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Intake and output evaluation in post-surgical patients during ICU stay

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Abstract

Background: Disturbances in fluid and electrolyte balance are common clinical issues encountered in the intensive care unit (ICU), and recent studies have shown that they can lead to increased morbidity and mortality rates among critically ill patients.

Objectives: This study aims to monitor patients' fluid and electrolyte imbalances post-operatively throughout their ICU stay.

Methods: The study design involved monitoring the patients' intake and output of fluids and electrolytes during their ICU stay from November 1st, 2022, until July 13th, 2023. This was carried out using a systematic approach that accounted for the patients' general health characteristics and included relevant information related to the patients' surgical history, duration of surgery, complications post-anesthesia, and the type of surgical intervention.

Results: The study revealed that 55.6% of the patient sample had surgery that lasted 1-3 hours. The majority of patients complained of apnea post-anesthesia, and laparotomy intervention was the most common surgical operation (37.7%). Major surgeries accounted for 95.6% of the interventions, while minor surgeries only accounted for 4.4%.

Conclusion: The study highlights that fluid and electrolyte imbalances are major problems in post-operative patients, particularly those admitted to the ICU. The most common complications related to fluid and electrolyte imbalance in ICU patients were either hypertension or hypotension, with a consequent deterioration of the patients' overall health status.

Keywords: Post-surgical, Surgery, Electrolytes, Water-Electrolyte Balance, Intensive Care Units.

Introduction

Electrolytes, crucial for maintaining homeostasis and regulating key physiological processes such as cardiac and neurological functioning, fluid balance, oxygen supply, and acid-base equilibrium, play a critical role in the body.[1] Disturbances in fluid and electrolyte balance are among the most common clinical issues encountered in the intensive care unit (ICU), and recent research has shown that such imbalances are associated with increased morbidity and mortality rates in critically ill patients.[2] Unfavorable outcomes, including prolonged ICU stays, increased healthcare costs, and higher mortality rates, have been linked to fluid administration.[3]

Severe burns, trauma, infection, brain damage, and heart failure are examples of critical illnesses that can disrupt fluid and electrolyte homeostasis. Contributing variables may include hormonal system dysregulation (e.g., the renin-angiotensin-aldosterone system and vasopressin) and kidney injury from ICU-related ischemia, nephrotoxicity, or medication-related insults.[4] Fluid and electrolyte balance, vital for cellular function, tissue perfusion, and acid-base equilibrium, presents a fundamental challenge to maintaining bodily homeostasis.[5]

In critically ill individuals, imbalances in fluids and electrolytes can have lethal consequences. Clinicians must possess a thorough understanding of fluid and electrolyte homeostasis, as well as the underlying pathophysiology of each condition, in order to provide optimal care. Additionally, intensivists should be aware of medications and fluid administration practices that may contribute to electrolyte and fluid abnormalities.[6]

Surgical complications result in numerous deaths each year, and many of these fatalities may have been preventable. Water-electrolyte imbalances have significant yet potentially preventable consequences that can increase the risk of mortality.[7]

Changes in the fluid and electrolyte levels of critically ill individuals can result from numerous causes, although underlying disease processes represent the primary source of imbalance in such patients.[8] Patients in critical care settings are at an elevated risk of developing fluid and electrolyte disturbances, which have been shown to increase mortality and morbidity rates. Disturbances in the distribution of electrolytes are found in approximately 27.9% of patients with abnormalities, a rate approximately three times higher than that of normal electrolyte patients, and are associated with ICU stays of more than seven days. Patients on mechanical ventilation are also more likely to experience potassium disturbances, which have been linked to elevated mortality and morbidity.[9]

A cross-sectional study in Iraq, titled "Electrolyte disturbances in a sample of hospitalized patients from Iraq," discovered that 80.5% of hospitalized patients had hypokalemia, with 73% having hypochloremia, 72% having hypocalcemia, and 56.7% having hyponatremia. These conditions, commonly affecting hospitalized patients, can increase mortality and lead to ventricular arrhythmias.[10]

Critical care nurses are critical to providing continuous monitoring and advanced care for critically ill patients, including the early detection of changes that require prompt management, such as fluid and electrolyte imbalances. Qualified nursing staff with the knowledge and clinical skills needed to maintain patients' hydration status and electrolyte balance is essential. These nurses must also be equipped with critical thinking and advanced problem-solving abilities and should base their practice on research evidence to deliver high-quality patient care.[11,12]

Fluid balance is an essential aspect of critical care clinical practice, requiring full awareness from all personnel responsible for patient care. Small changes in fluid balance levels can have a significant impact on patient health outcomes and progress, necessitating careful charting and review by the multidisciplinary team.[13]

Objectives

The objective of this study was to monitor post-operative patients' fluid intake and output and electrolyte alterations throughout their ICU stay.

