

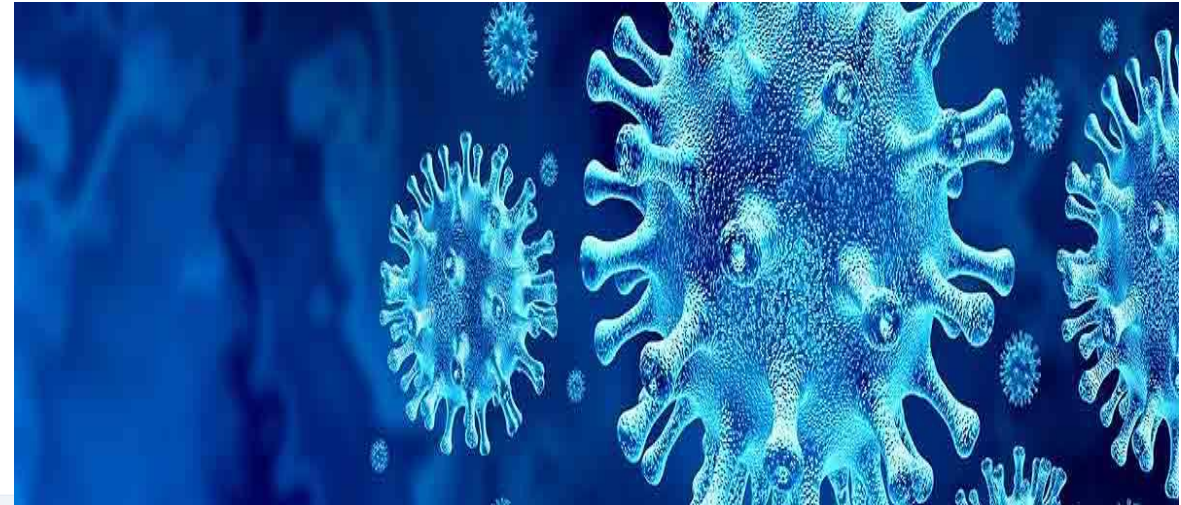
Effect of Electrolyte Imbalance on Mortality and Late Acute Kidney Injury in Hospitalized COVID-19 Patients

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نفروتوکسین ها و کلیه

Kidney and Nephrotoxins

۱۳-۱۵ مهر ۱۴۰۱-تهران

Outline:

