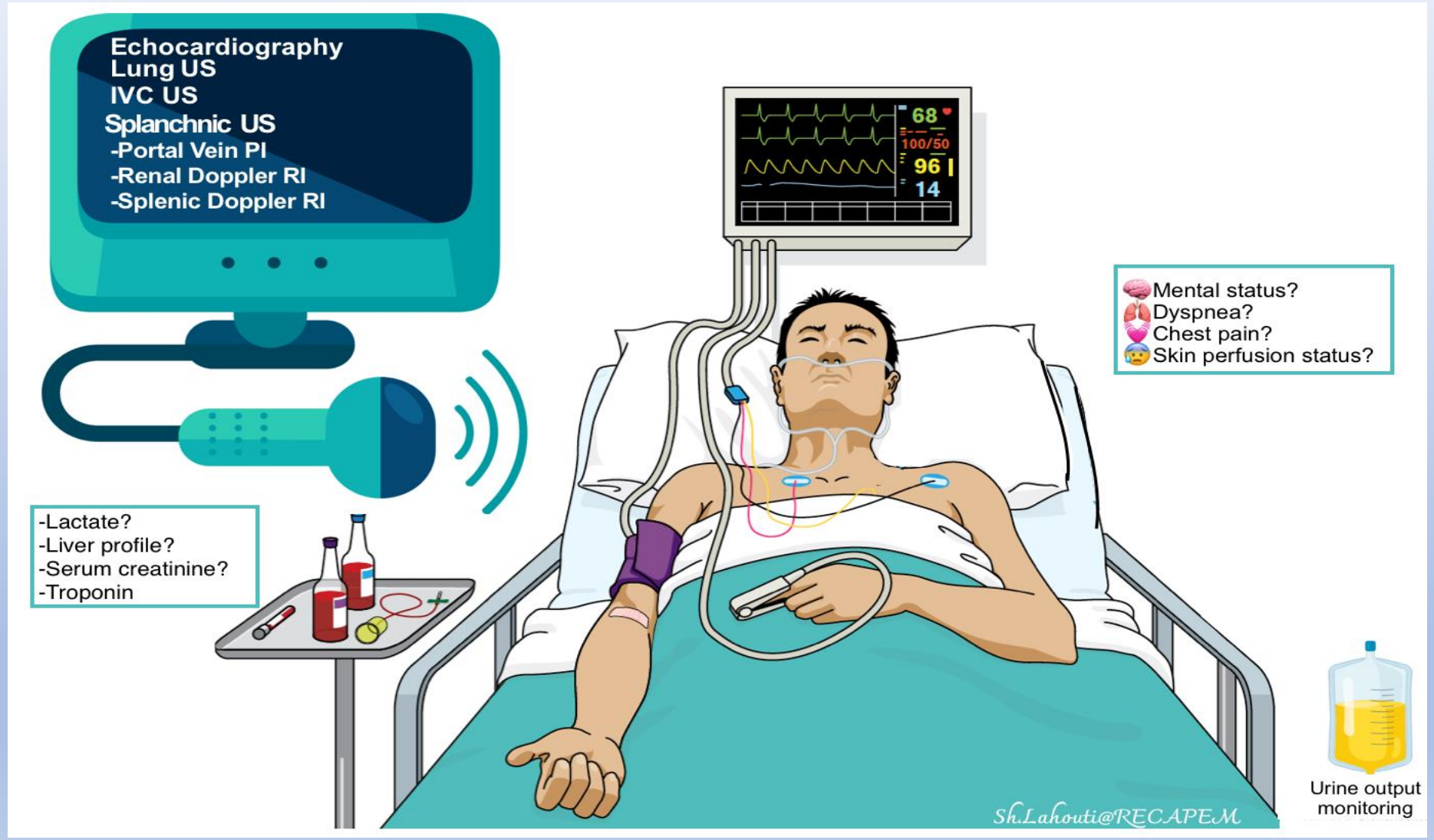
- **Target PaCO2 35–45 mmHg.**

- It may be reasonable to consider targeted therapeutic mild hypercapnia, i.e. PaCO2 50–55 mmHg, if there is evidence of low cerebral oxygenation and no contraindications to mild hypercapnia such as raised ICP or severe metabolic acidosis.

