Water and Electrolyte Disturbances in a Surgical Emergency Intensive Care Unit: A Descriptive Study of 288 Adult Patients.

ABSTRACT

Background: Water and electrolytedisturbances are frequent in intensive care unit (ICU) patients and maycontribute to significantmorbidity and mortality. Data specific to surgical emergency ICU settings remainscarce.

Objective: To describe the epidemiological, clinical, etiological, and outcomecharacteristics of dysnatremias and dyskalemias in a surgical emergency ICU.

Methods: Weconducted a retrospective descriptive study over twelvemonths (January–December 2018) in the Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca, Morocco. All patients hospitalizedduring the studyperiodwereincluded. Hyponatremiawasdefined as serum sodium <135 mmol/L, hypernatremia as >145 mmol/L, hypokalemia as <3.5 mmol/L, and hyperkalemia as >5.5 mmol/L.

Results: Among 288 patients, 173 (60%) developed at least one disturbance. Hyponatremiawas the mostfrequent (n=79; 27.5%), followed by hypernatremia (n=66; 23%), hyperkalemia (n=64; 22.5%), and hypokalemia (n=57; 20%). Hypovolemichyponatremiapredominated (46%), mainly due to digestive and renallosses and SIADH (17%);mortalitywas 39%. Hypernatremiawasdriven by renal (38%) and digestive (34%) losses, with 61% mortality. Hyperkalemiawasprimarilyrelated to renalfailure, withcardiovascular complications in 41% and mortality of 64%. Hypokalemiaresultedmainlyfrom digestive (52%) and renal (40%) losses, with 30% mortality.

Conclusion: Water and electrolytedisturbances are common in surgical emergency ICU patients and are associatedwith high mortality. Regular electrolyte monitoring enables timely correction and preventionwhileavoiding the risks of overlyrapid correction.

Keywords: Dysnatremia; Dyskalemia; Dehydration; Intensive care; Electrolyte disorders.

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1. INTRODUCTION

Disturbances of water and electrolytemetabolism, particularlyinvolving sodium and potassium, are commonlyencountered in the intensive care unit (ICU) and may cause considerablemorbidity and mortality [1,2]. Theyusuallyresultfrom an underlyingdiseasethat causes losses and/or impairs regulatorymechanisms [3].

Digestive disorders, surgicalprocedures, polytrauma, renal and hepaticfailure, endocrine diseases, and impairedconsciousness are situations in whichionogramabnormalitiesshouldbeanticipated [4]. A substantial proportion of thesedisturbances are iatrogenic, related to hypotonic infusions, artificialnutrition, and diuretic use [2]. Regardless of etiology, theymayevolveindependently and cause complications distinct from the underlyingdisease.

Thesedisturbances are usuallyreversiblewhendetected and treatedearly [3], yet few studies have specificallyaddressedthem in the ICU despitetheir high prevalence. The aim of thisstudywas to provide an epidemiological, clinical, paraclinical, therapeutic, and prognosticoverview of water and electrolytedisturbances in the Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

Retrospective descriptive study of 288 cases conducted in the 12-bed Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca, whichadmits patients from the emergency department, otherhospitaldepartments, and other national hospitals.

2.2 StudyPeriod

Twelve months, from 1 January 2018 to 31 December 2018.

2.3 Inclusion and Exclusion Criteria

All patients admittedduring the studyperiodwereincluded. No exclusion criteriawereapplied.

2.4 Data Collection

Recorded variables includeddemographics (age, sex, origin, pre-ICU length of stay), priorhealthstatus, clinicalparameters (recorded on the day the disturbanceoccurred: hemodynamic and respiratorystatus, Glasgow Coma Scale off sedation, seizures, hydrationsigns, urine output, digestive symptoms), and biologicalparameters (serum and corrected sodium, natriuresis, potassium, chloride, anion gap, glucose, urea, creatinine, plasma/urinaryosmolality, total protein, hemoglobin, calcium, phosphorus, transaminases, bilirubin, prothrombin time).

