OPTIMIZED SUPPORT CARE FOR PATIENTS WITH EBOLA VIRUS DISEASE (EVD)

SEVERE HYDRO-ELECTROLYTE ABNORMALITIES

Learning objectives

At the end of this lecture, you will be able to:

- Describe the importance of early recognition of patients with severe electrolyte abnormalities
- Describe the diagnostic tests used during the epidemic and the importance of the “Point of care tests”
- Know how to prevent and treat in EVD:
  - Hypokalemia
  - Hyponatremia
  - Hypocalcemia
  - Hypomagnesemia
  - Hyperkalemia (included in AKI)
  - Hypernatremia

Electrolyte abnormalities are frequent in EVD

Table 2. Proportion of Patients with Abnormal Laboratory Values at Admission or at Any Time during Hospitalization in the United States or Europe.*

Abnormal Laboratory Result	At Admission	During Hospitalization	Treatment Received during Hospitalization†
	no./total no. tested (%)		*no./total no. (%)*
Hyponatremia (sodium <135 mmol/liter)‡	12/27 (44)	21/27 (78)	21/21 (100)
Hypokalemia (potassium <3.5 mmol/liter)	10/27 (37)	18/27 (67)	18/18 (100)
Hypocalcemia (total calcium <8 mmol/liter)	10/16 (62)	15/20 (75)	10/15 (67)
Hypomagnesemia (magnesium <0.85 mmol/liter)	9/10 (90)	14/17 (82)	10/14 (71)
Hypoalbuminemia (albumin <3.5 g/dl)	20/25 (80)	25/25 (100)	7/25 (28)
Elevated creatinine (>1.3 mg/dl)	5/27 (19)	11/27 (41)	

Frequent electrolyte abnormalities:

- **Hyponatremia**
- **Hypokalemia**
- **Hypocalcemia**
- **Hypomagnesemia**

Hypoalbuminemia can influence Calcium concentration

- Give calcium if the Corrected Ca is <1.9 mmol/L (<7.5mg/dl)
- Calculation for Correctd Ca based in Albumin:

Corrected Ca mg/dl= Ca (mg/dl)+(0-8x (Normal Alb (4g/dL)- Patient Alb in g/dL)

Uyeki et al, NEJM 2016

Electrolyte abnormalities, What is the problem? Potential complications?

- Hypokalemia?
- Hyperkalemia?
- Hypomagnesemia?
- Hypocalcemia?
- Hyponatremia?
- Hypernatremia?

Signs:

- Astenia and general weakness. Agitation, nausea, vomiting.

- Myalgias, muscular weakness (Hypocalcemia, Hypokalemia, Hypomagnesemia)

- Fasciculations (Hypocalcemia)

- Coma, convulsions (Hyponatremia)

- Arrythmias, cardiac arrest (hyperkalmia & Acidosis; Hypokalemia, Hypocalcemia, Hypomagnesemia, hypo- hypernatremia)

Electrolyte abnormalities: Main causes

Causes of Electrolyte abnormalities

- Diarrhea, vomit
- Fluid overload-> hyponatremia
- Acute Kidney injury-> hyperkalemia, metabolic acidosis
- Dehydration –Water loses -> Hypernatremia
- Renal losses: Diuretics; Poliuric phase of AKI
- Severe Rhabdomyolisis /Tumor Lysis Crushing Syndrome
- Administration of Hypotonic fluids-> hyponatremia

HEALTH EMERGENCIES programme

Electrolyte abnormalities- How to avoid them

?

Prevention of electrolyte disbalances: Rehydration with ORS

- Start enteral fluids as soon as possible
  - Orally if possible
  - Consider NGT in coma patients (Careful: Risk bleeding in patients with EVD)
  - Use ORS for rehydration and prevention of dehydration in case of diarrhea.

	Na^+ mmol/l	K^+ mmol/l	Cl^- mmol/l	Bicarbonate mmol/l	Glucose g/l	Magnesium mmol/l
WHO ORS	90	20	80	30	111	-

- When patient tolerates enteral fluids,consider:

- Introduction of enteral nutrition
  - Pro- active
  - Careful! Increase the volumen progressively
  - The flow of maintenance fluids will be reduced at the same time.
  - The total volume of maintenance fluids remains constant

Prevention of Electrolyte disturbances

Example: Management of moderate dehydration - Plan B

Management of moderate dehydration:
Consider oral hydration if:
ABCDE hydration is stable and orally well tolerated

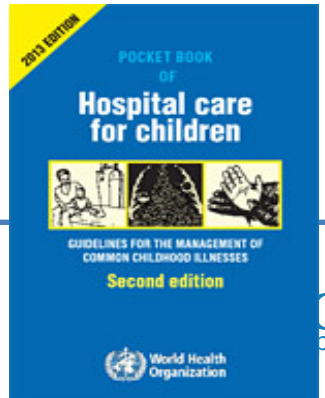
- Follow the correction for oral intake.
- The situation can deteriorate quickly.
- Use ORS for oral rehydration *
- If the patient is unable to drink, do not hesitate to take the IV route!

1. Determine amount of IV fluid to be given: 100 ml/kg.
2. Determine rate of fluid to be given based on age: Infant < 1 year or child > 1 year.

