



Sultanate of Oman
Ministry of Health
Directorate General of Khoula Hospital
General Surgery Department

Institution Name: Directorate General of Khoula Hospital					
Document Title: Electrolytes Imbalance Management Protocol for Surgical Patients					
Approval Process					
	Name	Title	Institution	Date	Signature
Written by	Dr. Khalid Al-Hamadani	Specialist	DGKH		
	Dr. Aadil Al Ghafri	Consultant Internal Medicine	DGKH		
Reviewed by	Reviewers signature in next page				
Validated by	Ms.Salama Al-Hajri	Head of Accreditation	DGKH		
	Dr. Said Al Mughairi	Director of Quality Management and Patient Safety	DGKH		
Approved by	Dr. Mazin Al-Khaouri	Director General	DGKH		

Location of original copy: Document Owner

Distribution to: Quality Management & Patient Safety Directorate & Shared File



Electrolytes replacement Protocol in Surgical patients

MoH/DGKH/GS/PRT/002/Vers.01
Effective Date: January/ 2022
Review Date: January / 2025

Reviewed by:

S.NO	Name	Title
1	Dr. Yasser Abbas	Senior Consultant, HoD General Surgery
2	Dr. Adil Al Kharusi	Consultant Intensivist (ICU)
3	Ms. Salama Al-Hajri	Head of accreditation
4	Ms. Hasna Al-Tooqi	Nursing
5	Ms. Huda Alabri	Sr staff, Accreditations Department QM&PSD
6	Ms. Suhaila Al-Kindi	Laboratory
7	Ph. Yahya Al Rashdi	Pharmacist



Contents Table:

Acronyms:.....	1
.1 Introduction	2
2. Scope	2
3. Purpose	2
4. Definitions	2
5. Protocol.....	2
7. Responsibilities.....	4
8. Document History and Version Control.....	5
9. Related Documents:.....	5
10. References:.....	



Acronyms:

DGKH.	Directorate General Khoula Hospital
D5W	5% dextrose in water, intravenous therapy
ECG	Electrocardiogram
HDU	High dependency units
Hr	Hours
KCL	Potassium chloride
MgSO4	Magnesium sulfate
mEq/l	Milliequivalent per liter
ml/kg	Milligrams per kilograms, a unit of measure
mg /dL	Milligrams per deciliter, a unit of measure
IV	Intravenous
NPO	Nil by mouth
PO	Per Oral
µmol/L	Micromoles per liter, a unit of measure



Electrolytes Replacement Protocol in Surgical Patients

1. Introduction

Electrolyte imbalance is a common challenge faced in admitted patients. Surgical patients are prone to such a complication during their admission. As these patients are kept fasting to undergo surgery and occasionally post-surgery depending on the nature of the procedure. These fasting period in addition to the stress of the surgery, leads to electrolytes imbalance that needs to be corrected to prevent further complications.

2. Scope

This protocol applies for all healthcare professionals dealing with surgical patients admitted in high dependency units and other wards at DGKH.

3. Purpose

The purpose of the protocol is to standardize the approach for electrolytes replacement in the surgical patients in the high dependency units (HDU) and the normal bed wards. It is focused on replacement of the following electrolytes: potassium, magnesium, phosphate and calcium.

4. Definitions

4.1 Electrolyte imbalance: disorder occurs when the level of electrolytes in the blood are too high or too low.

5. Protocol

5.1 The management of surgical patient with electrolyte imbalance should include the following:

5.1.1 The doctor should put a request in the electronic patient record (Al Shifa system).

5.1.2 It applies to patient who fulfill the following criteria:

- A. Serum creatinine $< 150 \mu\text{mol/L}$.
- B. Adult > 13 years old.
- C. Urine output $> 0.5 \text{ ml/kg/hr}$ for 2 consecutive hours.