Methods

Prior to conducting the study, official consent was obtained from the Department of Training Center and Human Development/Nineveh Health Directorate, Iraq, to access the collected data. Informed consent was obtained from the field supervisor and patients or their caregivers for the utilization of study tools. The study utilized a quantitative prospective follow-up design aimed at studying the research objectives, which lasted from November 1, 2022, until July 13, 2023. The study aimed to collect data and implement the instrument scale on patients admitted to the surgical intensive care unit at AL-Jumhory, AL-Salam, Ibn Senna, and Al-Mosul General Teaching Hospitals in Mosul City.

A non-probability (purposive) sample of 67 patients was chosen for the study, and 22 of those patients were excluded as they had either been discharged or had died within 3-5 days. Thus, the study sample consisted of 45 patients.

Data were collected from participants who had undergone surgical intervention and had been admitted to the ICU for post-operative critical care and follow-up management. The investigator utilized an appropriate instrument and scale according to the following steps:

Step one

Patient inclusion criteria for this study consisted of patients admitted to the ICU with post-surgical and anesthetic-related complications, irrespective of surgical intervention type and age (above 15 years). Patients who stayed in the ICU for more than five days were also included. The exclusion criteria for this study were as follows: patients with cardiovascular disease (including arrhythmia, heart failure, and conductive abnormalities), renal impairment, and open-heart surgery. The initial stage of the study involved the gathering of information regarding patient health status characteristics, which was obtained from conscious patients or their relatives for

unconscious patients. Following that, the patient file and surgical and anesthetic notes were reviewed to ensure the accuracy and adequacy of information throughout the patient's ICU stay until discharge or death. Each case took approximately 10–20 minutes to complete the data collection process through an interview process.

Steps Two

The second stage of the study involved the evaluation of the intake and output follow-up chart for the validity and reliability of the study instrument. A panel of 11 experts from different specialties and related agencies was involved in reading and reviewing the initial draft of the study instrument sheets to ensure that they met the study objectives. The experts provided their opinions about the instrument items and their adequacy. Additionally, a sample of five patients who had been admitted to the ICU following post-surgical intervention were included, and the study tools were implemented on these patients to assess the reliability of measurement parameters and identify any potential error techniques that could occur during data collection. The pilot study was also carried out to obtain information about the research problem, which would help in modifying the approaches or skills required during data collection at a later time.

Statistical analysis

The continuous variables were expressed as the mean ± SD, and the categorical variables were presented as a percentage and frequency. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc, Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The present study did not interfere with the process of diagnosis and treatment of patients and all participants signed an informed consent form.

Results

Table 1 displays the age and habit descriptions of the patient sample group. The data show that 22.2% of the patient sample group was between the age groups of 46 and 55 years old, and an equal percentage (22.2%) was between 56 and 65 years old. Additionally, 11.1% of the age group consisted of patients between 26 and 35 years old; 11.1% of the age group were between 66 and 75 years old; and the remaining 33.3% were 76 years old or older. Furthermore, 55.6% of the patient sample group was male. Concerning habits, the majority of patients (75.6%) were non-smokers, while only 6.7% were former smokers. Additionally, 93.3% of the patients did not consume alcohol.

