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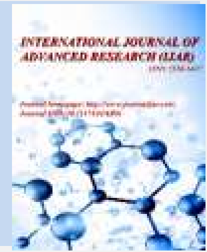

RESEARCH ARTICLE

WATER AND ELECTROLYTE DISTURBANCES IN A SURGICAL EMERGENCY INTENSIVE CARE UNIT: A DESCRIPTIVE STUDY OF 288 ADULT PATIENTS

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

Abstract

Background: Water and electrolyte disturbances are frequent in intensive care unit (ICU) patients and may contribute to significant morbidity and mortality. Data specific to surgical emergency ICU settings remain scarce.
Objective: To describe the epidemiological, clinical, etiological, and outcome characteristics of dysnatremias and dyskalemias in a surgical emergency ICU.
Methods: We conducted a retrospective descriptive study over twelve months (January–December 2018) in the Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca, Morocco. All patients hospitalized during the study period were included. Hyponatremia was defined 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. Hyponatremia was the most frequent (n=79; 27.5%), followed by hypernatremia (n=66; 23%), hyperkalemia (n=64; 22.5%), and hypokalemia (n=57; 20%). Hypovolemic hyponatremia predominated (46%), mainly due to digestive and renal losses and SIADH (17%); mortality was 39%. Hypernatremia was driven by renal (38%) and digestive (34%) losses, with 61% mortality. Hyperkalemia was primarily related to renal failure, with cardiovascular complications in 41% and mortality of 64%. Hypokalemia resulted mainly from digestive (52%) and renal (40%) losses, with 30% mortality.
Conclusion: Water and electrolyte disturbances are common in surgical emergency ICU patients and are associated with high mortality. Regular electrolyte monitoring enables timely correction and prevention while avoiding the risks of overly rapid correction.

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Introduction:-

Disturbances of water and electrolyte metabolism, particularly involving sodium and potassium, are commonly encountered in the intensive care unit (ICU) and may cause considerable morbidity and mortality.(1,2) They usually

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result from an underlying disease that causes losses and/or impairs regulatory mechanisms.(3) Digestive disorders, surgical procedures, polytrauma, renal and hepatic failure, endocrine diseases, and impaired consciousness are situations in which ionogram abnormalities should be anticipated.(4) A substantial proportion of these disturbances are iatrogenic, related to hypotonic infusions, artificial nutrition, and diuretic use.(2) Regardless of etiology, they may evolve independently and cause complications distinct from the underlying disease. These disturbances are usually reversible when detected and treated early,(3) yet few studies have specifically addressed them in the ICU despite their high prevalence. The aim of this study was to provide an epidemiological, clinical, paraclinical, therapeutic, and prognostic overview of water and electrolyte disturbances in the Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca.

Methods:-

Study Design and Setting:-

This was a retrospective descriptive study of 288 cases conducted in the 12-bed Surgical Emergency ICU of Ibn Rochd University Hospital, Casablanca, which admits patients from the emergency department, other hospital departments, and other national hospitals.

Study Period:-

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

Inclusion and Exclusion Criteria:-

All patients admitted during the study period were included. No exclusion criteria were applied.

Data Collection:-

Recorded variables included:-

- Demographics: age, sex, origin, pre-ICU length of stay
- Prior health status: comorbidities and medical history
- Clinical parameters: hemodynamic and respiratory status, Glasgow Coma Scale off sedation, seizures, hydration signs, urine output, digestive symptoms
- Biological parameters: serum and corrected sodium, natriuresis, potassium, chloride, anion gap, glucose, urea, creatinine, plasma/urinary osmolality, total protein, hemoglobin, calcium, phosphorus, transaminases, bilirubin, prothrombin time

Plasma and urinary osmolalities were calculated as follows:

Plasma osmolality = (Na+K) x 2 + glucose x 5.5 + urea x 16.5

Urinary osmolality = (Na+K)urinary x 2 + urinary urea x 16.5

Diagnostic Definitions:-

Hyponatremia was defined as serum sodium below 135 mmol/L, hypernatremia as serum sodium above 145 mmol/L, hypokalemia as serum potassium below 3.5 mmol/L, and hyperkalemia as serum potassium above 5.5 mmol/L.

Results:-

Overall Incidence:-

Among 288 patients, 115 (40%) had no disturbance, while 173 (60%) developed at least one water or electrolyte disturbance. Among these, 39 patients (22%) had more than one ionic disorder, and 18 patients (6%) had hydration disorders without ionic abnormality.

Hypernatremia (n=66; 23%):-

Mean age was 49±5 years (range 22–73), with male predominance (sex ratio 1.6). Comorbidities included cardiovascular disease (27%), medication use (21%), neurological disease (18%), and diabetes (15%). Admission reasons were postoperative (60%), trauma (45%), and stroke (10%).

Impaired consciousness was present in 72% and mechanical ventilation was required in 79%. Mean sodium was 150.3±5 mmol/L, with mild hypernatremia most frequent (63%). Renal losses (38%) and digestive losses (34%) were the main etiologies. Complications occurred in 41 patients (63%); 40 patients died (61%), while 26 patients (39%) had a favorable outcome.

