ISSN: 2149-2018

Applied Medical Research, 2024
VOL 11, NO. 5, PAGE 1 – 8
DOI: doi.org/10.47363/AMR/2024(11)239

RESEARCH ARTICLE

Open Access

Characteristics and Outcome of Elderly Admitted to the Intensive Care Unit in Bahrain

Fatema Husain Mandeel[1], Hussein Hifnawi AlHafnawi[2], Hasan Mohamed Naser[3], Ebrahim Mohamed Alshaibah[4], Hawra Ahmed Salman[4], Aysha Asif Sarwani[5]*, Mahmood Kadhem Alsaeed[1] and Ahmed Hashem Alsadah[6]

[1]Geriatric Medicine Department, Salmaniya Medical Complex, Ministry of Health, P.O. Box:12, Bahrain

[2]Research Projects Coordinator, Clinical Research Center, Arabian Gulf University, Manama, Bahrain

[3]Intensive Care Unit, Salmaniya Medical Complex, Ministry of Health, P.O.Box 12, Bahrain

[4]Internal Medicine Department, Salmaniya Medical Complex, Ministry of Health, P.O.Box:12, Bahrain

[5]Endocrine and Diabetes Department, Salmaniya Medical Complex, Ministry of Health, P.O. Box:12, Bahrain

[6]Accident and Emergency Department, Qatif Central Hospital, Ministry of Health, P.O.Box 1444, KSA

ABSTRACT

Background: The elderly population is growing worldwide, leading to increased healthcare needs and geriatric specialists.

Aim: Our study aims to explore the clinical characteristics and outcomes of elderly admitted to the Intensive Care Unit (ICU) at Salmaniya Medical Complex (SMC), Bahrain

Methods: The study followed a descriptive retrospective design via medical chart review over two years (2021-2023) in the non-COVID-19 ICU at SMC. Elderly patients aged 70 years and above were included. Baseline clinical characteristics and outcomes were captured and analyzed.

Results: 205 elderly patients were admitted to the non-covid-19 ICU; the mean age was 78.3 ± 1.75 years. There were 54.6% (n=112) medical patients and 45.4% (n=93) surgical patients. The overall mortality rate over the two-year study period was 28.8% (n=59). The ICU's mean length of stay (LOS) was 7.32 ± 7.86 days. In multivariate analysis, 44.4% (n=91) of admitted patients were mechanically ventilated on admission, and 27.8% (n=57) were on vasopressor. More than half of the patients underwent central venous and urinary catheter insertion (64.9% (n=133) and 83.4% (n=171)). Our study revealed a statistically significant association between patients with mechanical ventilation (p-value < 0.01), urinary catheters (p-value < 0.01), inotropes (p-value < 0.01), and ICU death. Additionally, the number of comorbidities and age does not affect the length of stay (p-value 0.77 and 0.58), and surgical patients have significantly shorter LOS (p-value < 0.001).

Conclusion: During ICU stay, organ dysfunctions and infections had a significant impact on the outcomes in elderly critically ill patients. The factors associated with mortality were mechanical ventilation and vasopressors. Moreover, surgically admitted patients have shorter lengths of stay and better ICU outcomes.

ARTICLE HISTORY

Received May 13, 2024
Accepted May 18, 2024
Published May 27, 2024

KEYWORDS

Elderly, Intensive Care Unit, Outcome, Mortality

Background

Bahrain has reported a relatively low mortality rate of 2.2 deaths per 1,000 citizens per year between 2015 and 2020 [1-3]. Compared to the global rate of 8.0 deaths per 1,000 citizens per year in 2020 [4]. Moreover, the comprehensive healthcare system contributed to an increase in the life expectancy for Bahrainis, as it reached 75 years for males and 77 years for females, compared to a global life expectancy of 70.85 for males and 75.87 for females [1,5].

The elderly population is growing in Bahrain and worldwide, resulting in a higher hospitalization rate and admission to the Intensive Care Unit (ICU) [6,7]. The elderly population requires more healthcare resources, suitable facilities, and geriatric specialists [8].