- The use of end tidal carbon dioxide (ETCO2) for continuous monitoring is invaluable and the PaCO2-PETCO2 gradient should be determined daily.

- Both hypothermia and the use of neuromuscular blocking agents can reduce CO2 production and increase the risk of hypocapnia.

➢Haemodynamic monitoring



- Treatment should be guided by blood pressure (BP), cardiac output, central venous oxygen saturation (ScvO2), urine output and lactate clearance.

- An arterial cannula should be inserted for continuous BP monitoring.

- Serial focused ultrasonography for fluid responsiveness and echo-Doppler techniques to monitor stroke volume may also be performed.

❖Haemodynamic targets

- The recommended MAP target is at least 65 mmHg, and a higher MAP target (e.g. 80–85 mmHg) may be reasonable if the patient has chronic hypertension, or evidence of raised ICP or end-organ hypoperfusion.

❖Bradycardia

- Bradycardia is common during induced mild hypothermia.

- no need to intervene if the patient develops sinus bradycardia with a heart rate of 30–40/min, if the BP, ScvO2 and lactate clearance are adequate.

❖Haemodynamic support

- Post-resuscitation myocardial dysfunction causes haemodynamic instability, manifesting as hypotension, low cardiac output and arrhythmias.

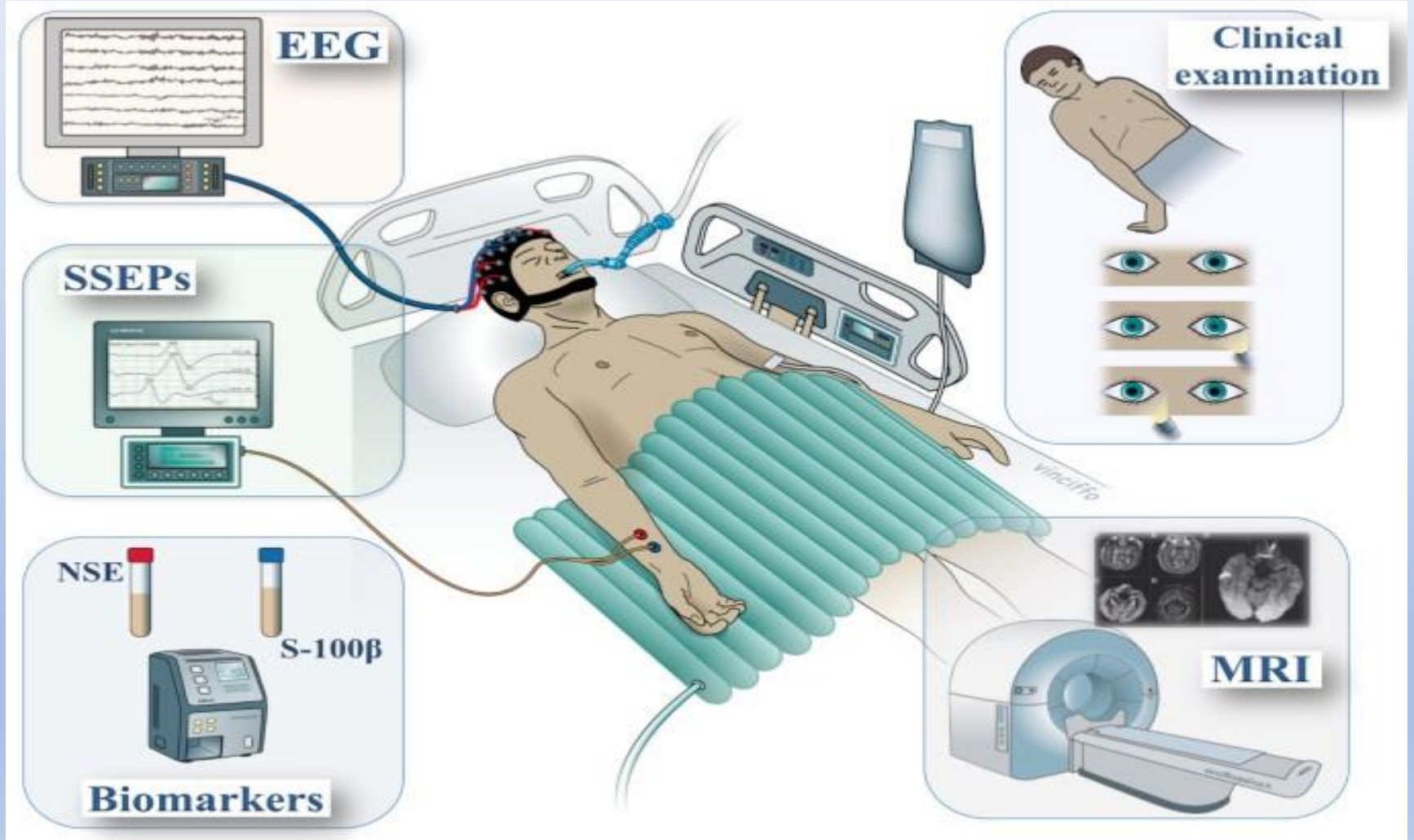
- Myocardial dysfunction often requires inotropic support, with dobutamine having the most evidence for use.