Recommended volume of IV fluid and type to treat severe dehydration			
Age	First fluid bolus, 30 ml/kg	Second fluid bolus, 70 ml/kg	Fluid composition
Infants < 12 months	1 hour*	5 hours	RL with 10% dextrose or NS with 10% dextrose
12 months to 5 years	30 minutes*	2.5 hours	RL with 5% dextrose or NS with 10% dextrose

	Na^+ mmol/l	K^+ mmol/l	Cl^- mmol/l	Bicarbonate mmol/l	Glucose g/l	Magnesium mmol/l
WHO ORS	90	20	80	30	111	-

* Child with MAS - Plan B: See WHO guide; Use of Resomal Resomal - Be careful with massive diarrhea. Risk of hyponatriemia.



World Health Organization

CIES programme

Fluids- Infusion rate and weight

Weight	Fluids (ml/kg/h)	Fluids(ml/kg/d)
4kg	16ml	400ml
5kg	20ml	500ml
6kg	24ml	600ml
7kg	28ml	700ml
8kg	32ml	800ml
9kg	36ml	900ml
10kg	40ml	1000ml
12kg	44ml	1100ml
14kg	48ml	1200ml
16kg	52ml	1300ml
18kg	56ml	1400ml
20kg	60ml	1500ml
22kg	62ml	1550ml
24kg	64ml	1600ml
26kg	66ml	1650ml
28kg	68ml	1700ml
30kg	70ml	1750ml

If oral not enough: adequate IV Mainteinance Fluid administration

0- 10kg	100ml/kg/d or	4ml/kg/h
11-20kg	50ml/kg/d or	2ml/kg/h
> 20kg	25ml/kg/d or	1ml/kg/h

Use isotonic fluids with Dextrose!
Give Dextrose 5% or 10% without electrolytes!

70% de "4-2-1" in some circumstances: for example:
- **Respiratory problems**
- **Encephalopathy**

Careful in specific cases, for example:
- **Renal problems**
- **Cardiac problems**

HEALTH EMERGENCIES programme

Estimation of needs for daily fluid administration

Electrolytes	Need per day mmol/kg/d
Sodium, Na+	2-4
Potassium, K+	1-2
Calcium, Ca++	1
Magnesium, Mg++	1
Chloride, Cl-	3-5
Phosphate, PO4-	2-3

+

Losses
Diarrhea
Vomit
Transpiration
Surgical drainages
Other

Prevention of Hyponatremia
Maintenance fluids: do NOT use hypotonic fluids.

Manual preparation: RL + Dextrose

450 ml RL + 50 ml D50%

Remove - 50 ml of RL

Add + 50 ml of D50 %

- 0.9% NaCL – Last resource
- Pre-fixed formulation

DEXTROSE 5% / RINGER LACTATE		GLUCOSE 5% / RINGER LACTATE
DINFDERI5FBF5	DEXTROSE 5%/ RINGER LACTATE , 500ml, flex. bag, PVC free GLUCOSE 5%/ RINGER LACTATE, 500 ml, poche souple, sans PVC	WHO Class: 26.2 STERILE
Synonym: glucose 5% / ringer lactate		*Synonyme: dextrose 5% / ringer lactate*

HEALTH EMERGENCIES programme

Prevention of Hyponatremia
Maintenance fluids

+

Consider adding electrolytes
KCL 20 to 40mmol/l
Consider – Mg, Calcium

Practical approach: Ringer/Dextrose 5%

Or if fluids or enteral nutrition is started

Attention!!!

To avoid mistakes, it is always better to use prefixed formulations.

If the electrolytes are added, it should be written clearly on the bag of fluids.

DEXTROSE 5% / RINGER LACTATE

GLUCOSE 5% / RINGER LACTATE

DINFDERI5FBF5	DEXTROSE 5%/ RINGER LACTATE , 500ml, flex. bag, PVC free GLUCOSE 5%/ RINGER LACTATE, 500 ml, poche souple, sans PVC	WHO Class: 26.2 STERILE

Synonym: glucose 5% / ringer lactate

Synonyme: dextrose 5% / ringer lactate

HEALTH EMERGENCIES programme

Pediatric perfusion system

Use use pediatric infuser for children:

- 60 drops / ml

- Example:

➢ 40ml / hour = 40 drops / min

➢ The equivalent of fluid required for 2-3 hours can be placed in the reservoir.

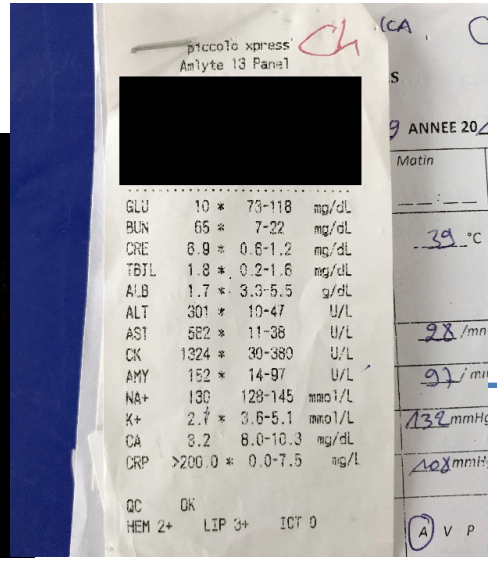
➢ Filling continues after each of these temp intervals.