Table 1. Distribution of patient sample description according to their demographic characteristic (n=45)

Variable	Group		Frequency	Percentage	Mean	SD
Age	15-25 year		9	20.0%	45	18.24
	26-35 year		5	11.1%		
	36-45 year		6	13.3%		
	46-55 year		10	22.2%		
	56-65 year		10	22.2%		
	66-75 year		5	11.1%		
Gender	Male		25	55.6%		
	Female		20	44.4%		
Habits	Smoking	Non- Smoker	34	75.6%	1.42	0.783
		Ex-Smoker	3	6.7%		
		Currently Smoker	8	17.7%		
	Alcohol Consumption	Not	42	93.3%		
		Yes	3	6.7%		

Table 2 demonstrates the patient sample descriptions based on their medical history, ICU stay days, and comorbidity disease. The findings indicate that 95.6% of the patients did not use steroids, while 4.4% used steroids regularly for more than 30 days. Moreover, 93.3% of the patients did not take diuretics, while only 6.7% did. On the other hand, 82.2% of the patients did not use minerals and supplements, while the remaining 17.8% did. Finally, a high percentage of patients, 91.1%, did not receive any chemotherapy medication.

Regarding the total daily ICU stay, data show that the majority of patients (44.4%) stayed in the ICU for between 8 and 14 days. Conversely, the lowest proportion of patient stays, 17.8%, were for a period ranging from 14 to 21 days. Reviewing the comorbidity parameter, the results showed that 35.6% of patients experienced hypertension, while the next highest value was diabetes mellitus, which affected 20.0% of patients. Furthermore, only 2.2% of the patients had a neurological problem, such as seizures.

Table 2. Distribution of patient samples description according to their health characteristics

Variable		Group		Frequency	Percentage	Mean	SD
Medication History	**Steroid Used**	Not used		43	95.6%	1.09	0.416
		Used less than 30 days		0	0.0%		
		Used for more than 30 days		2	4.4%		
	Diuretics	Not used		42	93.3%	-	-
		Used		3	6.7%		
	Minerals and Supplement	Not used		37	82.2%	-	-
		Used		8	17.8%		
	Chemotherapy	Not received		41	91.1%	1.133	0.457
		Received currently		2	4.4%		
		30 days before surgery		2	4.5%		
ICU Total Daily Stay		0-7 day (1week)		17	37.8%	9.911	4.516
		8-14 day (2week)		20	44.4%		
		14-21 day (3week)		8	17.8%		
Comorbidity Disease		Non		41	91.1%	-	-
		Hematologic Disease		4	8.9%		
		Non		41	91.1%	-	-
		Renal Disease		4	8.9%		
		Non		29	64.4%	-	-
		Hypertension		16	35.6%		
		Metabolic Disease	Non	34	75.6%	1.288	0.548
			DM	9	20.0%		
			Thyroid	2	4.4%		
		Lung Disease	Non	42	93.3%	-	-
			Asthma	3	6.7%		
		Non		40	88.9%	-	-
		Impaired Immune response		5	11.1%		
		Non		41	91.1%	-	-
		Oncologic Disease		4	8.9%		
		Neurological	Non	42	93.3%	1.088	0.358
			CVA	2	4.4%		
			Seizure	1	2.3%		
		Other	Non	42	93.3%	-	-
			IHD	3	6.7%		

Table 3 presents the results of the three observational episodes of intravenous fluid intake in terms of percentages. The first observation episode shows that 64.4% of patients received normal saline, 6.6% received dextrose water, 91.1% received glucose saline, and 20.0% received Ringer's solution. The package volumes of

intravenous fluid ranged from 500 to 3000 ml. In the second observation episode, 77.7% of patients received normal saline, 6.6% received dextrose water, 91.1% received glucose saline, and 26.7% received Ringer's solution. The package volumes of intravenous fluid ranged from 500 to 3000 ml. In the third observation episode, 75.6% of patients received normal saline, 6.6% received dextrose water, 86.7% received glucose saline, and 28.8% received Ringer's solution. The package volumes of intravenous fluid ranged from 500 to 3000 ml.

Table 3. The intake of intravenous infusion parameter with alteration changes during 3 observation episode interval