- If vasoplegia predominates, it is recommended to start noradrenaline first to achieve haemodynamic targets and also because it is less arrhythmogenic.

- However, if up-titration of noradrenaline reduces stroke volume or ScvO2 (suggesting an excessive increase in left ventricular afterload causing a drop in cardiac output), it may be useful to add on a low-dose inotrope (e.g. dobutamine 3–5 mcg/kg/min).

- Noradrenaline, with or without an inotrope, is usually the most effective therapeutic regime.

❖D – DISABILITY (NEUROLOGY)



- in the presence of symptoms or signs suggestive of a neurological cause (headache, seizures, focal neurological deficits) for the cardiac arrest, computed tomography (CT) of the head should be considered.

- In approximately one-third of patients who remain comatose after ROSC. Therefore, patients should be on continuous electroencephalography (cEEG) monitoring.

- In addition, cerebral blood flow and cerebral tissue oxygenation may be indirectly monitored using nearinfrared to measure cerebral regional oxygen saturation (rSO2).

❖Sedation

- Adequate sedation reduces oxygen consumption and improves the balance between oxygen supply and demand.

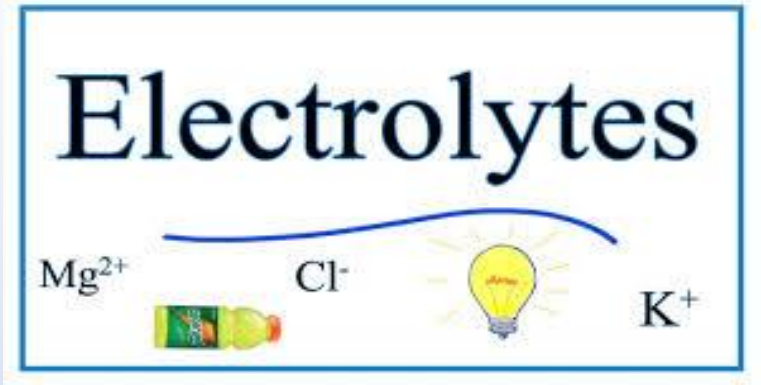
- it is recommended to use short-acting drugs (e.g. remifentanil and propofol).

❖Seizures

- Myoclonus is the most common seizure and occurs in 18%–25% of patients.