Background

Material & method

Result

Message



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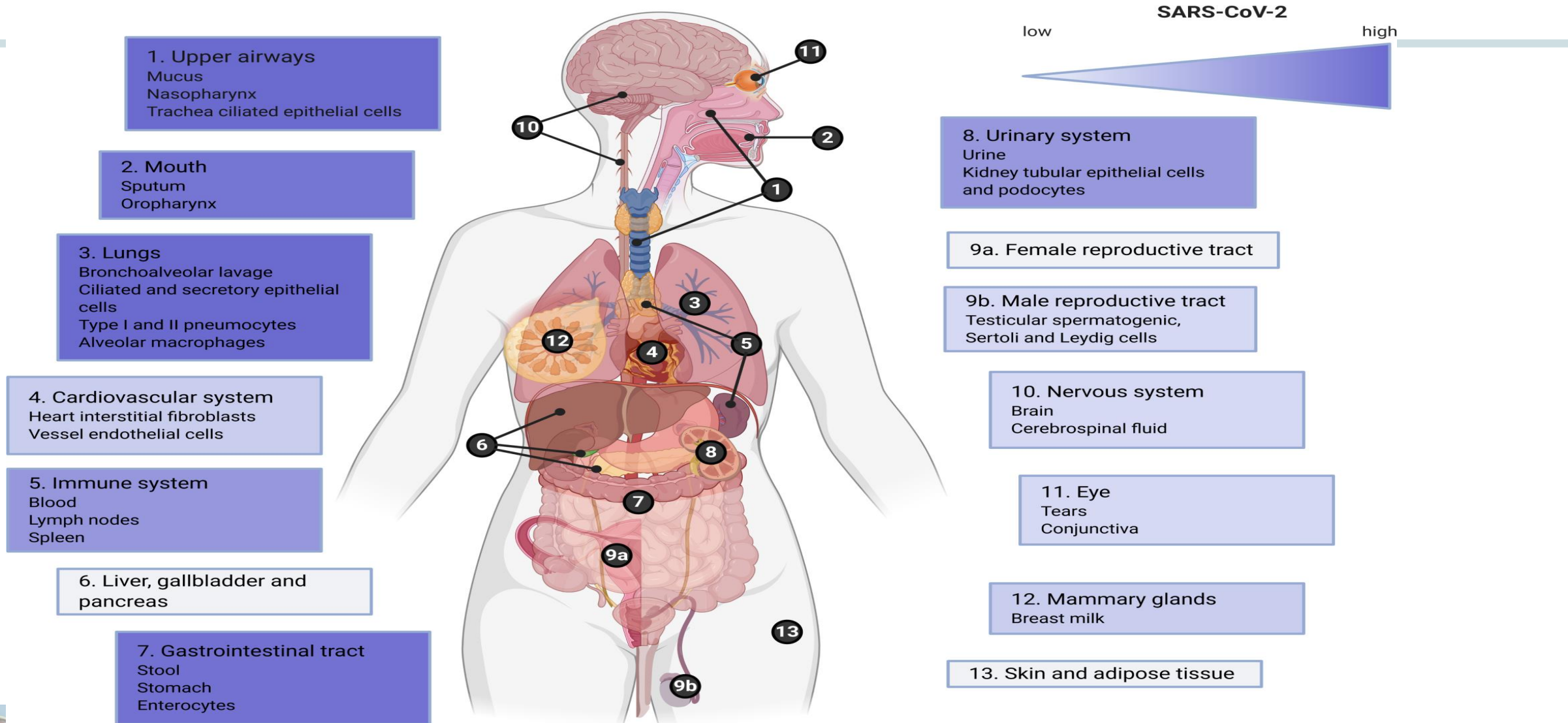
Introduction