Plasma osmolality = (Na + K) × 2 + glucose × 5.5 + urea × 16.5
Urinaryosmolality = (Na + K)urinary × 2 + urinaryurea × 16.5

Someparameters (calcium, phosphorus, magnesium, natriuresis, kaliuresis, bloodgases) wereinconsistentlyavailable. Etiologies wereclassified by hydrationstatus (dehydration, overhydration, normal hydration). Therapeutic and outcome data werecollected, including ICU length of stay, duration and number of episodes, time to correction, complications, and mortality.

3. RESULTS

3.1 Overall Incidence

Among 288 patients, 115 (40%) had no disturbance, while 173 (60%) developed at least one water or electrolytedisturbance. Amongthese, 39 (22%) had more than one ionicdisorder, and 18 (6%) hadhydrationdisorderswithoutionicabnormality.

3.2 Hypernatremia (n = 66; 23%)

Meanage 49 ± 5 years (range 22–73); 36 men, 30 women (sex ratio 1.6). Comorbiditiesincludedcardiovasculardisease (27%), medication use (21%), neurologicaldisease (18%), and diabetes (15%). Admission reasonswerepostoperative (60%), trauma (45%), and stroke (10%).

Impairedconsciousnesswaspresentin 72% and mechanical ventilation requiredin 79%. Mean sodium was 150.3 ± 5 mmol/L, withmildhypernatremiamostfrequent (63%). Renallosses (38%) and digestive losses (34%) were the main etiologies.

Outcome: Complications occurredin 41 patients (63%) and none in 25 (37%). Survival was favorable in 26 patients (39%); 40 patients died (61%).

3.3 Hyponatremia (n = 79; 27.5%)

True (hypotonic) hyponatremiawasfoundin 58% — hypovolemic (46%), normovolemic (24%), hypervolemic (2%); false hyponatremiain 8%; pseudo-hyponatremiain 20%. Meanage 60.2 years (range 23–83);sex ratio 1.6. Comorbidities:diabetes (43%), heartfailure (26%), cirrhosis (13%).

Neurologicaldisturbancesoccurredin 71%;mechanical ventilation in 64%. Mean sodium was 127.2 mmol/L, withmildhyponatremiamostfrequent (76%). Main etiologies: digestive losses (25%), renallosses (21%), SIADH (17%).

Outcome: Mean ICU stay 17 ± 18 days. Complications occurredin 47 patients (60%) and none in 32 (40%). Survival was favorable in 48 patients (61%); 31 died (39%).

3.4 Hyperkalemia (n = 64; 22.5%)

Meanage 50.5 years (range 28–73); 44 men, 20 women (sex ratio 2.14). Comorbidities:medication use (36%), cardiovasculardisease (27%), renalfailure (18%). Mean potassium was 5.58 ± 0.43 mmol/L;elevatedcreatininein 91% and elevatedureain 50%. Renalfailure (36%) was the principal etiology.

Outcome: Complications occurredin 52 patients (82%) and none in 12 (18%); cardiovascular complications in 41%. Survival was favorable in 23 patients (36%); 41 died (64%).

3.5 Hypokalemia (n = 57; 20%)

Meanage 49 years (range 17–84); 30 men, 27 women (sex ratio 1.13). Comorbidities:medication use (47%), cardiovasculardisease (29%), diabetes (20%). Mean potassium was 2.99 ± 0.34 mmol/L, frequentlyassociatedwithdysnatremia. Main etiologies: digestive losses (52%), renallosses (40%).

Outcome: Complications occurredin 30 patients (53%) and none in 27 (47%); neurological complications in 40%, cardiovascularin 30%. Survival was favorable in 40 patients (70%); 17 died (30%).

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4. DISCUSSION

In ourseries, 60% of patients developed an electrolytedisturbance, consistent withreported ICU rates of 49–59% [5,6]. ICU patients are particularlyvulnerableowing to diseaseseverity and limitedautonomy.

Hyponatremiawas the mostfrequentdisorder (27.5%), higherthan the 13.7% reported in a Rabat study [21], likelyreflectingourthreshold (<135 vs <130 mmol/L) and inclusion of hospital-acquiredcases. Reported incidences varywidely (1–50%) depending on population, setting, threshold, and age [18–45].