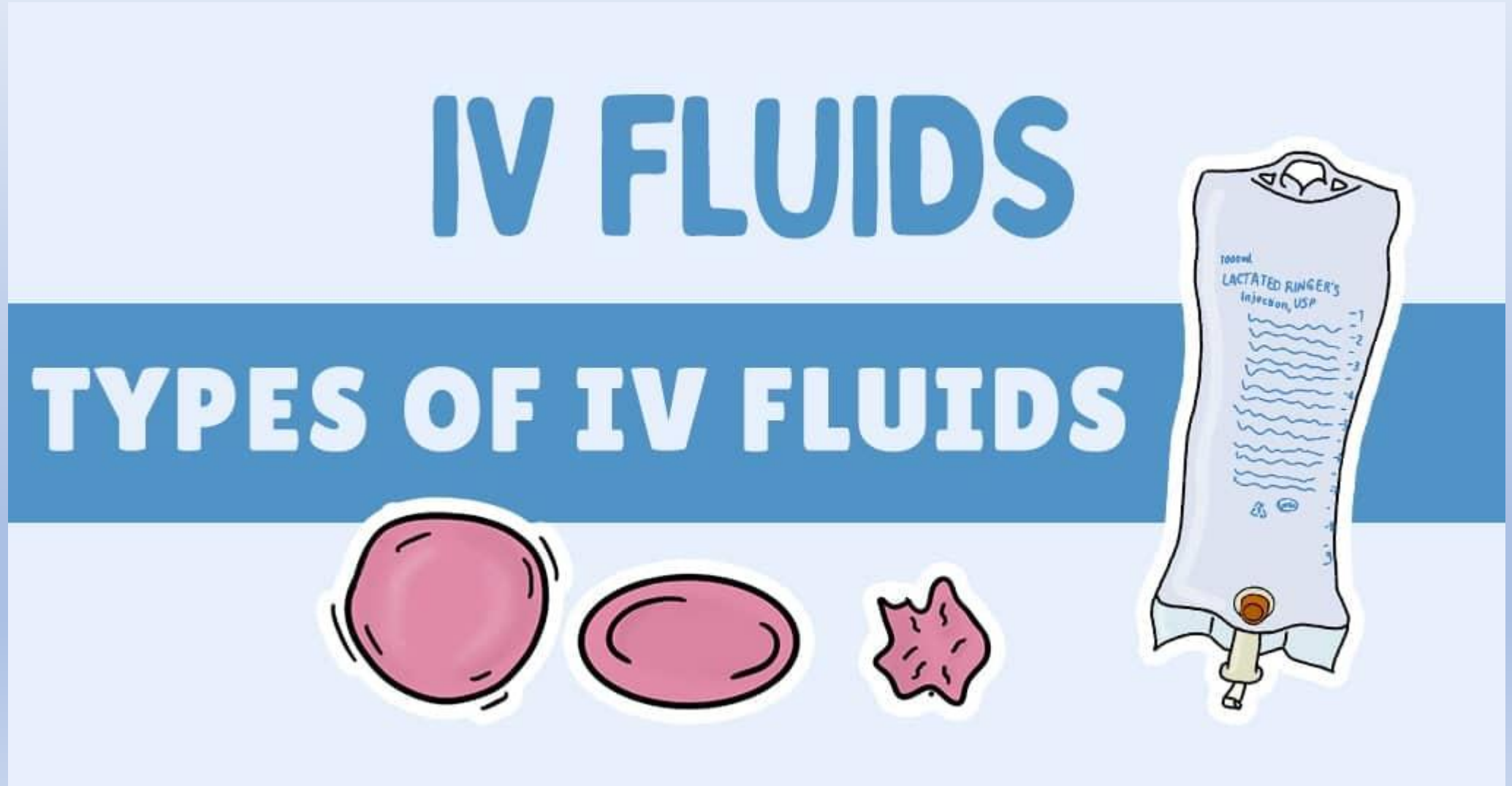
- They should be treated aggressively, and the recommended options are levetiracetam and sodium valproate, as they have less adverse cardiac effects.

❑E – ELECTROLYTES



- Aim for normal sodium level (e.g. 140–145 mmol/L),
- if ICP is raised, the target can be increased (e.g. to 150–155 mmol/L)
- Mild hypokalaemia during hypothermia is common because of cold diuresis and transcellular shift.
- Accept mild hypokalaemia (e.g. 3.0–3.5 mmol/L) if there are no significant arrhythmias,