The importance of Electrolyte Imbalance

The purpose of the study



The importance of Electrolyte Imbalance

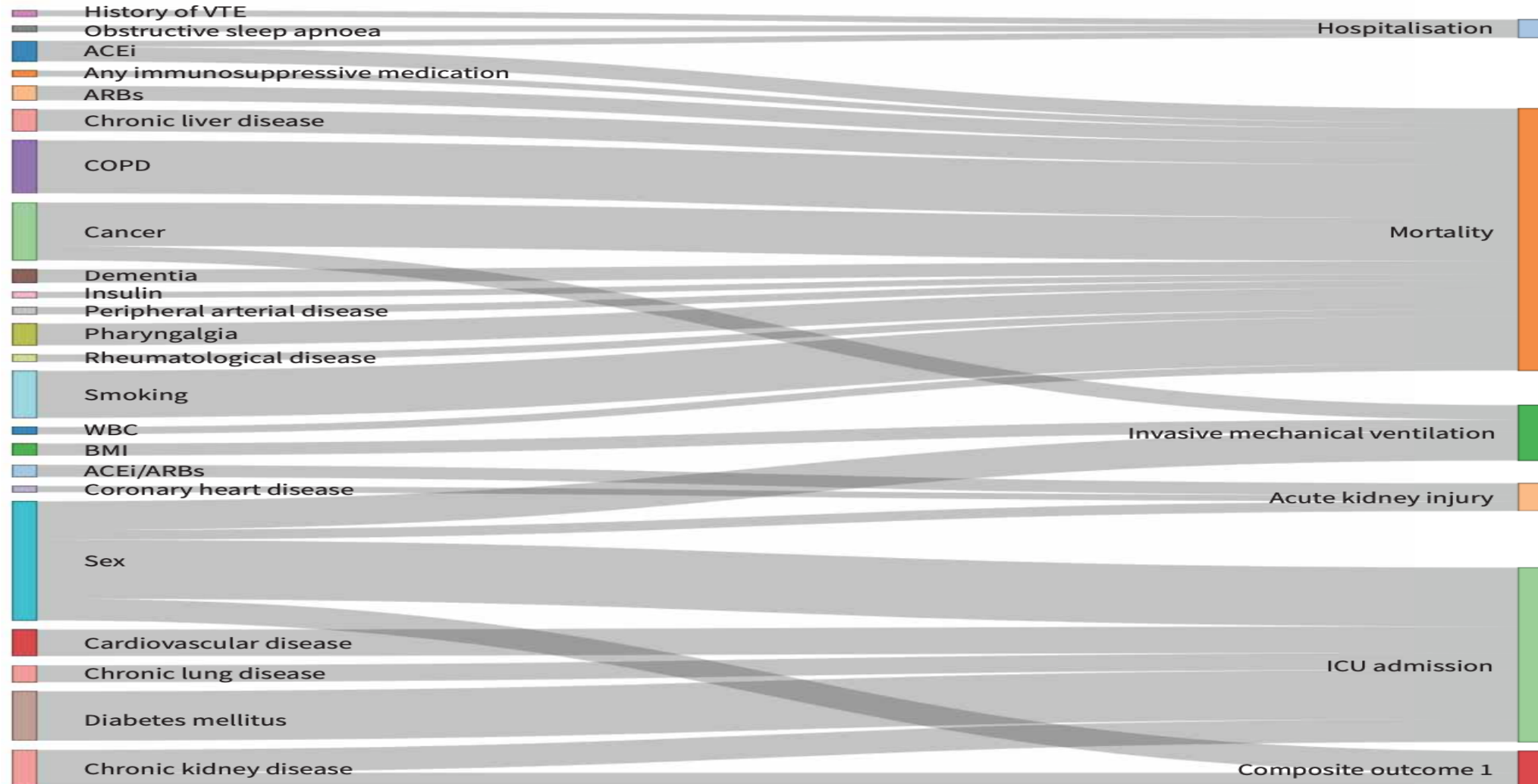


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۱۳-۱۵ مهر ۱۴۰۱ - تهران

Prognostic factors for adverse outcomes in patients with COVID-19: a field-wide systematic review and meta-analysis



The importance of Electrolyte Imbalance

Hindawi

BioMed Research International

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<https://doi.org/10.1155/2022/2350063>

Research Article

Epidemiology of COVID-19 in Tehran, Iran: A Cohort Study of Clinical Profile, Risk Factors, and Outcomes

Hamidreza Hatamabadi ¹, Tahereh Sabaghian ², Amir Sadeghi ³, Kamran Heidari,⁴



The importance of Electrolyte Imbalance

Variables		Total (n = 5318)	Survivor (n = 4204)	Deceased (n = 1112)	Cramer's V/Eta	p value
WBC ($\times 10^3/\mu\text{L}$)	—	7.3 (5.2, 10.5)	6.9 (5.0, 9.7)	9.1 (6.2, 13.2)	0.17	<0.001
Lymphs (%)	—	15.6 (10.0, 24.9)	17.9 (11.0, 25.4)	10.1 (7.1, 17.1)	0.22	<0.001
NEUT (%)	—	79.5 (70.0, 85.0)	76.9 (68.0, 85.0)	85.0 (77.4, 90.0)	0.23	<0.001
PLT ($\times 10^3/\mu\text{L}$)	—	194.0 (150.0, 255.0)	196.0 (152.0, 254.0)	186.0 (138.5, 259.0)	0.04	<0.001
HB (g/dL)	—	12.4 (10.9, 13.7)	12.5 (11.1, 13.8)	11.9 (10.1, 13.3)	0.12	<0.001
MCV (μm^3)	—	84.6 (80.5, 88.3)	84.3 (80.4, 88.0)	85.7 (80.7, 89.7)	—	<0.001
BUN (mg/dL)	—	19.0 (13.0, 31.0)	17.0 (12.0, 26.0)	29.0 (18.3, 48.8)	0.29	<0.001
CR (mg/dL)	—	1.1 (1.0, 1.5)	1.1 (0.9, 1.4)	1.4 (1.1, 2.2)	0.19	<0.001
NA (mEq/L)	—	138.0 (135.0, 141.0)	138.0 (135.0, 140.0)	138.0 (135.0, 141.0)	0.04	0.031
K (mEq/L)	—	4.1 (3.8, 4.4)	4.1 (3.8, 4.4)	4.2 (3.9, 4.7)	0.13	<0.001
CA (mg/dL)	—	8.6 (8.1, 9.3)	8.7 (8.2, 9.3)	8.5 (8.0, 9.1)	0.09	<0.001
MG (mEq/L)	—	1.9 (1.7, 2.2)	1.9 (1.7, 2.1)	2.0 (1.8, 2.2)	0.08	<0.001
P (mg/dL)	—	3.5 (2.9, 4.1)	3.4 (2.9, 4.0)	3.8 (3.1, 4.7)	0.22	<0.001