Hyponatremia (n=79; 27.5%):-
True (hypotonic) hyponatremia was found in 58% — hypovolemic (46%), normovolemic (24%), hypervolemic (2%); false hyponatremia in 8%; pseudo-hyponatremia in 20%. Mean age was 60.2 years (range 23–83); sex ratio 1.6. Comorbidities included diabetes (43%), heart failure (26%), and cirrhosis (13%). Neurological disturbances occurred in 71% and mechanical ventilation was required in 64%. Mean sodium was 127.2 mmol/L, with mild hyponatremia most frequent (76%). Main etiologies were digestive losses (25%), renal losses (21%), and SIADH (17%). Mean ICU stay was 17±18 days. Complications occurred in 47 patients (60%); 31 patients died (39%), while 48 patients (61%) had a favorable outcome.

Hyperkalemia (n=64; 22.5%):-
Mean age was 50.5 years (range 28–73), with marked male predominance (sex ratio 2.14). Comorbidities included medication use (36%), cardiovascular disease (27%), and renal failure (18%). Mean potassium was 5.58±0.43 mmol/L. Elevated creatinine was found in 91% of cases and elevated urea in 50%. Renal failure was the principal etiology (36%). Complications occurred in 52 patients (82%), including cardiovascular complications in 41%. 41 patients died (64%), while 23 patients (36%) had a favorable outcome.

Hypokalemia (n=57; 20%):-
Mean age was 49 years (range 17–84), with sex ratio 1.13. Comorbidities included medication use (47%), cardiovascular disease (29%), and diabetes (20%). Mean potassium was 2.99±0.34 mmol/L, frequently associated with dysnatremia. Main etiologies were digestive losses (52%) and renal losses (40%). Complications occurred in 30 patients (53%), predominantly neurological (40%) and cardiovascular (30%). 17 patients died (30%), while 40 patients (70%) had a favorable outcome.

Discussion:-

Overall Prevalence:-
In our series, 60% of patients developed an electrolyte disturbance, consistent with reported ICU rates of 49–59%.(1,2) ICU patients are particularly vulnerable owing to disease severity, limited autonomy, and the multiplicity of therapeutic interventions.

Hyponatremia:-
Hyponatremia was the most frequent disorder (27.5%), higher than the 13.7% reported in a Moroccan ICU study.(5) This difference likely reflects our lower diagnostic threshold and the inclusion of hospital-acquired cases. Hypovolemic forms predominated (46%), mainly related to digestive and renal losses.(6) SIADH accounted for 17% of etiologies, consistent with published data in postoperative and neurological ICU contexts.(7) Neurological manifestations were prominent (71%), and the observed mortality (39%) reflects both the severity of underlying pathologies and the complications of the disturbance itself.

Hypernatremia:-
Hypernatremia (23%) carried the highest mortality among dysnatremias (61%), reflecting the frailty of the affected population: 79% were mechanically ventilated and 72% had neurological impairment. Excessive fluid losses accounted for 72% of etiologies. Advanced age is a well-recognized risk factor due to reduced osmotic sensitivity and decreased renal concentrating capacity.(8) The predominance of renal (38%) and digestive (34%) losses is consistent with published series in surgical ICUs.(9)

Hyperkalemia:-
Hyperkalemia (22.5%) was strongly associated with renal failure, with elevated creatinine in 91% of cases, consistent with the literature identifying renal insufficiency as the principal cause in critically ill patients.(10) Cardiovascular complications were observed in 41% of cases, accounting for the highest mortality among dyskalemias (64%). These results emphasize the importance of systematic electrocardiographic monitoring and early management whenever potassium exceeds 5.5 mmol/L.

Hypokalemia:-
Hypokalemia (20%) was primarily attributable to digestive (52%) and renal (40%) losses, in line with prior reports.(11) Its frequent association with dysnatremia underlines the combined nature of electrolyte disturbances in ICU patients. The lower mortality (30%) reflects the greater reversibility of this disorder when detected and corrected early.

Management Considerations:-

Clinical manifestations of dysnatremias are predominantly neurological, with severity correlating with the magnitude and rapidity of onset. Correction must not exceed the rate of initial development, to avoid osmotic demyelination syndrome in hyponatremia or cerebral edema rebound in hypernatremia.(12) Dyskalemias carry mainly cardiac risks, mandating systematic electrocardiographic assessment and prompt therapeutic intervention.

Study Limitations:-

This study has several limitations inherent to its retrospective single-center design. The unavailability of certain biological parameters (blood gases, magnesium, natriuresis, kaliuresis) for all patients, and the absence of standardized severity scoring, limit the generalizability of findings. Prospective multicenter studies incorporating these parameters would be necessary to confirm and extend these observations.

Conclusion:-

Water and electrolyte disturbances are common in the surgical emergency ICU and are associated with high mortality, related both to the underlying illness and to the disturbance itself. Diagnosis is primarily clinical, supported by simple and accessible laboratory tests. Correction should be cautious, gradual, and proportionate to the rate of onset of the disorder. Regular monitoring of serum electrolytes enables timely correction and prevention of complications, while avoiding the risks associated with overly rapid correction.

Declarations:-

Ethics Approval: This retrospective study was conducted in accordance with the Declaration of Helsinki. Anonymized data were used and patient confidentiality was maintained throughout.

Consent: Not applicable (retrospective anonymized data).

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Conflicts of Interest: The authors declare no conflicts of interest.

Author Contributions: KE collected and analyzed the data and drafted the manuscript. MAB supervised the work and revised the manuscript critically. AT and AM contributed to data interpretation and manuscript review. All authors read and approved the final manuscript.

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