- F – FLUIDS

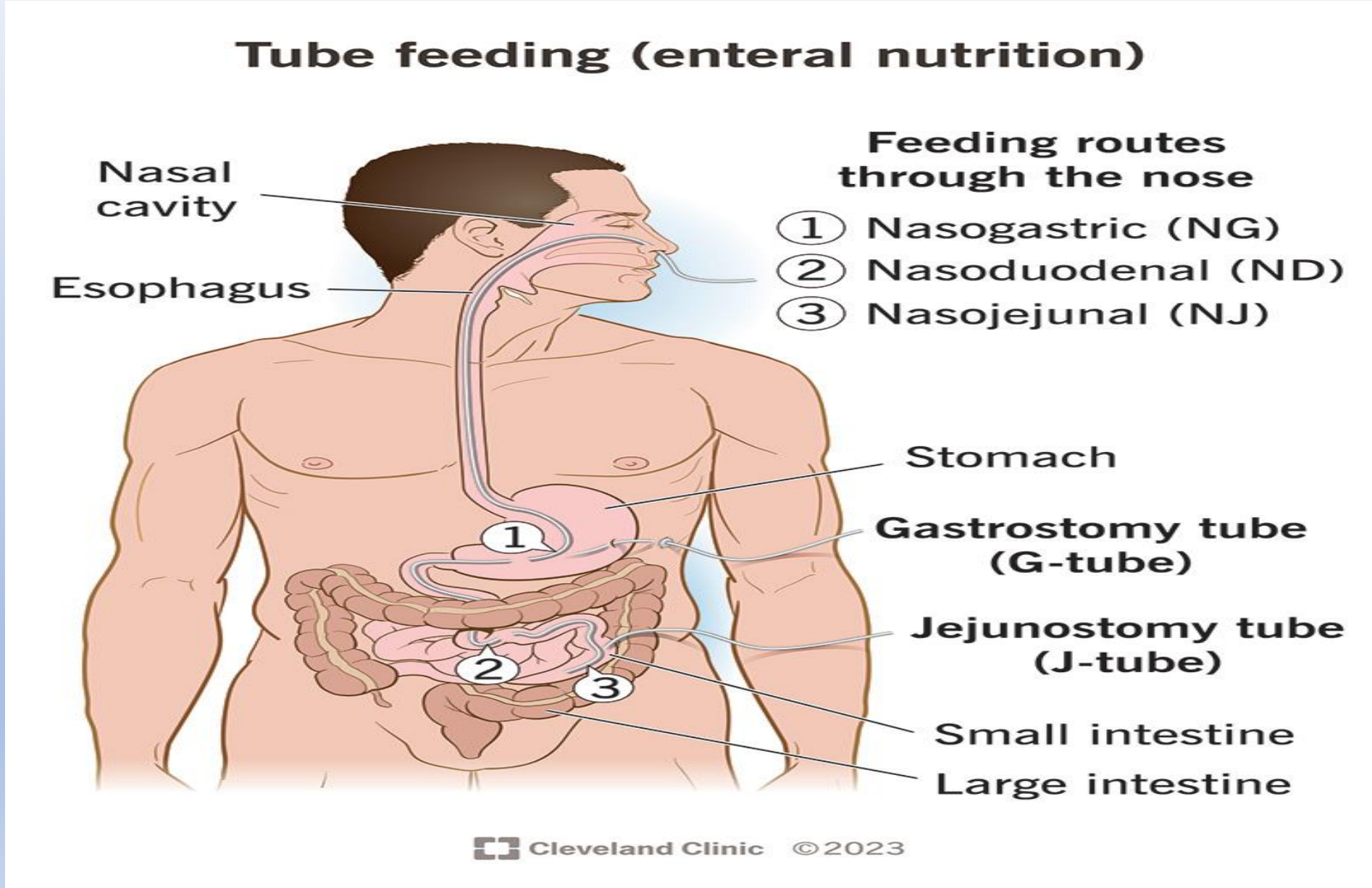

IV FLUIDS
TYPES OF IV FLUIDS
1000ml
LACTATED RINGER'S
Injection, USP

- Cerebral oedema may occur transiently after ROSC, but it is rarely associated with a clinically relevant increase in ICP.

- it is important to avoid hypotonic solutions, which may worsen brain swelling.

- Balanced electrolyte solutions such as lactated Ringer's Solution and Plasma-Lyte A are recommended.

❑G – GASTROINTESTINAL FEEDING AND GLUCOSE



- Early enteral feeding is recommended as per standard ICU practice to reduce infectious complications.