- Or

➢ IV filling

➢ Administration of certain drugs

Electrolyte abnormalities- How can we diagnose
Important of « Point of care » Tests



- The tests are done by the patient´s bed.
- No delays: the results can be available in minutes.
- The treatment can be prescribed immediately

- Careful with the transportation of the blood sample:
- Avoid hemolysis
- Example – It can produce a false hypoerkalemia or hypokalemia that can be dangerous.

i-STAT: CG8+ reference

RANGE		REFERENCE (ARTERIAL)	REFERENCE (VENOUS)
Sodium (Na)	100-180 mmol/L	138-146 mmol/L	138-146 mmol/L
Potassium (K)	2.0-9.0 mmol/L	3.5-4.9 mmol/L	3.5-4.9 mmol/L
Ionized Calcium (iCa)	0.25-2.50 mmol/L, 1.0-10.0 mg/dL	1.12-1.32 mmol/L, 4.5-5.3 mg/dL	1.12-1.32 mmol/L, 4.5-5.3 mg/dL
Glucose (Glu)	20-700 mg/dL	70-105 mg/dL	70-105 mg/dL
Hematocrit (Hct)	15-75%PCV	38-51%PCV	38-51%PCV
Hemoglobin* (Hgb)	5.1-25.5 g/dL	12-17 g/dL	12-17 g/dL
pH	6.5-8.2	7.35-7.45	7.31-7.41
PCO_2	5-130 mmHg	35-45 mmHg	41-51 mmHg
PO_2	5-800 mmHg	80-105 mmHg	
TCO_2*	5-50 mmol/L	23-27 mmol/L	24-29 mmol/L
HCO_3*	1.0-85.0 mmol/L	22-26 mmol/L	23-28 mmol/L
Base Excess (BE)*	(-30)-(+30) mmol/L	(-2)-(+3) mmol/L	(-2)-(+3) mmol/L
sO_2*	0-100%	95-98%	

i-STAT: CHEM8+

	REPORTABLE RANGE	REFERENCE RANGE (ARTERIAL)	REFERENCE RANGE (VENOUS)
Sodium (Na)	100-180 mmol/L	138-146 mmol/L	138-146 mmol/L
Potassium (K)	2.0-9.0 mmol/L	3.5-4.9 mmol/L	3.5-4.9 mmol/L
Chloride (Cl)	65-140 mmol/L	98-109 mmol/L	98-109 mmol/L
TCO_2	5-50 mmol/L	23-27 mmol/L	24-29 mmol/L
Anion Gap*	(-10)-(+99) mmol/L	10-20 mmol/L	10-20 mmol/L
Ionized Calcium (iCa)	0.25-2.50 mmol/L	1.12-1.32 mmol/L	1.12-1.32 mmol/L
Glucose (Glu)	20-700 mg/dL	70-105 mg/dL	70-105 mg/dL
Urea Nitrogren (BUN)/Urea	3-140 mg/dL	8-26 mg/dL	8-26 mg/dL
Creatinine (Crea)	0.2-20.0 mg/dL	0.6-1.3 mg/dL	0.6-1.3 mg/dL
Hematocrit (Hct)	15-75%PCV	38-51%PCV	38-51%PCV
Hemoglobin* (Hgb)	5.1-25.5 g/dL	12-17 g/dL	12-17 g/dL

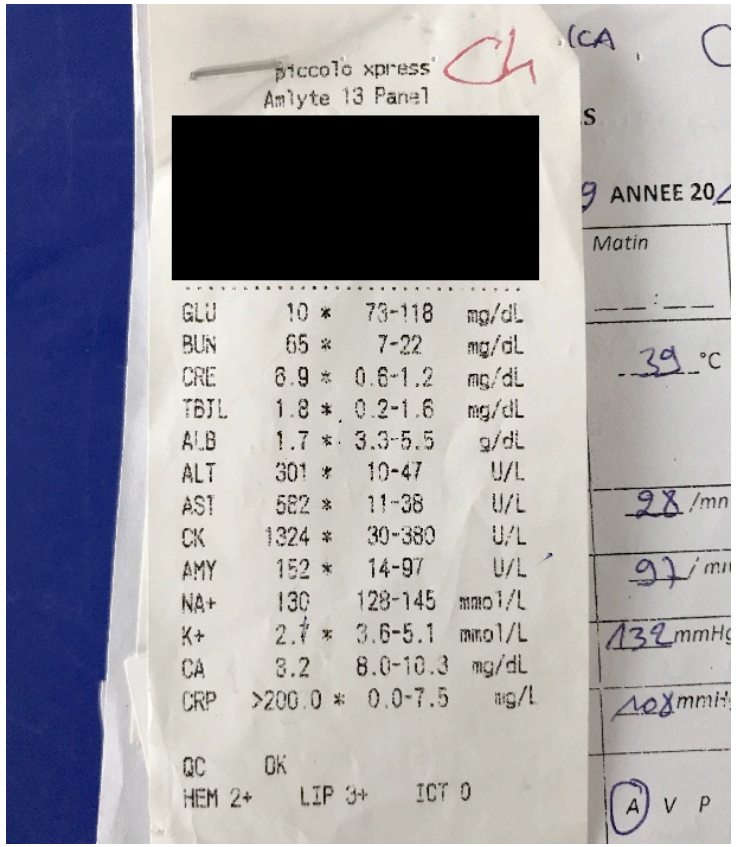
Electrolyte abnormalities: Treatment- Practicalities

- Hypokalemia
- Hyperkalemia
- Hypomagnesemia
- Hypocalcemia
- Hyponatremia
- Hypernatremia