The purpose of the study

Previous studies showed that EI and AKI were associated with poor prognosis in COVID-19 patients

whether the effect of EI on mortality results from AKI, or it has an independent association with mortality

We evaluated the role of EI abnormality and occurrent late AKI in COVID-19 cases



Method & material

Design of study

Patient selection



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Design of study & Selection of patient

Retrospective study

567 covid-19 patients were enrolled Between 20 February and 20 March, 2021

Inclusion criteria :

positive COVID-19 (RT-PCR) tests ,admit on Hospital

The criteria for hospitalization were in concordance with the National COVID-19 guideline (SPO2 < 90%, RR > 30, or CT involvement > 50%)

Exclusion criteria:

68 patients were excluded due to transfer to other hospitals (n = 9) or a history of chronic kidney disease (CKD) (n = 59)

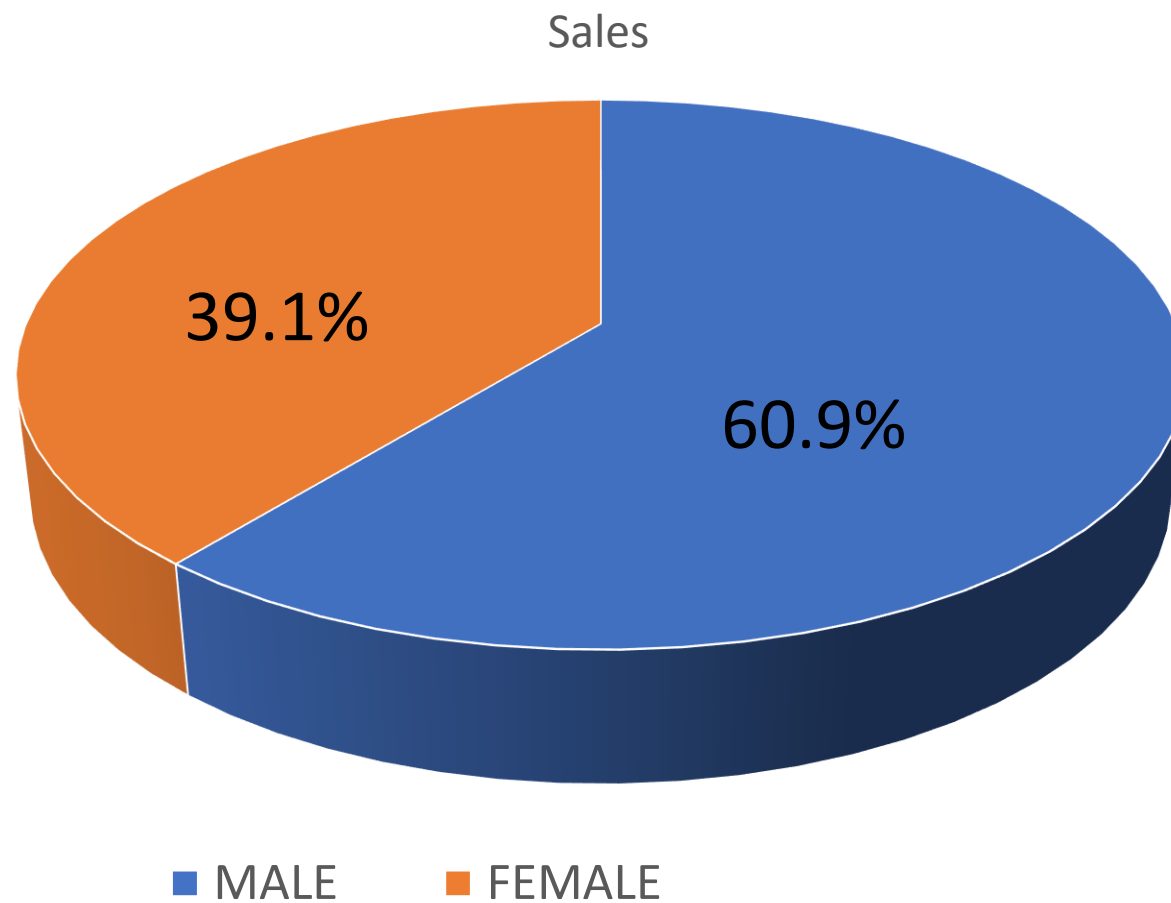


Results

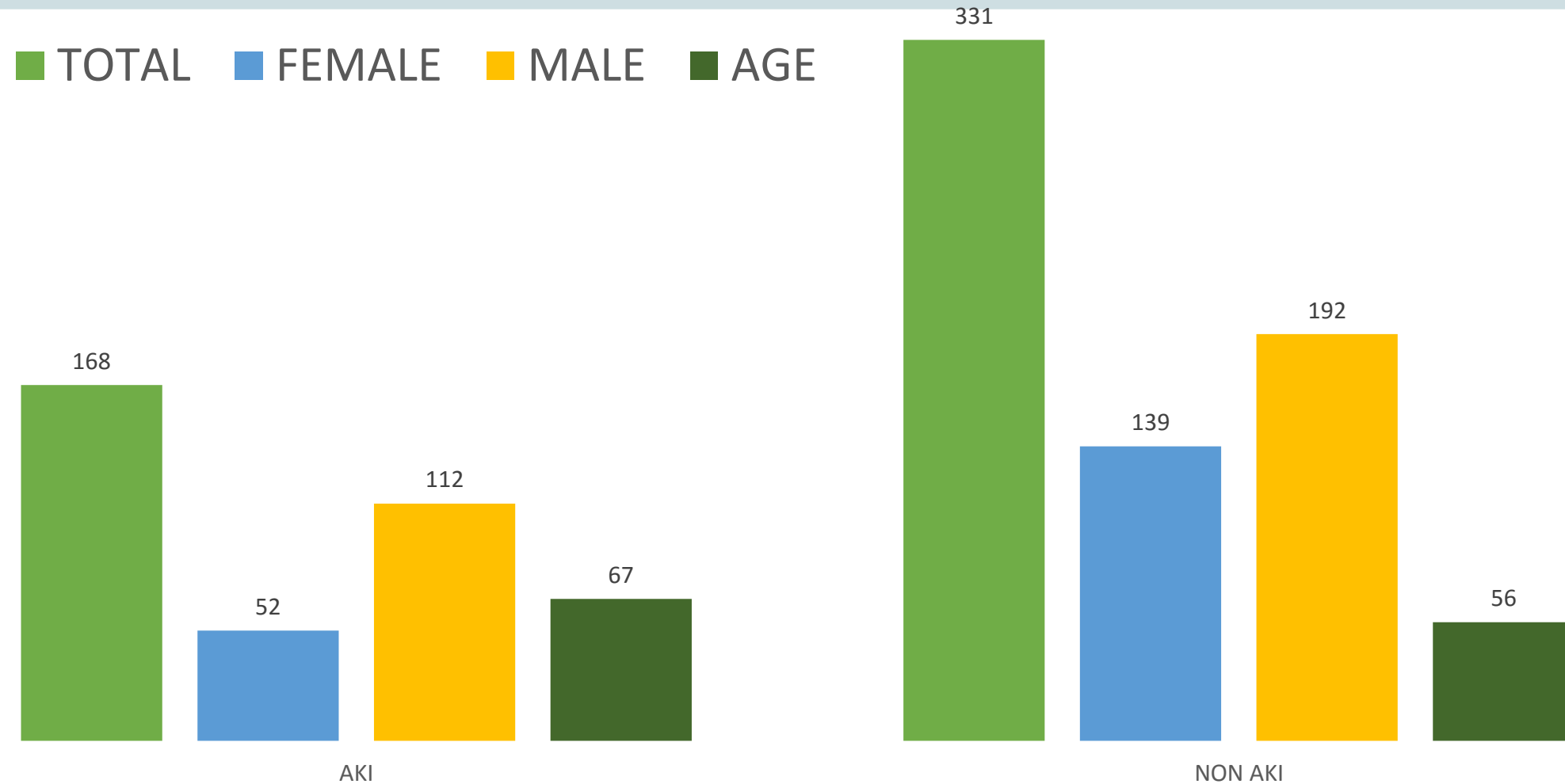
- Sex distribution
- AKI & Non AKI distribution
- Clinical presentations & Comorbidities
- EI on admission
- Mortality of Patients Based on Electrolyte Abnormalities on Admission & during Hospitalization
- Electrolyte Abnormality on Admission and Occurrence of Late AKI Among Patients with Normal Kidney Function in the First Week