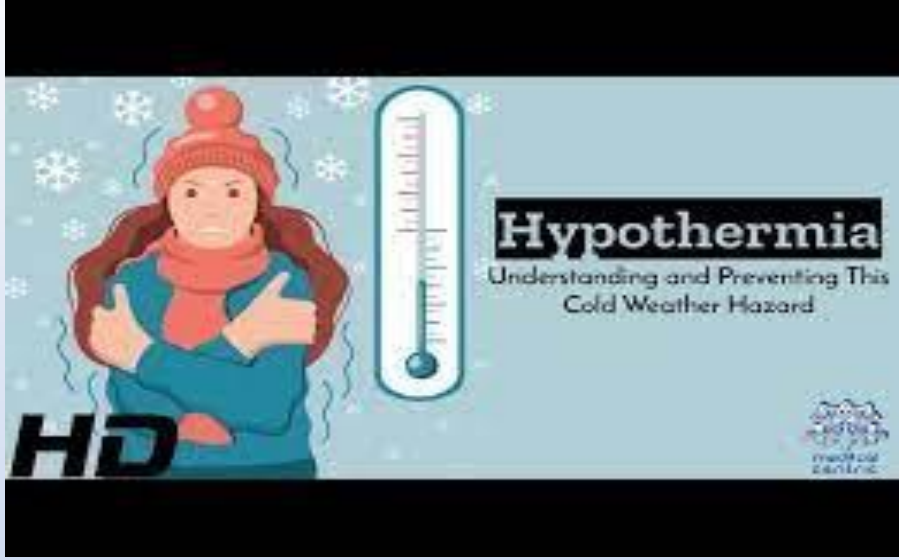
- feeding should be started at low rates (trophic feeding), as hypothermia may lead to gastroparesis and prolonged intestinal transit time.

- Both low and high blood glucose levels have adverse effects on the neurological prognosis.

- Based on the available data, the recommendation is to target normoglycaemia (e.g. blood glucose 6–10 mmol/L).

- Use intravenous insulin infusion, rather than subcutaneous insulin, to control blood glucose levels when the patient is on vasopressors and/or hypothermia therapy,

❑H – HYPOTHERMIA/HYPERTHERMIA



- TTM includes both targeted hypothermia (targeting core body temperature 32°C–34°C) and targeted normothermia (targeting core body temperature 35°C–37°C).

- Guidelines advocate TTM for all adult patients with OHCA and in-hospital cardiac arrest (IHCA) who remain comatose after ROSC regardless of initial cardiac rhythm.

❑I – INFECTIOUS DISEASES

- There is a higher incidence of lower respiratory tract infections with hypothermia therapy because of mild immune paresis.
- There is no current recommendation for prophylactic antibiotics.
- If systemic vascular resistance remains persistently low, screen for sepsis and check infective markers, as the patient will not mount a fever response during TTM.

❑CONCLUSION

- The quality of postresuscitation ICU care has a major influence on the final clinical outcome.

Table I. Summary of recommendations for post-cardiac arrest management.

No.	Recommendation
	A – Airway
1	Use ETT with subglottic secretion drainage to reduce VAP
	B – Breathing
2	Target SpO_2 94%–98% *(use lowest FiO_2 & avoid PEEP > 10 cmH_2O)*
3	Target $PaCO_2$ 35–45 mmHg *(may consider mild hypercapnia if low cerebral oxygenation and no evidence of raised ICP and pH > 7.2)*
4	Use lung protective ventilation strategies *(tidal volume 6–8 mL/kg PBW & Pplateau ≤ 30 cmH_2O)*
	C – Circulation
5	Emergent coronary angiography for patients with cardiac arrest if ECG shows STEMI and no treatment limitations
6	Consider coronary angiography if no STEMI but likely coronary cause for cardiac arrest and/or electrical or haemodynamic instability
7	Continuous BP monitoring *(may consider continuous cardiac output/$ScvO_2$ monitoring if available)*
8	Target MAP at least 65 mmHg (*may consider higher MAP target if baseline hypertension, evidence of raised ICP or end-organ hypoperfusion, e.g. AKI*)

	D – Disability (neurology)
9	cEEG monitoring *(may consider sedation monitors with continuous frontal EEG monitoring as alternative)*
10	Spot EEG if seizures suspected and no cEEG monitoring
11	Continuous cerebral regional oxygen saturation monitoring
12	Ultrasonography ONSD to estimate ICP
13	Use short-acting sedative medications