Age is strongly associated with ICU outcomes. Nonetheless, it is yet to be determined whether elderly mortality in ICU is independently determined by age or other factors. Elderly patients frequently suffer from multiple comorbidities before admission and meet the physiological demands of critical illness [9-11].

Contact Aysha Asif Sarwani, Endocrine and Diabetes Department, Salmaniya Medical Complex, Ministry of Health, P.O. Box:12, Bahrain.

E-mail: ayshasif@hotmail.com

© 2024 The Authors. This is an open access article under the terms of the Creative Commons Attribution NonCommercial ShareAlike 4.0 (https://creativecommons.org/licenses/by-nc-sa/4.0/).

The mortality rate remains high in critically ill elderly patients in hospital and ICU, with a vast difference in outcome depending on the admission reason. Thus, surgical patients have a satisfactory result compared to medical patients at greater risk of death [12,13].

The rising numbers of elderly admitted to ICU in many countries necessitate further research [14,15]. Given the above, our study explores the characteristics and outcomes of elderly admitted to the ICU.

Methodology

Design and Population

Our retrospective and descriptive study was conducted in a non-COVID-19 ICU (mixed medical and surgical patients) at Salmaniya Medical Complex (SMC), a training governmental hospital in Manama, Bahrain. ICU at Salmaniya Hospital has an overall capacity of twenty-two beds, where patients are managed by intensivists. The medical charts were reviewed for two years, from January 2021 to January 2023.

Inclusion Criteria

Patients aged >70 years with medical and surgical illnesses who were admitted to the ICU.

Exclusion Criteria

Patients aged <70 years. Patients with COVID-19 infection and cardiac diagnosis on admission were excluded from the study as they were admitted to separate intensive care units.

Data Collection

Patients who met the inclusion and exclusion criteria were included in this study. Prior permission and ethical clearance from the Secondary Healthcare Research Subcommittee, Salmaniya Medical Complex, Bahrain was conducted. The demographics and clinical variables: age, gender, nationality, diagnosis, comorbidities, length of stay (LOS), and outcome were extracted from medical records. Comorbidities, including hypertension, diabetes mellitus, cardiovascular disease, chronic renal disease, chronic liver disease, neurological disease, pulmonary disease, hematological disease, and malignancy, were noted.

Clinical data encompasses the type of admission (medical or surgical), the need for organ support (Mechanical Ventilation (MV) and inotropes), and ICU procedures (central line insertion and urinary catheter). From medical records, blood, urine, and deep tracheal aspiration (DTA) cultures were identified. The study sample was divided into groups according to age (70 - 79 years old, 80 - 89 years old, and above 90 years old).

The data was interpreted by descriptive analysis using IBM SPSS Statistical software for Windows version 28. Descriptive analysis was used, and mean, median and standard deviations were calculated. The Pearson correlation test was applied to investigate the relationship between the outcome and other characteristics. Risk statistics, i.e., odds ratio, was used to estimate risk. A p-value of <0.05 was considered to be significant.

Results

A total of 205 geriatric admissions to non-Covid-19 ICU over two years from January 2020 to January 2023; 62.4% (n=128) of the admissions were in the age group 70-79 years old, and only 10.2 % (n=21) where the age 90 years or more. The majority of the admitted patients were Bahrainis (93.2 %, n=191) (Table 1).

Regarding patient's comorbidities, the majority of admitted cases had at least one comorbidity (n=186, 92.2 %), and the mean number of comorbidities was 2.57 for each admission. The most common comorbidity was hypertension 65.9 % (n=135), followed by diabetes mellitus 58.0 % (n=119). The least reported comorbidity was chronic liver disease, reported by only two male cases (Table 1).