Consider correct these abnormalities, PO/IV only if:

- The staff is well trained to do it
- There is adequate equipment, monitoring and surveillance

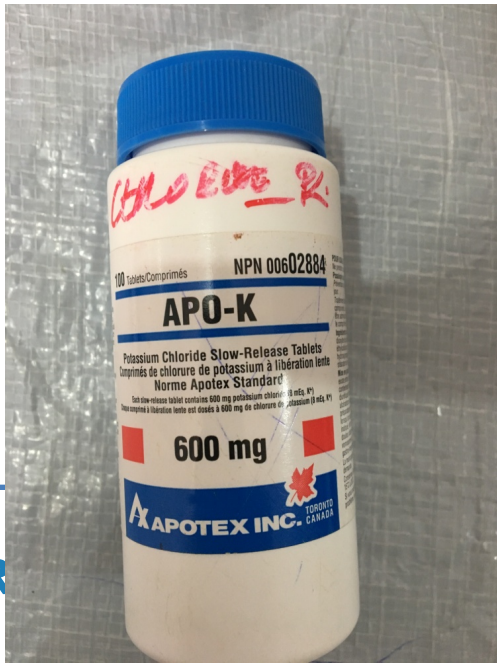
Electrolyte abnormalities
Treatment- Practicalities



- Hypoglycemia (severe)
- Acute kidney failure
- Hypoalbuminemia (severe)
- AST Increased> ALT
- Incrased CK
- Hyponatremia
- Hypokalemia
- Hypocalcemia
- CRP: highly increased

Management of Moderate hypokalemia

- Oral intake if possible.
- Adapt the supplement to the laboratory tests.
- Laboratory control after administration of K+ supplements
- An oral daily suplement may be necessary in patients with severe losses (Important diarrhea)

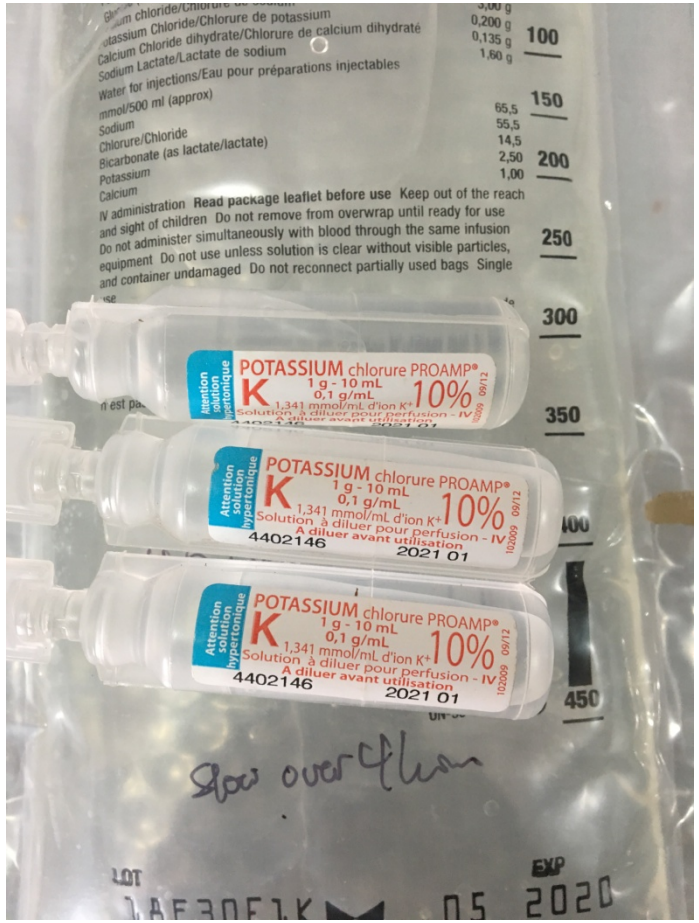


Management of Hypokalemia: oSOC

Potassium level	Adult dosing
3.3–3.5	40 mmol oral dose. Re-check serum K level and repeat dose if needed.
2.5–3.2	60–80 mmol oral dose. Re-check serum K level and treat if necessary.
< 2.4 (severe)	10 mmol per hour IV/ for 4 hours. Re-check serum K level. Give additional dose at 2–4 hours, if still needed. Always re-check serum K level between dosing.
	Paediatric dosing
K 2.5–2.9 mmol/l	0.5–1.0 mmol/kg oral dose. Re-check serum K level. Can repeat every 6–12 hours. Can repeat to a total of 2–4 mmol/kg/day in 2–4 divided doses.
K < 2.5 mmol/l	0.5 mmol/kg/hour IV for 2 hours + 2 mmol/kg oral dose. Re-check serum K level. Can repeat every 12 hours.