- D. Patient not at risk of fluid overload (e.g., dialysis, heart failure).
 - E. No arrhythmia.
 - F. Patient no known renal or endocrine disease as etiology of electrolytes imbalance e.g., adrenal insufficiency.
- 5.1.3. If serum creatinine above 150 $\mu\text{mol/L}$ and/or documentation of renal failure or dialysis, contact medical team doctors for specific orders. If multiple IV electrolytes to be replaced, please discuss with the clinical pharmacist.
- 5.1.4 Not all patients with electrolyte imbalance will require medical team referral.
- 5.1.5 Patients with refractory electrolyte imbalance after correction by the surgeon will require medical team referral (Internal Medicine).
- 5.1.6 Electrolytes abnormalities are based on serum lab values (not only ABG sample).
- 5.1.7 Patients with symptomatic electrolyte imbalance and those with ECG changes will need medical team referral after initiating the replacement by the surgeon to be followed up.
- 5.1.6 The parent team is responsible to follow up the electrolytes results post correction and manage accordingly even if the medical team is involved.
- 5.1.7 The parent team who is taking care of the patient are responsible to recognize, put the order for the replacement of the electrolytes, order the post correction labs and inform the nursing staff to carry out the order as per protocol.
- 5.1.8 The parent team taking care of the patient should handover patients on replacement of their electrolytes to the on-call team after putting all the orders of replacement and lab orders, if the replacement and collection of labs will be continuing beyond 14:30hrs.
- 5.1.9 The parent team is responsible to communicate with medical team as required e.g refractory cases, electrolyte imbalance with complications like arrhythmia, etc.
- 5.1.10 After the handover, the on-call team is responsible for the follow up of such patients and further management according to the patient lab values and clinical condition.



5.2 Electrolytes replacement:

- 5.2.1 Hypokalemia management should be as per appendix 1
- 5.2.2 Hyperkalemia management should be as per appendix 2
- 5.2.3 Hypomagnesaemia management should be as per appendix 3
- 5.2.4 Hypophosphatemia management should be as per appendix 4
- 5.2.5 Hypocalcemia management should be as per appendix 5
- 5.2.6 Hypercalcemia management should be as per appendix 6

6. Responsibilities:

6.1 The Head of Department shall:

- 6.1.1 Emphasize to the consultants /doctors the importance of following the electrolytes replacement protocol in surgical patients.

6.2 The Director of Nursing Affairs shall:

- 6.2.1 Emphasize to the HoS/Unit Supervisors the importance of following the electrolytes replacement protocol in surgical patients.

6.3 The Ward In-Charges/Shift In-charges shall:

- 6.3.1 Ensure all nurses are adhering to the electrolytes replacement protocol in surgical patients.

6.4 The nurses shall:

- 6.4.1 Adhere to the electrolytes replacement protocol in surgical patients.
- 6.4.2 Report any incident related the electrolytes replacement protocol in surgical patients.
- 6.4.3 Liaise with treating team as needed.

6.5 Treating Doctors shall:

- 6.5.1 Adhere to this protocol.



7. Document History and Version Control

Document History and Version Control			
Version	Description of Amendment	Author	Review Date
01	Initial Release	Dr. Khalid Al Hamadani Dr. Yasser Abbas Dr Aadil Al Ghafri	2024
02			
03			
04			
05			
Written by		Reviewed by	Approved by
Dr. Khalid Al hamadani Dr Aadil Al Ghafri			Dr.Abdulla Al-Harthi



8.1 Appendix 1

Potassium Level	Preferred Route	Oral Replacement (if not NPO)	Peripheral IV	Central Line	Monitoring
Mild 3.0- 3.5 mmol/L	<u>Oral</u> Potassium Chloride Syr 1Mmol/MI Oral: <u>15 mmol TID</u> OR Potassium Chloride Tab 600mg Oral: <u>1200mg BID</u>	Potassium Chloride Syr 1Mmol/MI Oral: <u>15 mmol TID</u> OR Potassium Chloride Tab 600mg Oral: <u>1200mg BID</u>	If urgent correction required OR patient cannot take orally (e.g NPO) give Potassium Chloride inj 20Mmol/10MI IV infusion: <u>20 Mmol Stat (add to 500ml 0.9% NS infusion over 2 hours)</u>	If urgent correction required OR patient is cannot take orally (e.g NPO) Potassium Chloride inj 20Mmol/10MI IV infusion: <u>20 Mmol Stat (add to 500ml 0.9% NS infusion over 2 hours)</u>	- Add KCL to non-dextrose solution. - Not to exceed rate 20 mmol/h using central line or 10mmol/hr using peripheral line. - Re-check K level 2 hours after infusion completion. - Repeat dose if category range remain same or move to the new level's corresponding management.
Moderate 2.6-2.9 mmol/L	<u>IV Infusion</u> Potassium Chloride inj 20Mmol/10 MI IV infusion: <u>30 Mmol Stat (add to 500ml 0.9% NS infusion over 4 hours)</u>	Potassium Chloride Syrup or Tablets can be added to KCL IV: Potassium Chloride Syr 1Mmol/MI Oral: <u>30 mmol TID</u> OR Potassium Chloride Tab 600mg Oral: <u>1200mg TID</u>	Potassium Chloride inj 20Mmol/10MI IV infusion: <u>30 Mmol Stat (add to 500ml 0.9% NS infusion over 4 hours)</u>	Potassium Chloride inj 20Mmol/10MI IV infusion: <u>30 Mmol Stat (add to 500ml 0.9% NS infusion over 2 hours)</u>	- Always check magnesium level and correct imbalance (please refer to Mg replacement section). - Potassium and magnesium replacement can be done simultaneously - If fluid overload is a concern, liaise with medical team for low fluid replacement regiment.
Severe <2.6 mmol/L OR Symptomatic	<u>IV Infusion</u> Potassium Chloride inj 20Mmol/10 MI IV infusion: <u>60 Mmol Stat (add to 500ml 0.9% NS infusion over 6 hours)</u>	Potassium Chloride Syrup or Tablets can be added to KCL IV: Potassium Chloride Syr 1Mmol/MI Oral: <u>40 mmol TID</u> <u>OR</u> Potassium Chloride Tab 600mg Oral: <u>1200mg TID</u>	Potassium Chloride inj 20Mmol/10MI IV infusion: <u>60 Mmol Stat (add to 600ml 0.9% NS infusion over 6 hours)</u>	Potassium Chloride inj 20Mmol/10MI IV infusion: <u>60 Mmol Stat (add to 500ml 0.9% NS infusion over 3 hours)</u>	-Treat moderate & severe hypokalemia in HD bed with cardiac monitoring (especially if ECG/arrhythmia developed). - In severe hypokalemia, preferable route is central line if available.