Table 1: Information on Patients' Characteristics and Comorbidities

		Sex				Total	Row N %
		Male		Female			
		Count	Row N %	Count	Row N %		
Gender	Male	110	100.0%	0	0.0%	110	53.7%
	Female	0	0.0%	95	100.0%	95	46.3%
Age group (78.34 +- 1.751)	70-79	77	60.2%	51	39.8%	128	62.4%
	80-89	24	42.9%	32	57.1%	56	27.3%
	≥ 90	9	42.9%	12	57.1%	21	10.2%
Type of admission	Medical	56	50.0%	56	50.0%	112	54.6%
	Surgical	54	58.1%	39	41.9%	93	45.4%
Nationality	non-Bah	6	42.9%	8	57.1%	14	6.8%
	Bah	104	54.5%	87	45.5%	191	93.2%

Diabetes	No	46	53.5%	40	46.5%	86	42.0%
	Yes	64	53.8%	55	46.2%	119	58.0%
Hypertension	No	41	58.6%	29	41.4%	70	34.1%
	Yes	69	51.1%	66	48.9%	135	65.9%
Heart Disease	No	64	48.9%	67	51.1%	131	63.9%
	Yes	46	62.2%	28	37.8%	74	36.1%
Chronic Renal Disease	No	86	52.8%	77	47.2%	163	79.5%
	Yes	24	57.1%	18	42.9%	42	20.5%
Chronic Liver Disease	No	108	53.2%	95	46.8%	203	99.0%
	Yes	2	100.0%	0	0.0%	2	1.0%
Neurological Disease	No	81	50.3%	80	49.7%	161	78.5%
	Yes	29	65.9%	15	34.1%	44	21.5%
Pulmonary Disease	No	98	55.1%	80	44.9%	178	86.8%
	Yes	12	44.4%	15	55.6%	27	13.2%
Hematological Disease	No	103	53.9%	88	46.1%	191	93.2%
	Yes	7	50.0%	7	50.0%	14	6.8%
Dyslipidemia	No	84	55.6%	67	44.4%	151	73.7%
	Yes	26	48.1%	28	51.9%	54	26.3%

Table (2) demonstrates patients' status upon ICU admission in terms of mechanical ventilator, inotropes, urinary catheter, and central line insertion; we found that 83.4 % (n=171) of the admitted cases had a urinary catheter inserted; 44.4% (n=91) of admitted patients were mechanically ventilated and 27.8% (n=57) were on inotropes. Moreover, most elderly underwent central venous catheter and urinary catheter insertion (64.9%, n=133, and 83.4%, n=171, respectively).

Additionally, the majority of urine and blood cultures revealed negative readings (60.0%, n=123, and 81.5%, n=167, respectively), and 36.1 % (n=48) of deep tracheal aspiration (DTA) cultures were positive.

Table 2: Intensive Care Unit's Organ Support, Procedures, and Cultures

		Sex				Total	Row N %
		Male		Female			
		Count	Row N %	Count	Row N %		
MV on Admission	No	58	50.9%	56	49.1%	114	55.6%
	Yes	52	57.1%	39	42.9%	91	44.4%
Inotropes on admission	No	79	53.4%	69	46.6%	148	72.2%
	Yes	31	54.4%	26	45.6%	57	27.8%
Central line on admission	No	36	50.0%	36	50.0%	72	35.1%
	Yes	74	55.6%	59	44.4%	133	64.9%
Urinary catheter on admission	No	18		16		34	16.6%
	Yes	92		79		171	83.4%
Blood Culture	negative	91	54.5%	76	45.5%	167	81.5%
	Positive	13	65.0%	7	35.0%	20	9.8%
	unavailable	6	33.3%	12	66.7%	18	8.8%
DTA Culture	negative	44	51.8%	41	48.2%	85	41.5%
	Positive	29	60.4%	19	39.6%	48	23.4%
	unavailable	37	51.4%	35	48.6%	72	35.1%
Urine Culture	negative	72	58.5%	51	41.5%	123	60.0%
	Positive	18	46.2%	21	53.8%	39	19.0%
	unavailable	20	46.5%	23	53.5%	43	21.0%

The ICU mean length of stay was 7.32 +/- 7.86 (n=204, mode = 1, mdn = 4) days, where 50% of the admissions lasted for four days or less (Table 3). Moreover, the LOS mean and median were higher for the non-survived group compared to the survived patients (n=59) at eight days compared to seven for the mean and five compared to four for the median. Furthermore, the number of comorbidities does not affect the LOS ((f=0.86, p-value = 0.768)). 59 (28.8%) admitted patients expired during their ICU stay (Table 3).