IV potassium: details

1 10 ml ampoule = 1 gram = 13.4 mmol = 13.4 mEQ



Precaution:

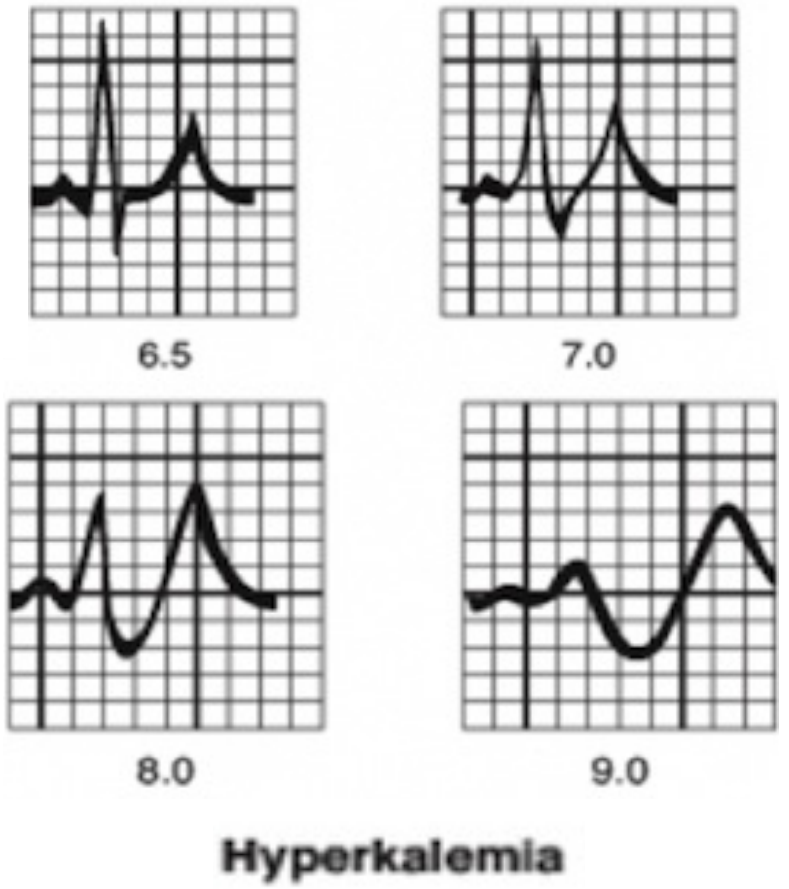
It is preferable the potassium given through pump to a syringe to control the debit

Never administer in bolus IV

Management of Hyperkalemia

- ECG
  - Peaked T waves
  - Elevation T waves
  - QRS prolonged
  - Arrythmia risk +/-
    - VT→ VF

- Remove fluids, perfusions and oral médications containing K +,
- Start treatmentof hyperkalemia



Management of hyperkalemia and acidosis
For example, in the case of Acute kidney failure

Optimized Supportive Care for Ebola Virus Disease
CLINICAL MANAGEMENT STANDARD OPERATING PROCEDURES

PEC ABCD Arrêtez tous les médicaments / perfusions contenant du potassium	
Médicaments	**Effets**
Calcium Gluconate/Chloride	Myocardium stabilizer
Nebulization of Salbutamol	Rapid reduction of potassium in serum
Sodium Bicarbonate	Correction of the acidosis and transient reduction of K+
Insulin / Dextrose	Deplacement of extra potassium inside of cells Careful, only when the glycemia is stable and can be monitored.
Furosemide	If hypervolemia, to reduce fluid and potassium
Sodium polystyrene sulfonate	Not for acute phase. Can be given with Chronic renal disease for the moderate hyperkalemia

Management of Hyperkalemia and acidosis
For example, if Acute Kidney disease

Hyperkalaemia is a dangerous complication that is associated with arrhythmias and/or death and is extremely difficult to manage in EVD outbreaks given that the diarrhoea associated with the disease complicates the use of kayexalate and dialysis is rarely available.

- **Most cases of hyperkalaemia in the EVD patient are due to kidney injury and/or spurious causes like haemolysis of the sample. If a spurious result is suspected repeat the lab.**
- Electrocardiogram (ECG) monitoring if possible: peaked T waves → widened QRS and flattened P waves → loss of P waves, progressive QRS widening and eventual ventricular fibrillation.
- Check for spurious causes, e.g. ethylenediaminetetraacetic acid (EDTA) contamination, haemolysed sample, IV drip sample or leukocytosis.
- Ensure all medications that could potentiate hyperkalaemia are stopped.
- Monitor glucose (every 30 minutes) and potassium (every 60 minutes), if correcting using insulin/dextrose, until stabilized.

Management of Hyperkalemia and acidosis
For example, if Acute Kidney disease

Potassium level	
K 5.5–6.4 mmol/l	Repeat test and monitor. Obtain ECG. If K > 5.5 and hyperkalaemia ECG changes, treat as below. Eliminate K through kidneys and GI tract (ensure euvolaemia and establish good urine output). If hypovolaemic: administer fluid bolus. Can consider furosemide only if hypervolaemic.
K > 6.5 mmol/l or ECG changes	
	Adult dosing
	1. Calcium gluconate 10% 10 ml over 10 minutes (may need one to three ampoules to achieve the same effect as calcium chloride); or calcium chloride 10% 5–10 ml IV over 10 minutes, repeat if necessary until ECG changes improve. Calcium chloride may cause local irritation at injection site; use larger vein. 2. Insulin: administer IV 10 units Humulin R insulin with two ampoules 50% glucose. 3. Bicarbonate IV 50 mEq slow push over 2 minutes. 4. Consider use of sodium polystyrene sulfonate 15 or 30 g once and can repeat every 8 hours in patients WITHOUT copious diarrhoea. Caution: does not have immediate effect and DO NOT use in patients with constipation. 5. Dialysis for refractory hyperkalaemia if available.
	Paediatric dosing
	1. 10% calcium gluconate: dose 0.11 mmol/kg (= 0.5 ml/kg) IV slow push over 5 minutes. Maximum 20 ml. 2. IV insulin and dextrose infusion: insulin 0.05 units/kg (maximum 10 units) + 1 ml/kg 50% glucose IV or 5 ml/kg 10% glucose or 2 ml/kg of 25% glucose. 3. Bicarbonate 1 mmol/kg IV slow push over 10–15 minutes. 4. Dialysis for refactory hyperkalaemia if available.