Type of Intravenous Infusion Solution	Package Volume Intake	Observational Episode Interval					
		E1		E2		E3	
		N	%	N	%	N	%
Normal Saline (0.9%)	Non	16	35.6	10	22.3	11	24.4
	500 ml	9	20.0	11	24.4	12	26.7
	1000 ml	10	22.2	11	24.4	7	15.6
	1500 ml	8	17.8	9	20.0	12	26.7
	2000 ml	2	4.4	4	8.9	2	4.4
	2500 ml	0	0.0	0	0.0	0	0.0
	3000 ml	0	0.0	0	0.0	1	2.2
	Mean±SD	1.355±1.264		1.688±1.276		1.688±1.411	
Dextrose Water (5%)	Non	42	93.4	42	93.4	42	93.4
	500 ml	0	0.0	1	2.2	1	2.2
	1000 ml	2	4.4	0	0.0	0	0.0
	1500 ml	0	0.0	0	0.0	0	0.0
	2000 ml	1	2.2	1	2.2	1	2.2
	2500 ml	0	0.0	1	0.0	1	2.2
	3000 ml	0	0.0	0	2.2	0	0.0
	Mean±SD	0.177±0.716		0.244±1.069		0.222±0.950	
Glucose Saline (5%, 0.9%)	Non	4	8.9	4	8.9	6	13.3
	500 ml	2	4.4	2	4.4	5	11.1
	1000 ml	13	28.9	17	37.8	14	31.1
	1500 ml	14	31.1	12	26.7	12	26.7
	2000 ml	6	13.3	4	8.9	3	6.7
	2500 ml	5	11.1	4	8.9	3	6.7
	3000 ml	1	2.3	2	4.4	2	4.4
	Mean±SD	2.777± 1.428		2.666±1.46		2.400±1.543	
Ringer's Solution	Non	36	80.0	33	73.3	32	71.1
	500 ml	0	0.0	1	2.2	1	2.2
	1000 ml	5	11.1	6	13.3	6	13.3
	1500 ml	4	8.9	3	6.7	5	11.1
	2000 ml	0	0.0	2	4.5	1	2.3
	2500 ml	0	0.0	0	0.0	0	0.0
	3000 ml	0	0.0	0	0.0	0	0.0
	Mean±SD	0.488±1.014		0.666±1.206		0.711±1.198	

Table 4 depicts the types of fluid intake through both oral intake and via NG tube gavage during the three observation episodes. It shows a considerable change in oral intake among patients during their ICU stay. In the first episode, only 8.9% of patients registered any oral intake, while this increased to 26.7% in the second episode, and finally, 35.5% of patients had an average oral fluid intake ranging from 250 to 750 ml. Liquid or semi-solid nutrient intake showed a similar pattern, with 8.9%, 26.7%, and 35.5% of patients receiving this type of nutrition

through an oral route. NG tube gavage nutrition showed 8.9% of patients receiving this type of nutrition in the first episode, while it increased to 35.6% in the second episode and remained relatively stable with 33.3% in the third episode, administered at volumes ranging from 500 to 1500 ml.

Table 5 presents the output fluid parameters, including alteration and amount, during the three episodes. Urine output ranging from <3000 ml was recorded in 44, 36, and 35 cases in the first, second, and third episodes, respectively. The amount of NG lavage tube secretion was recorded in 2, 6, and 4 cases for the first, second, and third episodes, respectively. Similarly, the amount of tube drain secretion was recorded in 22, 21, and 10 cases for the first, second, and third episodes, respectively. Oral secretion suction was noted in 11, 11, and 7 cases, respectively, for the first, second, and third episodes. Stool excretion results displayed a pattern of 44, 16, and 27 cases of non-elimination or absence of stool in the first, second, and third episodes, respectively. Lastly, the parameter of vomit was recorded in 6, 16, and 8 cases for the first, second, and third episodes, respectively.

Table 4. Intake of oral liquid and NG tube gavage parameter with alteration changes during 3 observation episode interval

Type of Oral / NG Gavage Liquid Intake	Package Volume Intake	Observational Episode Interval					
		E1		E2		E3	
		N	%	N	%	N	%
Oral/ Liquid intake (ml)	Non	41	91.1	33	73.3	29	64.4
	250 ml	3	6.7	1	2.2	1	2.2
	500 ml	1	2.2	11	24.5	13	28.9
	750 ml	0	0.0	0	0.0	2	4.5
	Mean±SD	0.111±0.382		0.511±0.869		0.777±1.125	
Oral/ Semi Liquid intake (ml)	Non	41	91.1	33	73.3	29	64.4
	250 ml	3	6.7	1	2.2	1	2.2
	500 ml	1	2.2	11	24.5	13	28.9
	750 ml	0	0.0	0	0.0	2	4.5
	Mean±SD	0.111±0.382		0.511±0.869		0.777±1.125	
NG / Gavage Tube Liquid and Semiliquid intake ml	Non	41	91.1	29	64.4	30	66.7
	500 ml	1	2.2	1	2.2	1	2.2
	750 ml	3	6.7	10	22.2	7	15.6
	1000 ml	0	0.0	5	11.2	6	13.3
	1500 ml	0	0.0	0	0	1	2.2
	Mean±SD	0.155±0.520		0.800±1.140		0.822±1.248	