Sex distribution (%)



AKI & Non AKI distribution



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Clinical presentations & Comorbidities

	AKI Patients (n = 168)	Non-AKI Patients (n = 331)	Total (n = 499)	P
	Count/mean (%SD)	Count/mean (%SD)	Count/mean (%SD)	
Presenting Symptoms				
Dyspnea	100 (59.5)	189 (57.1)	289 (57.9)	> .05
Cough	79 (47)	216 (65.3)	295 (59.1)	< .001
Fever	84 (51.2)	145 (43.8)	229 (46.3)	> .05
Chills	54 (32.1)	126 (38.1)	180 (36.1)	> .05
Fatigue				> .05
Anosmia				< .001
Diarrhea				> .05
Constipation				> .05
Nausea				> .05
Vomiting				> .05
Rectorrhagia				> .05
Headache				< .001
Myalgia	24 (14.6)	84 (26.4)	108 (22.4)	< .05
Medical History				
Diabetes	35 (21.5)	67 (21.1)	102 (21.3)	> .05
Hypertension	52 (31.9)	73 (23)	125 (26)	< .05
Respiratory	15 (9.2)	29 (9.1)	44 (9.1)	> .05
Cardiovascular	32 (19.6)	41 (12.9)	73 (15.2)	> .05
Neurologic	28 (17.2)	29 (9.1)	57 (11.9)	< .05
Immunodeficiency	4 (2.6)	4 (1.7)	8 (2)	> .05
Cancer	17 (10.4)	21 (6.6)	38 (7.9)	> .05
Rheumatologic	1 (0.6)	4 (1.3)	5 (1)	> .05

most common clinical presentations on admission were cough (59.1%), dyspnea (57.9%), and fever (46.3%), and the most frequent comorbidities were hypertension (26%) and diabetes mellitus (21.3%)



Electrolyte imbalance on admission

- ✓ 55.7% of the patients
- ✓ hypocalcemia (n = 134; 38%) the most frequent abnormality, followed by hyponatremia (n = 104; 22.6%)