Electrolyte abnormalities: Hypomagnesemia Treatment

Hypomagnesemia

- Concomitant magnesium deficiency occurs in approximately 40% of patients with hypokalaemia and should be considered when replacing potassium.
  - » Magnesium should be replaced first in concomitant magnesium and potassium deficiency.
- For refractory hypokalaemia or for hypomagnesemia, give magnesium sulphate 2 g IV over 1 hour in adult patients. In children, give 0.2 mmol/kg (maximum 10 mmol) over 1 hour.

Electrolyte abnormalities- Treatment
Hypocalcemia

General considerations

- Replace calcium if corrected calcium < 1.9 mmol/l (< 7.5 mg/dl).
- Formula to correct calcium for albumin level:

Corrected calcium mg/dl = serum calcium (mg/dl) + (0.8 x (normal albumin (4 mg/dl) – patient's albumin mg/dl).

Acute management in adults

- 1–2 g or 2.25–4.5 mmol calcium gluconate IV in 50 ml of D5 or normal saline (0.9% NS) over 10–20 minutes.
- May repeat after 10 to 60 minutes if needed.

Acute management in children

10% calcium gluconate:

- Dose = 0.11 mmol/kg = 0.5 ml/kg.
- Give slowly over 10–20 minutes. Can dilute dose in D5 or normal saline (0.9% NS).
- May repeat after 10–60 minutes if needed.

Severe Hypocalcemia

- Parestesia, tetanus, fasciculations, convulsion, arrythmias, subit death.
- Th Calcemia muct be interpreted related to the albumin, as 50% of Ca is bonded to albumin and only the free ionic Ca is active.
- Corrected Ca (mg/dL) = Measured Ca (mg/dL) + 0.8 (4 g/dL (Albumin normal) – Albumine measurd (g/dl))
  - Corrected Ca (mmol/L) = for every 1g/dl of Albumin, incrase the Ca 0-2mmol/L (or 0,02mmol/l if calculated Albumin g/l)
- In case of severe hypocalcemia, IV supplement is required.

Severe hyponatremia

Solutés cristalloïdes	Na mmo/l	K mmo/l	Cl mmo/l
Ringer lactate	131	4	109
Sérum salé à 0,9%	154	0	154

- **Clinical prsentation:** Neurological presentation, convulsions, coma
  - **ABCD + O2; therapy for other causes (e. g. Malaria/sepsis)**

** The natremia can NOT increase mor than 9mmol per 24h (there is a risk of neurological complications – centro-pontine myelinolysis).*

  - **Adaptation of fluid + fluid balance**
    - *Consider (NaCl 0,9%) if dehydration*
    - If seizures: NaCL 3% (0,5 mmol Na per ml) – 3- 5 ml/kg

(It can incrase the sodium 3 mmol / litre and may control potentially the convulsions).

Hyponatremia

General considerations

- Hyponatraemia is often seen in the EVD patient and may be associated with mental status changes and/or seizures.
- Management should be guided by the volume status, the duration of hyponatraemia and the severity of symptoms.
- In EVD, the acute nature of the disease, makes hypovolaemic hyponatraemia the most likely etiology; individual clinical assessment is warranted.

Acute management

- Avoid administration of free water or hypotonic fluids as this will worsen hyponatraemia. Use isotonic or balanced solutions for IV resuscitation. Use ORS for oral rehydration.
- Determine etiology of hyponatraemia based on volume status: hypovolaemic, euvolaemic, hypervolaemic. For hypovolaemic patient: give fluid resuscitation (as described above). For euvolaemic patient: avoid free water. Treat underlying disease. For hypervolaemic patient, diuretics can be given.
- **Do not correct sodium rapidly as overly rapid correction can cause complications including central pontine myelinolysis. The maximum correction rate is 9 mmol/l in 24 hours.**
- Any clinical change must prompt repeat assessment of sodium level.

Hypernatremia

General considerations

- Hypernatraemia represents a net water loss or a hypertonic sodium gain. In EVD this is most often due to net water loss (dehydration) from diarrhoea/vomiting.
- Early symptoms include anorexia, muscle weakness, restlessness, nausea and vomiting. More serious signs follow, with altered mental status, lethargy, irritability, stupor and coma.
- Water deficit (in litres) = (current sodium/target sodium – 1) x .6 (body weight in kg); must eliminate the existing water deficit and replace ongoing water losses.
- **The rate of correction should not exceed 9 mmol/l per day.**

Summary

- Electrolyte abnormalities are frequent.
- Main causes: Enteral losses and Renal failure.
- This electrlyte disbalance can be associated to severe complications, for example Cardiac Arrythmias.
- The prevention of electrolyte abnormalities is possible if:
- Rehydration with ORS
- Use of adequate fluids
- The early identification of electrolyte abnormalitis save lifes
- Hypokalemia and hyponatremia are frequent in patients with EVD and can be measured and monitored.
- The hypocalcemia must also be monitored and treated (Always consider the Ca corrected with the levels of albumin)

Questions?