Discussion

The study included 45 patients with a range of ages from 15 to 75 years old and a mean age of 45±18.24. The majority of the sample (22.2%) fell in the age groups of 46–55 and 56–65 years old, while the lowest percentage (11.1%) was in the age groups of 26–35 and 66–75 years old. These findings are consistent with Das et al.'s study, which found that 74% of patients admitted to the ICU for electrolyte and fluid imbalances were between the ages of 31 and 50.[14]

The results revealed that 55.6% of the sample group were male patients, while 44.4% were female patients. This finding is consistent with a study by Upadhyay et al.,[15] which found that male patients comprised 58.6% of the total sample of 14,654 patients admitted to the ICU. However, in contrast to our results, a study by Van Regenmortel et al. found that the majority of the sample group were female patients, comprising 57% of the total enrolled in the study compared to male patients at 43%. The higher proportion of male patients in this study may be attributed to the post-operative cause of surgical intervention related to injuries, which occurred more frequently in males.[16]

Table 5. Output of urine, NG tube lavage, drain, oral secretion, stool, and vomit parameter with alteration changes during 3 observation episode interval

Type of Out put	Volume/ Quantity	Observational Episode Interval					
		E1		E2		E3	
		N	%	N	%	N	%
Urine	Non	1	2.2	0	0.0	0	0.0
	1000 ml	4	8.9	3	6.7	3	6.7
	1500 ml	10	22.2	3	6.7	4	8.9
	2000 ml	27	60.0	14	31.1	16	35.6
	2500 ml	3	6.7	16	35.6	12	26.7
	3000 ml	0	0.0	8	17.8	8	17.8
	3500 ml	0	0.0	1	2.1	2	4.3
	Mean±SD	2.600±0.836		3.577±1.137		3.533±1.217	
NG/ Lavage Tube Secretion	Non	43	95.6	39	86.6	41	91.1
	50 ml	1	2.2	3	6.7	1	2.2
	100 ml	0	0.0	3	6.7	3	6.7
	>100ml	1	2.2	0	0.0	0	0.0
	Mean±SD	0.088±0.468		0.200±0.547		0.155±0.520	
Drain Tube Discharge	Non	23	51.1	24	53.3	35	77.8
	50 ml	2	4.4	10	22.2	8	17.8
	100 ml	13	28.9	9	20.0	2	4.4
	> 100ml	7	15.6	2	4.5	0	0.0
	Mean±SD	1.088±1.202		0.755±0.933		0.266±0.539	
Oral Secretion Suction	Non	34	75.6	34	75.6	38	84.4
	50 ml	10	22.2	8	17.8	7	15.6
	100 ml	0	0.0	3	6.6	0	0.0
	>100ml	1	2.2	0	0.0	0	0.0
	Mean±SD	0.288±0.588		0.311±0.586		0.155±0.366	
Stool	Non	44	97.8	16	35.6	27	60.0
	100 ml	1	2.2	7	15.6	7	15.6
	200 ml	0	0.0	17	37.7	7	15.5
	>300ml	0	0.0	5	11.1	4	8.9
	Mean±SD	0.022±1.409		1.244±1.066		0.733±1.031	
Vomit	Non	39	86.7	29	64.4	37	82.2
	50 ml	4	8.9	4	8.9	5	11.1
	100 ml	1	2.2	9	20.0	3	6.7
	>100ml	1	2.2	3	6.7	0	0.0
	Mean±SD	0.200±0.587		0.688±1.018		0.244±0.570	

Regarding the habit variable, specifically smoking, the results show that 75.6% of the sample were non-smokers, while 17.8% and 6.7% reported being current and former smokers, respectively, with a mean and standard deviation of 1.42±0.783.