	AKI Patients (n = 168)	Non-AKI Patients (n = 331)	Total (n = 499)	P
	Count/mean (%SD)	Count/mean (%SD)	Count/mean (%SD)	
Electrolyte on admission				
Na				
Hyponatremia	48 (28.7)	56 (19)	104 (22.6)	< .05
Hypernatremia	8 (4.8)	4 (1.4)	12 (2.6)	< .05
Normal	111 (66.5)	234 (79.6)	345 (74.8)	
K				
Hypokalemia	14 (8.4)	20 (6.8)	34 (7.4)	> .05
Hyperkalemia	13 (7.8)	7 (2.4)	20 (4.3)	< .05
Normal	140 (83.8)	266 (90.8)	406 (88.3)	
Mg				
Hypomagnesemia	18 (13.2)	15 (7.3)	33 (9.7)	> .05
Hypermagnesemia	6 (4.4)	3 (1.5)	9 (2.6)	> .05
Normal	112 (82.4)	188 (91.3)	300 (87.7)	
Ca				
Hypocalcemia	50 (36.5)	84 (39.1)	134 (38)	> .05
Hypercalcemia	8 (5.8)	7 (3.3)	15 (4.3)	> .05
Normal	79 (57.7)	124 (57.7)	203 (57.7)	
P				
Hypophosphatemia	19 (16.2)	31 (17.3)	50 (16.9)	> .05
Hyperphosphatemia	28 (23.9)	8 (4.5)	36 (12.2)	< .001
Normal	70 (59.8)	140 (78.2)	210 (70.9)	



Mortality of Patients Based on Electrolyte Abnormalities on Admission

	AKI Patients	Non-AKI Patients	Total	Adjusted Odd Ratio*	P
	Death Count (%)	Death Count (%)	Death Count (%)		
Sodium on Admission					
Hyponatremia	19 (39.6)	9 (16.1)	28 (26.9)	2.34 (1.30 to 4.18)	< .05
Hypernatremia	7 (87.5)	2 (50)	9 (75)	8.52 (1.95 to 37.32)	< .05
Normal Sodium Level [§]	29 (26.1)	19 (8.1)	48 (13.9)		
Potassium on Admission					
Hypokalemia	4 (28.6)	2 (10)	6 (17.6)	0.65 (0.22 to 1.91)	> .05
Hyperkalemia	8 (61.5)	2 (28.6)	10 (50)	4.63 (1.65 to 13.00)	< .05
Normal Potassium Level [§]	43 (30.7)	26 (9.8)	69 (17)		
Magnesium on Admission					
Hypomagnesemia	5 (27.8)	3 (20)	8 (24.2)	1.34 (0.53 to 3.41)	> .05
Hypermagnesemia	3 (50)	1 (33.3)	4 (44.4)	1.75 (0.41 to 7.43)	> .05
Normal Magnesium Level [§]	39 (34.8)	19 (10.1)	58 (19.3)		
Calcium on Admission					
Hypocalcemia	12 (24)	14 (16.7)	26 (19.4)	1.01 (0.55 to 1.87)	> .05
Hypercalcemia	4 (50)	1 (14.3)	5 (33.3)	1.32 (0.32 to 5.39)	> .05
Normal Calcium Level [§]	29 (36.7)	11 (8.9)	40 (19.7)		
Phosphorus on Admission					
Hypophosphatemia	6 (31.6)	3 (9.7)	9 (18)	1.13 (0.47 to 2.71)	> .05
Hyperphosphatemia	13 (46.4)	0 (0)	13 (36.1)	1.44 (0.60 to 3.43)	> .05
Normal Phosphorus Level [§]	21 (30)	16 (11.4)	37 (17.6)		