- Potassium Chloride Tab 600mg contain 8 Mequivalent of potassium.



8.2 Appendix 2

Hyperkalemia Management Lines	Monitoring
A. Calcium Gluconate inj 10% 10MI IV: <u>1g/10ml STAT over 10min</u> (for cardiac stabilization)	-Give for all patients with serum K >6.0 mmol/L.
B. 1- Salbutamol Sol 5mg/MI Nebulization: <u>10mg (5mg X 2 doses) STAT.</u> 2- Insulin Regular (R) Inj 100Iu/MI IV: <u>10 Iu STAT (with Dextrose 50% Inj 50% 25MI IV: 50ml STAT) over 30 minutes.</u> 3- Resonium Calcium Pow/300Grams Oral: <u>30g BID</u> 4- Diuretics/ dialysis if indicated (consult medical team)	- Ensure cardiac monitoring/ECG for ALL patients with hyperkalemia. - Check K level 1 hour after each cycle. - Avoid Salbutamol in tachyarrhythmias (consult medical team). - Exclude hemolyzed K level samples. - Repeat management cycles as required. (4 cycles and then call medicine)



8.3 Appendix 3

Magnesium Level	Magnesium Replacement	Monitoring
0.4-0.7 mmol/L	Magnesium Sulphate Tab 100mg Oral: <u>100mg OD</u> OR If urgent correction required/ or patient cannot take orally (e.g. NPO) use: Magnesium Sulphate Inj. 2.5 Grams/5MI IV infusion: <u>2.5g STAT (in 200ml of 0.9% NS over 4 hours)</u>	-Repeat serum Mg level within 24 hours post replacement measures. -If urgent replacement required, repeat serum Mg level 2 hours post replacement measures. - Repeat replacement dose if category range remain same.
< 0.4 mmol/L OR Symptomatic	Magnesium Sulphate Inj. 2.5 Grams/5MI IV infusion: <u>5 g STAT (in 500ml of 0.9% NS or D5W over 5 hours)</u> If life threatening give infusion over 20mins	-Repeat blood level after 2 hours after infusion completion. - Repeat replacement dose if category range remain same or move to the new level's corresponding management.



- 1 g of Magnisum Sulphate is 4 mmol, 8 mEq, or 98mg of elemental magnesium.

8.4 Appendix 4

Phosphorus Level	Phosphate Replacement	Monitoring
0.3-0.81 mmol/L	Phosphate Sandoz Tb 500mg Oral: 500mg TID OR If patient is NPO or urgent then to give Potassium Phosphate Inj10 mmol/10Ml IV: <u>10ml STAT (in 500ml 0.9% NS over 4 hours)</u>	-Use standard potassium phosphate infusion (use sodium phosphate if potassium >4.5mmol/L & consult medicine) -Repeat serum phosphate level 4 hours post replacement measures.
<0.3 mmol/L OR Symptomatic	Potassium Phosphate Inj10 mmol/10Ml IV: <u>40ml STAT (in 500ml 0.9% NS over 10 hours)</u>	

- Potassium Phosphate Inj10 mmol/10Ml contains K+ 10ml and H2Po4 10ml.
- Phosphate Sandoz tablet contains: Na (469mg, 20.4 mmol), K (123mg, 3.1 mmol), and phosphorus (500mg, 16.1 mmol).