The findings of the present study were consistent with those of Siddika et al., who found that the majority of patients admitted to the intensive care unit were non-smokers (34.8% smokers, 65.2% non-smokers).[17] However, Arena et al. reported contrasting results, where the majority of patients with electrolyte and fluid disturbance who had a longer hospital stay and higher mortality rate were smokers (20.1% of the total sample of 24,818 patients).[18] Moreover, the majority of patients in the present study reported being non-alcoholic due to religious and cultural beliefs, which was also consistent with the study by Azarasa et al.,[19] that found most patients had no history of alcohol consumption and had a shorter stay in the ICU with minimum fluid or electrolyte disturbance. However, Rubinsky et al.,[20] reported

controversial findings where patients who had a history of alcohol consumption had a higher mortality rate and severe electrolyte disturbance leading to organ failure.

The presented results in Table 1 depicted the patient's health characteristics upon admission to the ICU and were classified into three variables. The first variable is medication history, where 95.6% of patients reported taking medication, while 4.4% either didn't take medication or were on steroids for more than 30 days. The second variable pertains to diuretics, where 93.3% of patients used diuretics, while 6.7% either didn't use them or used other medications. The third variable refers to mineral supplements, where 82.2% of patients used them, while 17.8% either didn't use them or used other medication. Furthermore, 91.1% of patients did not receive chemotherapy, while 4.4% were currently receiving it and 4.5% received it within 30 days before surgery.

The findings in Table 1 align with a study by Wang et al.,[21] which found that post-surgical ICU patients with related complications of fluid and electrolyte disturbance were mainly due to medication side effects. However, the study by Asehnoune et al.,[22] contradicted our findings, as their sample of 122 patients who received chemotherapy, steroids, and other chronic illness medication showed no early effect on fluid disturbance in ICUs. Other complications occur during patient stays. These results agree with the findings of Martini et al.,[23] which showed that patients who undergo major surgical interventions and have post-anesthesia complications tend to have longer stays in the ICU. However, Mun et al.,[24] disagreed with this finding and reported shorter ICU stays due to highly qualified medical and nursing management. Finally, the results in Table 2 showed a high prevalence of comorbid diseases such as hypertension, diabetes mellitus, and impaired immune systems. These findings are consistent with the study by Moore et al.,[25] which included 392 ICU patients with chronic illnesses such as cardiovascular, neurological, and respiratory diseases, resulting in longer stays and higher mortality rates.

The findings of Table 3 are consistent with the study by Malbrain et al.,[26] which found that most patients who were admitted to critical care after surgical interventions required intravenous fluid and depended on it until their conscious level was corrected. This was particularly necessary for patients with problems that prohibited oral intake, such as those who had undergone laparotomy or maxillofacial surgery.

In terms of the other input parameters shown in Table 4, a clear image emerges of conscious or semi-conscious patients who needed a supporting approach to intravenous infusion in terms of nutrient substances and water. These findings agree with the study by Chittawatanarat and Chuntrasakul,[27] which analyzed 20 patients who had undergone post-operative abdominal surgery or neurological surgery. The study found that some patients required a nasogastric tube for careful nutritional support to meet the body's requirements for nutrient material feeding and measuring its effect on the patient's health status.

In contrast to our findings, a study[28] found that most patients who were admitted to the ICU were unconscious and depended entirely on a nasogastric tube, resulting in complications such as aspiration pneumonia.

Findings in Table 5 were consistent with those of Rajebhosale et al.,[29] who discovered that most patients had changes in input, output, or related secretion as a result of complications such as anesthesia medication, patient health status, use of life support machines, and fluid or electrolyte disturbances.

Conclusions

Fluid and electrolyte disturbances represent a significant challenge for post-operative patients, particularly those admitted to the ICU. Laparotomy and craniotomy are the most common surgical interventions related to ICU admission, while apnea and decreased level of consciousness are the leading causes of admission. Further studies are needed to investigate how healthcare workers can better manage fluid and electrolyte disturbances in these patients.

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Competing interests

The authors declare that they have no competing interests.

Abbreviations

Intensive care unit: ICU;

Renin-angiotensin-aldosterone system: RAAS.