	E – Electrolytes
14	Target sodium 140–145 mmol/L *(may consider higher sodium target if evidence of raised ICP)*
15	Accept mild hypokalaemia 3.0–3.5 mmol/L if no significant arrhythmias *(avoid aggressive replacement to prevent rebound hyperkalaemia during rewarming)*

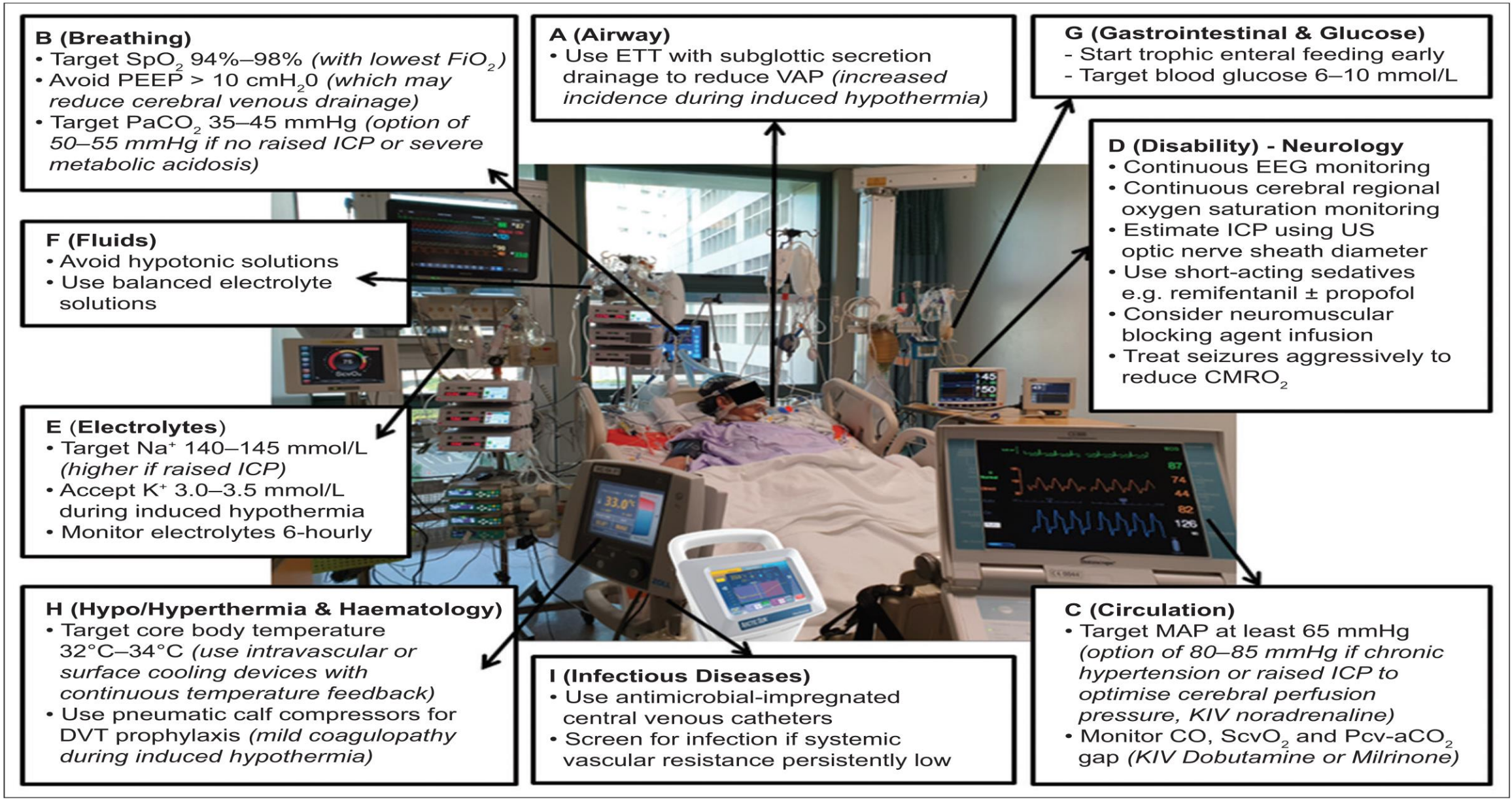
	F – Fluids
16	Avoid hypotonic solutions and use balanced electrolyte solutions