Table 3: Information on Patients' Outcomes

		Sex				Total	Row N %
		Male		Female			
		Count	Row N %	Count	Row N %		
Length of Stay (mean= 7.32 SD= 7.87, Mdn = 4.00, mode = 1)	0-10	83	50.9%	80	49.1%	163	79.5%
	11-20	16	61.5%	10	38.5%	26	12.7%
	21-30	7	87.5%	1	12.5%	8	3.9%
	>=31	3	42.9%	4	57.1%	7	3.4%
Inotropes on discharge	No	76	55.1%	62	44.9%	138	67.3%
	Yes	34	50.7%	33	49.3%	67	32.7%
MV on discharge	NO	65	54.6%	54	45.4%	119	58.0%
	Yes	45	52.3%	41	47.7%	86	42.0%
Expired	No	82	56.2%	64	43.8%	146	71.2%
	Yes	28	47.5%	31	52.5%	59	28.8%

The unadjusted odd ratio (OR) was calculated to determine the risk factors for elderly death in ICU; the results showed that patients who are admitted under surgical care have a statistically significantly lower mortality risk compared to medical patients (OR = 0.37, CI 95%: 0.19, 0.71, p.value = 0.003). Moreover, a statistically significant association was found between patients who were on MV (p-value < 0.01), urinary catheter insertion (p-value < 0.01), inotropic support (p-value < 0.01), and ICU death (Table 4, Figures 1 & 2).

Table 4: Risk Factors for ICU Death

Risk factor	Death in the exposed group (%)	Death in non-exposed group %	Unadjusted odds ratio and 95% CI	Chi-square	P value
Age 80 years and above	21 (27.3%)	38 (29.7%)	0.89 (0.47, 1.66)	0.137	0.752
Bahraini nationality	56 (29.3%)	3 (21.4%)	1.52 (0.49, 5.66)	0.396	0.761
Sex, Female	31 (32.6%)	28 (25.5%)	1.42 (0.77, 2.60)	1.28	0.281
Diabetes	32 (26.9%)	27 (31.4%)	0.80 (0.44, 1.48)	0.49	0.533
Hypertension	41 (30.4%)	18 (25.7%)	1.26 (0.66, 2.41)	0.49	0.519
Heart Diseases	17 (23.0%)	42 (32.1%)	0.63 (0.33, 1.22)	1.90	0.200
Chronic Renal Disease	14 (33.3%)	45 (27.6%)	1.31 (0.63, 2.71)	0.534	0.452
Chronic Liver Disease	1 (50%)	1 (50%)	2.50 (0.15, 40.6)	0.444	0.494
Neurological Disease	9 (20.5%)	50 (31.1%)	0.57 (0.25, 1.28)	1.895	0.192
Pulmonary Disease	7 (25.9%)	52 (29.2%)	0.85 (0.34, 1.22)	0.124	0.822
Hematological Disease	5 (35.7%)	54 (28.3%)	1.41 (0.45, 4.40)	0.352	0.550
Dyslipidemia	18 (33.3%)	41 (27.2%)	1.34 (0.69, 2.62)	0.741	0.388
Admission under Surgical care	17 (18.3%)	42 (37.5%)	0.37 (0.19, 0.71)	9.16	0.003 *
MV on admission	43 (47.3%)	16 (14.0%)	5.49 (2.80, 10.72)	27.2	<.001 *
Inotropes in admission	41 (71.9%)	18 (12.2%)	18.51 (8.66, 39.55)	71.7	<.001 *
Central line on admission	59 (44.4%)	0 (0.00%)			
Urinary catheter on admission	57 (33.3%)	2 (5.9%)	8.00 (1.85, 34.6)	10.42	<.001 *