Authors' contributions

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The present study did not interfere with the process of diagnosis and treatment of patients and all participants signed an informed consent form.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

References

1. Larivée NL, Michaud JB, More KM, Wilson JA, Tennankore KK. Hyperkalemia: Prevalence, Predictors and Emerging Treatments. Cardiol Ther. 2023;12(1):35-63. doi:10.1007/s40119-022-00289-z PMid:36503972 PMCid:PMC9742042
2. Kleindienst A, Georgiev S, Schlaffer SM, Buchfelder M. Tolvaptan versus fluid restriction in the treatment of hyponatremia resulting from SIADH following pituitary surgery. J Endocr Soc. 2020;4(7): bvaa068. doi:10.1210/jendso/bvaa068 PMid:32666012 PMCid:PMC7326480
3. Hazzard E, Gulliver S, Walton K, McMahon AT, Milosavljevic M, Tapsell L. The patient experience of having a feeding tube during treatment for head and neck cancer: a systematic literature review. Clin Nutr ESPEN. 2019;33:66-85.doi:10.1016/j.clnesp.2019.07.005 PMid:31451279
4. Indrebø M, Berg A, Holmstrøm H, Seem E, Guthe HJ, Wiig H, et al. Fluid accumulation in the staged Fontan procedure: the impact of colloid osmotic pressures. Interact Cardiovasc Thorac Surg. 2019;28(4):510-7. doi:10.1093/icvts/ivy298 PMid:30371784
5. Boldt J, Priebe HJ. Intravascular volume replacement therapy with synthetic colloids: is there an influence on renal function?. Anesth Analg. 2003;96(2):376-82. doi: 10.1097/00000539-200302000-00014 PMid:12538180
6. Fatima SP, Prashanthi DP. Serum electrolytes as mortality indicators in hypertension cases. Eur J Mol Clin Med. 2022;9(7): 3721-8.
7. Decaux G, Gankam Kengne F. Hypertonic saline, isotonic saline, water restriction, long loops diuretics, urea or vaptans to treat hyponatremia. Expert Rev Endocr Metabol. 2020;15(3):195-214. doi:10.1080/17446651.2020.1755259 PMid:32401559
8. Pearce D, Manis AD, Nesterov V, Korbmacher C. Regulation of distal tubule sodium transport: mechanisms and roles in homeostasis and pathophysiology. Pflügers Arch Eur J Physiol. 2022;474(8):869-84. doi:10.1007/s00424-022-02732-5 PMid:35895103 PMCid:PMC9338908
9. Argaiz ER, Koratala A, Reisinger N. Comprehensive assessment of fluid status by point-of-care ultrasonography. Kidney 360. 2021; 2(8):1326. doi:10.34067/KID.0006482020 PMid:35369665 PMCid:PMC8676400
10. Ibrahim SL, Alzubaidi ZF, Al-Maamory FA. Electrolyte disturbances in a sample of hospitalized patients from Iraq. J Med Life. 2022;15(9):1129. doi:10.25122/jml-2022-0039 PMid:36415511 PMCid:PMC9635247
11. Tewelde SZ, Mattu A. Electrocardiography in the Emergency Department. Textbook of Emergency Cardiology. 2021:30.
12. Friars D, Walsh O, McNicholas F. Assessment and management of cardiovascular complications in eating disorders. J Eat Disord. 2023;11(1):1-2. doi:10.1186/s40337-022-00724-5 PMid:36717950 PMCid:PMC9886215
13. Pearce D, Manis AD, Nesterov V, Korbmacher C. Regulation of distal tubule sodium transport: mechanisms and roles in homeostasis and pathophysiology. Pflügers Arch Eur J Physiol. 2022;474(8):869-84. doi:10.1007/s00424-022-02732-5 PMid:35895103 PMCid:PMC9338908
14. Das J, Das D, Mandal S, Maitra BC, Acharjee A, Mandal M. Serum sodium and water imbalance after sellar, suprasellar, and parasellar surgeries: A prospective and observational study. Asian J Med Sci. 2023;14(4). doi:10.3126/ajms.v14i4.51410
15. Upadhyay S, Bhalerao N, Pratinidhi SA. Study of level of consciousness and electrolyte abnormalities in patient admitted to intensive care unit (ICU). Int J Contemp Med Res. 2017;4(8):1739-42.
16. Van Regenmortel N, Verbrugghe W, Roelant E, Van den Wyngaert T, Jorens PG. Maintenance fluid therapy and fluid creep impose more significant fluid, sodium, and chloride burdens than resuscitation fluids in critically ill patients: a retrospective study in a tertiary mixed ICU population. Intensive Care Med. 2018; 44: 409-17. doi:10.1007/s00134-018-5147-3 PMid:29589054 PMCid:PMC5924672
17. Siddika N, Anowar MN, Islam MS, Mallick DR. Characteristics of Adult Intensive Care Unit Patients at a University Hospital. Open Access Libr J. 2023 ;10(3):1-5. doi:10.4236/oalib.1109891
18. Arena G, Cumming C, Lizama N, Mace H, Preen D. Hospital length of stay and readmission after elective surgery: a comparison of current and former smokers with non-smokers. 2023. doi:10.21203/rs.3.rs-2910058/v1