	G – Gastrointestinal feeding and glucose
17	Start trophic enteral feeding early
18	Target blood glucose 6–10 mmol/L *(use insulin infusion when on vasopressors or hypothermia therapy)*

	H – Hypo/hyperthermia and Haematology
19	TTM for all adult patients with OHCA/IHCA who remain comatose after ROSC regardless of initial cardiac rhythm *(note that bleeding diathesis, sepsis, bradycardia and prolonged QT interval are not contraindications to TTM, but a higher target temperature may be selected, up to 36°C)*
20	TTM at either 33°C or 36°C, with rapid induction to reach target temperature and maintain at target temperature with minimal fluctuations
21	Use a cooling device with continuous temperature feedback using thermistor measuring oesophageal or urinary bladder temperature
22	Maintain at target temperature for at least 24 hr *(may consider longer maintenance at target temperature if prolonged no flow and/or low flow time)*
23	Slow controlled rewarming at 0.1°C–0.25°C per hour to 37°C
24	Maintain patient at 37°C (controlled normothermia) for another 24 hr
25	Use intermittent pneumatic compression device for DVT prophylaxis

	I – Infectious diseases
26	Screen for infection if systemic vascular resistance persistently low

	Neuroprognostication
27	Delayed neuroprognostication (72 hr after returning to normothermia) in view of reduced metabolism of sedatives and neuromuscular blocking agents during hypothermia therapy
28	Use a multimodal strategy for neuroprognostication and not based on any single finding alone
29	Consider sensitivity and specificity of each test before making decision on withdrawal of life-sustaining therapy


B (Breathing)
• Target SpO_2 94%–98% *(with lowest FiO_2)*
• Avoid PEEP > 10 cmH_20 *(which may reduce cerebral venous drainage)*
• Target $PaCO_2$ 35–45 mmHg *(option of 50–55 mmHg if no raised ICP or severe metabolic acidosis)*
A (Airway)
• Use ETT with subglottic secretion drainage to reduce VAP *(increased incidence during induced hypothermia)*
G (Gastrointestinal & Glucose)
- Start trophic enteral feeding early
- Target blood glucose 6–10 mmol/L
D (Disability) - Neurology
• Continuous EEG monitoring
• Continuous cerebral regional oxygen saturation monitoring
• Estimate ICP using US optic nerve sheath diameter
• Use short-acting sedatives e.g. remifentanil ± propofol
• Consider neuromuscular blocking agent infusion
• Treat seizures aggressively to reduce $CMRO_2$
F (Fluids)
• Avoid hypotonic solutions
• Use balanced electrolyte solutions
E (Electrolytes)
• Target Na^+ 140–145 mmol/L *(higher if raised ICP)*
• Accept K^+ 3.0–3.5 mmol/L during induced hypothermia
• Monitor electrolytes 6-hourly
H (Hypo/Hyperthermia & Haematology)
• Target core body temperature 32°C–34°C *(use intravascular or surface cooling devices with continuous temperature feedback)*
• Use pneumatic calf compressors for DVT prophylaxis *(mild coagulopathy during induced hypothermia)*
I (Infectious Diseases)
• Use antimicrobial-impregnated central venous catheters
• Screen for infection if systemic vascular resistance persistently low
C (Circulation)
• Target MAP at least 65 mmHg *(option of 80–85 mmHg if chronic hypertension or raised ICP to optimise cerebral perfusion pressure, KIV noradrenaline)*
• Monitor CO, $ScvO_2$ and Pcv-aCO_2 gap *(KIV Dobutamine or Milrinone)*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شكراً جزيلاً
danke
謝謝
teşekkür ederim
спасибо
dank je
thank you
gracias
mochchakkeram
dziękuję
go raibh maith agat
obrigado
sukriya
kop khun krap
arigatō
dakujem
grazie
merci
감사합니다