Hypernatremia (23%) carried high mortality (61%), reflecting patient frailty (79% ventilated, 72% withneurologicalimpairment). Increasedfluidlossesaccounted for 72% of cases. Advanced ageis a recognizedrisk factor [22,47–51].

Hyperkalemia (22.5%) wasstronglyassociatedwithrenalfailure (elevatedcreatininein 91%), consistent with the literatureidentifyingrenalinsufficiency as the principal cause [58–64]. Itscardiacrepercussionsaccounted for the highestmortalityamongdyskalemias (64%).

Hypokalemia (20%) wasprimarilyattributable to digestive and renallosses, in line withprior reports [52–57].

Clinical manifestations of dysnatremias are predominantlyneurological, withseveritycorrelatingwith magnitude and rapidity of onset. Correction must not exceed the rate of initial development, to avoidosmoticdemyelination (hyponatremia) or cerebraledema (hypernatremia). Dyskalemias carry mainlycardiacrisks, mandatingelectrocardiographicassessment.

Limitations: The retrospective single-center design, unavailability of certain parameters (bloodgases, magnesium, natriuresis), and absence of severityscoringlimitgeneralizability.

5. CONCLUSION

Water and electrolytedisturbances are common in the surgical emergency ICU and are associatedwith high mortality, relatedboth to the underlyingillness and to the disturbanceitself. Diagnosisisprimarilyclinical, supported by simple laboratory tests. Correction shouldbecautious and proportionate to the rate of onset. Regular monitoring of serumelectrolytes enables timely correction and prevention.

TABLES

Table 1. Main characteristics and outcomes by disorder

Variable	Hypernatremia (n=66)	Hyponatremia (n=79)	Hyperkalemia (n=64)	Hypokalemia (
Incidence (%)	23	27.5	22.5	20
Meanage (years)	49 ± 5	60.2	50.5	49
Sex ratio (M/F)	1.6	1.6	2.14	1.13
Mean value (mmol/L)	150.3 ± 5	127.2	5.58 ± 0.43	2.99 ± 0.34
Mechanical ventilation (%)	79	64	73	60
Impairedconsciousness (%)	72	50	68	51
Complications, n (%)	41 (63)	47 (60)	52 (82)	30 (53)
Survivors, n (%)	26 (39)	48 (61)	23 (36)	40 (70)
Deaths, n (%)	40 (61)	31 (39)	41 (64)	17 (30)

Table 2. Main etiologies by disorder

Disorder	Principal etiologies (%)

Disorder	Principal etiologies (%)
Hypernatremia	Renallosses (38), digestive losses (34), severe sepsis (9)
Hyponatremia	Digestive losses (25), renallosses (21), SIADH (17)
Hyperkalemia	Renalfailure (36), transcellular shift (14), K-sparingdiuretics (14)
Hypokalemia	Digestive losses (52), renallosses (40)

Table 3. Comparison of hyponatremia incidence with the literature

Study	Country	Setting	Incidence (%)
De Vita et al. [36]	USA	Polyvalent ICU	30
Bennani et al. [21]	Morocco	Medical ICU	13.7
Maggioni et al. [39]	Italy	Cardiology	27.4
Pottier et al. [20]	France	Internalmedicine	12.1
Hawkins [22]	Singapore	Emergency	22.1
Presentstudy	**Morocco**	**Surgical emergency ICU**	**27.5**

DECLARATIONS

Ethicsapproval: This retrospectivestudywasconducted in accordance with the Declaration of Helsinki. Anonymized data wereused and patient confidentialitywasmaintainedthroughout.

Consent: Not applicable (retrospectiveanonymized data).

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Conflicts of interest: The authorsdeclare no conflicts of interest.

Authorcontributions: KE collected and analyzed the data and drafted the manuscript. MAB supervised the work and revised the manuscriptcritically. AT and AM contributed to data interpretation and manuscriptreview. All authorsread and approved the final manuscript.

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