19. Azarasa M, Azarfarin R, Changizi A, Alizadehasl A. Substance use among Iranian cardiac surgery patients and its effects on short-term outcome. Anesth Analg. 2009;109(5):1553-9. doi:10.1213/ANE.0b013e3181b76371 PMid:19843794
20. Rubinsky AD, Sun H, Blough DK, Maynard C, Bryson CL, Harris AH, et al. AUDIT-C alcohol screening results and postoperative inpatient health care use. J Am Coll Surg. 2012; 214(3):296-305. doi:10.1016/j.jamcollsurg.2011.11.007 PMid:22244208
21. Wang AS, Dhillon NK, Linaval NT, Rottler N, Yang AR, Margulies DR, et al. The impact of iv electrolyte replacement on the fluid balance of critically ill surgical patients. Am Surg. 2019;85 (10): 1171-4. doi:10.1177/000313481908501021 PMid:31657318
22. Asehnoune K, Le Moal C, Lebuffe G, Le Penndu M, Josse NC, Boisson M, et al. Effect of dexamethasone on complications or all cause mortality after major non-cardiac surgery: multicentre, double blind, randomised controlled trial. BMJ. 2021;373. doi:10.1136/bmj.n1162 PMid:34078591 PMCid:PMC8171383
23. Martini V, Lederer AK, Laessle C, Makowiec F, Utzolino S, Fichtner-Feigl S, et al. Clinical characteristics and outcomes of surgical patients with intensive care unit lengths of stay of 90 days and greater. Crit Care Res Pract. 2017;2017. doi:10.1155/2017/9852017 PMid:28828185 PMCid:PMC5554573
24. Mun E, Ceria-Ulep C, Umbarger L, Nakatsuka C. Trend of decreased length of stay in the intensive care unit (ICU) and in the hospital with palliative care integration into the ICU. Perm J. 2016; 20(4). doi:10.7812/TPP/16-036 PMid:27644048 PMCid:PMC5101091
25. Moore D, Durie ML, Bampoe S, Buizen L, Darvall JN. The risk of postoperative deterioration of non-cardiac surgery patients with ICU referral status who are admitted to the regular ward: a retrospective observational cohort study. Patient Saf Surg. 2021; 15:1-6. doi:10.1186/s13037-021-00283-9 PMid:33612120 PMCid:PMC7897383
26. Malbrain ML, Langer T, Annane D, Gattinoni L, Elbers P, Hahn RG, et al. Intravenous fluid therapy in the perioperative and critical care setting: executive summary of the International Fluid Academy (IFA). Ann Intensive Care. 2020;10:1-9. doi:10.1186/s13613-020-00679-3 PMid:32449147 PMCid:PMC7245999
27. Chittawatanarat K, Chuntrasakul C. Enteral feeding in surgical critically ill patients. Thai J Surg. 2006;27(1):5-10.
28. EuroSurg Collaborative, Glasbey JC, Bibi S, Pata F, Ozkan BB, Van Straten S, Hodson J, et al. Timing of nasogastric tube insertion and the risk of postoperative pneumonia: an international, prospective cohort study. Colorectal Dis. 2020;22(12):2288-97. doi:10.1111/codi.15311 PMid:34092023
29. Rajebhosale R, Miah M, Centea D, Cleto C, Yusuf R, Ravi P, et al. Are we monitoring urine output for the surgical patients in ward settings while indicated or planned?. Open Access Libr J. 2020; 7 (7):1-4. doi:10.4236/oalib.1106498

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