Generalized seizures in a 17 years-old patient with EVD

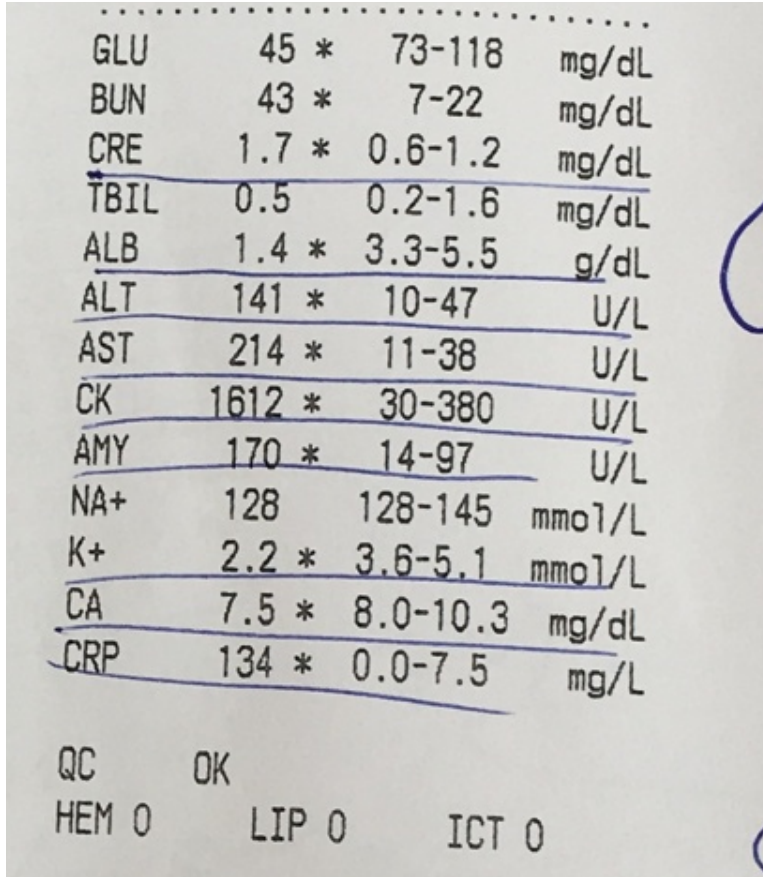
- Hospitalized yesterday – Confirmed EVD
  - ABCD – stable at admission
  - Diarrhea ++++
  - MRDT +
- Given treatment:
  - Artesunate & Ceftriaxone
  - Specific treatment
  - Maintainance fluids, not good notes
  - The patient has drunk a lot of water

Management

BTW ……Na – 115 mmol/l

World Health Organization

Piccolo: Day 3, diarrhea



GLU	45 *	73-118	mg/dL
BUN	43 *	7-22	mg/dL
CRE	1.7 *	0.6-1.2	mg/dL
TBIL	0.5	0.2-1.6	mg/dL
ALB	1.4 *	3.3-5.5	g/dL
ALT	141 *	10-47	U/L
AST	214 *	11-38	U/L
CK	1612 *	30-380	U/L
AMY	170 *	14-97	U/L
NA+	128	128-145	mmol/L
K+	2.2 *	3.6-5.1	mmol/L
CA	7.5 *	8.0-10.3	mg/dL
CRP	134 *	0.0-7.5	mg/L

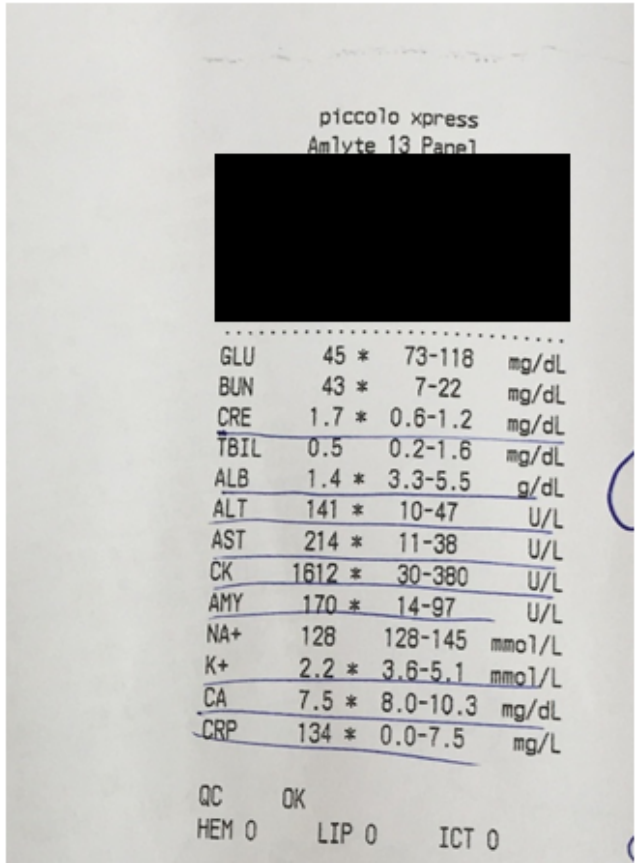
QC OK

HEM 0 LIP 0 ICT 0

What are the most important disorders?
What qustions would you ask the patient?
What examination would you do?