Mortality of Patients Based on Electrolyte Abnormalities During Hospitalization

	AKI Patients	Non-AKI Patients	Total	Adjusted Odd Ratio*	P
	Death Count (%)	Death Count (%)	Death Count (%)		
Sodium During Hospitalization					
Hyponatremia	24 (38.7)	14 (17.7)	38 (27)	3.27 (1.78 to 6.01)	< .001
Hypernatremia	22 (55)	7 (17.5)	29 (36.3)	4.07 (2.02 to 8.17)	< .001
Normal Sodium Level [§]	15 (19.5)	13 (6.9)	28 (10.6)		
Potassium During Hospitalization					
Hypokalemia	9 (22.5)	10 (21.3)	19 (21.8)	1.46 (0.75 to 2.86)	> .05
Hyperkalemia	22 (71)	4 (26.7)	26 (56.5)	7.74 (3.54 to 16.95)	< .001
Normal Potassium Level [§]	26 (25.7)	18 (7.6)	44 (13)		
Magnesium During Hospitalization					
Hypomagnesemia	8 (27.6)	4 (16.7)	12 (22.6)	1.16 (0.53 to 2.53)	> .05
Hypermagnesemia	10 (76.9)	3 (30)	13 (56.5)	4.31 (1.63 to 11.38)	< .05
Normal Magnesium Level [§]	32 (32.3)	17 (9.5)	49 (17.6)		
Calcium During Hospitalization					
Hypocalcemia	24 (32)	15 (13.9)	39 (21.3)	1.46 (0.8 to 2.66)	> .05
Hypercalcemia	6 (54.5)	1 (14.3)	7 (38.9)	2.29 (0.68 to 7.79)	> .05
Normal Calcium Level [§]	18 (30.5)	10 (9.3)	28 (16.9)		
Phosphorus During Hospitalization					
Hypophosphatemia	11 (39.3)	3 (8.8)	14 (22.6)	1.63 (0.75 to 3.55)	> .05
Hyperphosphatemia	18 (52.9)	0 (0)	18 (35.3)	2.24 (1.00 to 4.99)	< .05
Normal Phosphorus Level [§]	14 (23.3)	16 (12.3)	30 (15.8)		

Late AKI

- ✓ Twenty-five patients developed late AKI, among all participants
- ✓ The case fatality rate of late AKI (44%) was higher than that of early AKI (30.7%) and normal kidney function (11.1%)



Electrolyte Abnormality on Admission and Occurrence of Late AKI Among Patients with Normal Kidney Function in the First Week

Electrolyte	Late AKI Occurrence Count (%)	Adjusted OR (CI)*	P
Sodium			
Hyponatremia	12 (17.6)	3.02 (1.28 to 7.15)	< .05
Hypernatremia**	0 (0)	N/A	N/A
Normal Sodium Level [§]	13 (5.3)		
Potassium			
Hypokalemia	3 (13)	1.9 (0.49 to 7.32)	> .05
Hyperkalemia	2 (22.2)	3.02 (0.55 to 16.52)	> .05
Normal Potassium Level [§]	20 (7)		
Magnesium			
Hypomagnesemia	2 (11.8)	1.27 (0.26 to 6.18)	> .05
Hypermagnesemia	3 (50)	5.38 (0.94 to 30.62)	> .05
Normal Magnesium Level [§]	19 (9.2)		
Calcium			
Hypocalcemia	10 (10.6)	1.12 (0.44 to 2.89)	> .05
Hypercalcemia	2 (22.2)	2.91 (0.48 to 17.46)	> .05
Normal Calcium Level [§]	11 (8.1)		
Phosphorus			
Hypophosphatemia	4 (11.4)	1.69 (0.48 to 5.94)	> .05
Hyperphosphatemia	4 (33.3)	5.12 (1.24 to 21.09)	< .05
Normal Phosphorus Level [§]	10 (6.7)		

Conclusion& Message

- ✓ Hyponatremia is one of the most prevalent EI in covid-19
- ✓ Dysnatremia on admission or occurring during hospitalization, were correlate with mortality
- ✓ No correlation between hypokalemia on admission and death, while hyperkalemia, either on admission or during hospital stay, was associated with higher mortality
- ✓ Hypocalcemia is highly prevalent in severe COVID-19 cases. hypocalcemia on admission or its occurrence during hospitalization, did not correlate with late AKI or mortality



Conclusion& Message

Hypermagnesemia and hyperphosphatemia were found to be associated with mortality during hospitalization

All hyperphosphatemia-associated mortality in our study was observed in the AKI group. Therefore, hyperphosphatemia might predict poor outcome, only in patients with concomitant AKI



Conclusion& Message

- ✓ AKI occurring after seven days of hospitalization(15% of cases), were highly evident in cases with hyponatremia and hyperphosphatemia on admission
- ✓ Since EI may be predictive of late AKI and poor prognosis, we recommend physicians to be sensitive to this entity and correct any electrolyte imbalance that is present on admission or occurs during hospitalization



Thank you



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