8.5 Appendix 5

Corrected Calcium Level	Calcium Replacement	Monitoring
>1.9 mmol/L	<p>Calcium Carbonate Tab 600 Mg Oral: 600mg PO BID-TID</p> <p>Or</p> <p>If symptomatic/or cannot take orally (e.g. NPO) given</p> <p>Calcium Gluconate (or Calcium Chloride) inj 10% 10MI IV: <u>1g/10ml STAT in 50ml D5W over 2 hours</u></p>	<p>- Calcium Gluconate: can be given peripherally or through central line.</p> <p>- Calcium Chloride: must be administered through a central line.</p> <p>- Repeat corrected Calcium Level at 4 hours after infusion completion.</p>
< 1.9 mmol/L Or Symptomatic	<p>Calcium Gluconate (or Calcium Chloride) inj 10% 10MI IV: <u>1g/10ml (1 ampule) STAT in 50ml D5W or 0.9% NS over 30 minutes</u></p> <p><u>Then give slow infusion</u></p> <p>Calcium Gluconate (or Calcium Chloride) inj 10% 10MI IV: <u>11g/110ml (11 ampules) in 890ml D5W or 0.9% NS (total volume 1000ml) slow infusion at rate of 50 ml/hr over 20 hours.</u></p>	<p>- Repeat infusion if not corrected till get normal level.</p> <p>-Check Mg & K levels and replace as required as per protocol</p> <p>-Call the medical team for all cases of Hypocalcemia <1.9</p>



		mmol/L or Symptomatic hypocalcemia
--	--	------------------------------------

- Calcium Gluconate inj 10% 10MI IV: 1g/10ml contain 4.65 meq/ 2.325 mmol/ 93mg elemental of calcium.
- Lab request in Al shifa system for the calcium is (calcium panel, adjusted for albumin)

8.6 Appendix 6.

Inform medical team for all cases of hypercalcemia

Corrected Calcium Level	Hypercalcemia Management Lines	Monitoring
2.55-2.9 mmol/L (Mild)	Treat ONLY if symptomatic with: -0.9% NS 200- 300ml/hr (aim for UOP 100-150ml/hr (caution in elderly, at risk of fluid overload).	-Check corrected calcium level 4 hours post treatment.
3.0-3.5 mmol/L (Moderate)	-0.9% NS 200- 300ml/hr (aim for UOP 100-150ml/hr (caution in elderly, at risk of fluid overload). -Calcitonin Inj 100 Iu/MI IM: 4 IU/kg IM/SC 12 hourly (use within 48hours, nasal formula not effective), dose may be increased up to 6-8 IU every 6-8 hours. -Pamidronate 60 mg STAT (dose not to be repeated before 7 days), if malignancy related hypercalcemia give: Zolendonic acid 4 mg Inj 4 Mg/100MI IV infusion over 30 minutes.	-Check corrected calcium level 4 hours post treatment.

- Lab request in Al shifa system for the calcium is (calcium panel, adjusted for albumin)



<p>>3.5 mmol/L (Severe)</p>	<p>-0.9% NS 200- 300ml/hr (aim for UOP 100-150ml/hr (caution in elderly, at risk of fluid overload).</p> <p>-Calcitonin Inj 100 Iu/MI IM: 4 IU/kg IM/SC 12 hourly (use within 48hours, nasal formula not effective), dose may be increased up to 6-8 IU every 6-8 hours.</p> <p>-Pamidronate 90 mg IV STAT (dose not to be repeated before 7 days), if malignancy related hypercalcemia give: Zolendonic Acid 4 mg Inj 4 Mg/100MI IV infusion over 30 minutes.</p>	<p>-Check renal adjusted dose for bisphosphonate.</p>
--	--	---

9. References

Title of book/ journal/ articles/ Website	Author	Year of publication	Page
Pocket medicine: the Massachusetts general Hospital Handbook of Internal Medicine	Sabatine,Marc	2019	-
Endocrine and Metabolic Medical Emergencies’,	Glenn Matfin	2018	2nd Ed.
Clinical review: goal-directed therapy-what is the evidence in surgical patients? The effect on different risk groups	Maurizio Cecconi	2013	-
Harrisons Principles of Internal Medicine	Theodore A Kotchen	2011	247:2058.
Emergency mamangement of acute hypocalcaemia in adult patient	Jeremy Turne	2016	G7-G8