What are the priorities of the treatment?

Piccolo: ETU Day 4 (weakness, respiratory distress)



piccolo xpress
Amlyte 13 Panel

[redacted]

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K+	2.2 *	3.6-5.1	mmol/L
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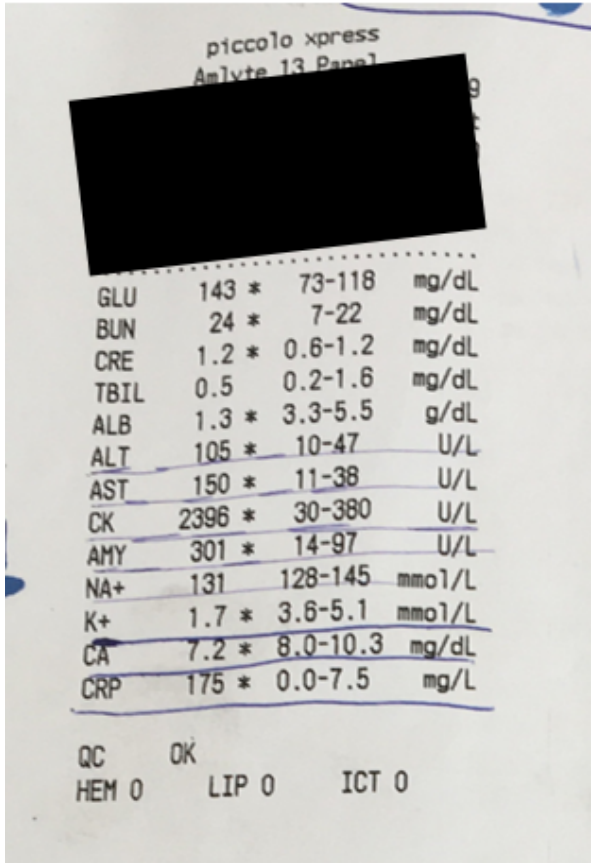
QC OK
HEM 0 LIP 0 ICT 0



piccolo xpress
Amlyte 13 Panel

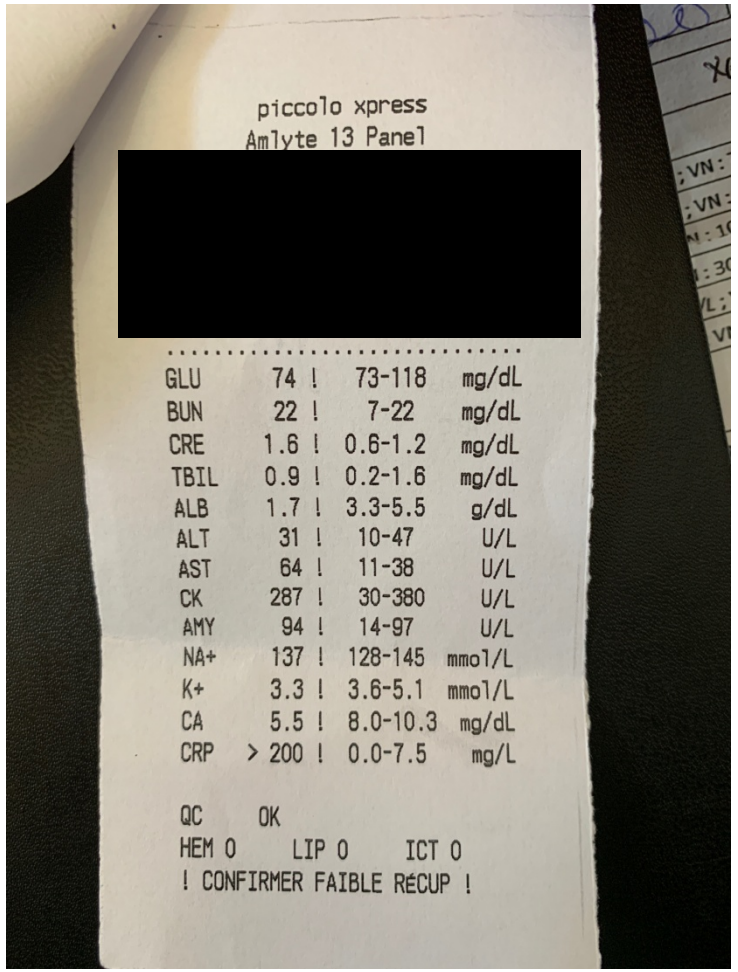
[redacted]

GLU	143 *	73-118	mg/dL
BUN	24 *	7-22	mg/dL
CRE	1.2 *	0.6-1.2	mg/dL
TBIL	0.5	0.2-1.6	mg/dL
ALB	1.3 *	3.3-5.5	g/dL
ALT	105 *	10-47	U/L
AST	150 *	11-38	U/L
CK	2396 *	30-380	U/L
AMY	301 *	14-97	U/L
NA+	131	128-145	mmol/L
K+	1.7 *	3.6-5.1	mmol/L
CA	7.2 *	8.0-10.3	mg/dL
CRP	175 *	0.0-7.5	mg/L

QC OK
HEM 0 LIP 0 ICT 0

- What is the problem?
- Is there any problem with Potassium?
- How would you approach the management?

Case: Patient with muffled voice and muscle spasms



What are the main laboratory disorders?
What questions would you ask the patient?
What examination would you do?

What are the priorities of the treatment?