Positive Blood culture (n=187)	7 (35.0%)	45 (26.9%)	1.46 (0.55, 3.90)	0.577	0.439
Positive DTA culture (n=133)	18 (37.5%)	26 (30.6%)	1.36 (0.65, 2.87)	0.662	0.447
Positive Urine Culture (n=162)	8 (20.5%)	34 (27.6%)	0.68 (0.28, 1.62)	0.784	0.411

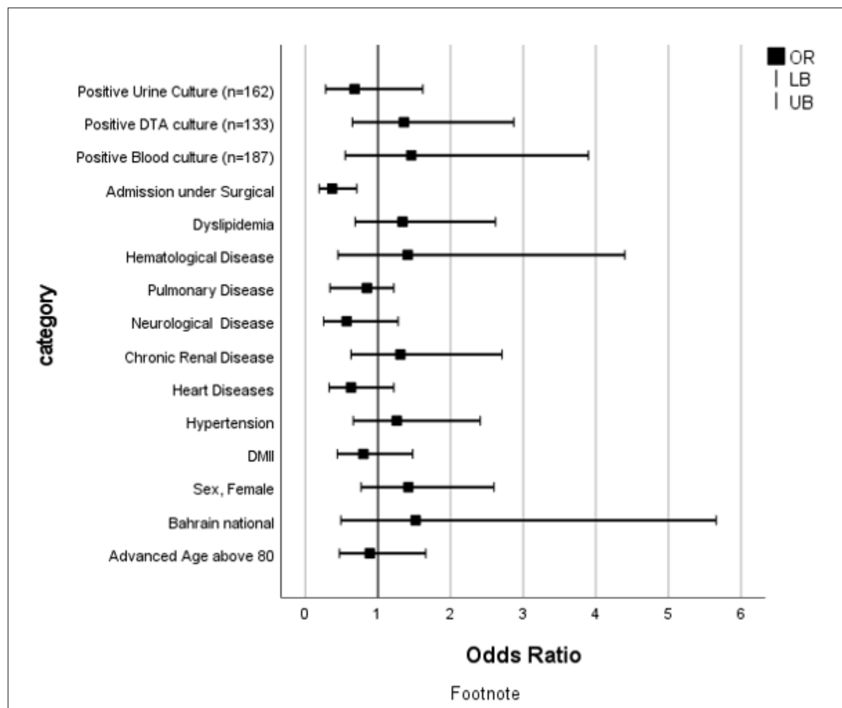

Figure 1: Risk Factors odd Ratio for Death

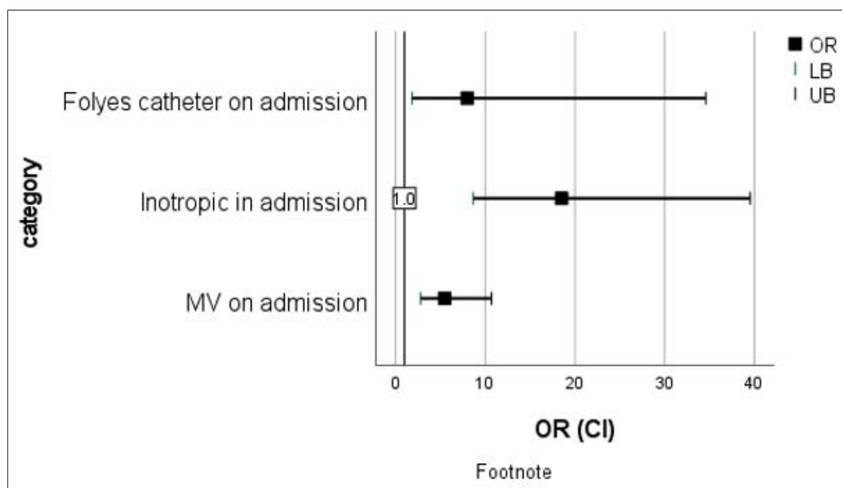

Figure 2: ICU Support Procedures odd Ratio for Death

Mann-Whitney U test was used to explore the factors affecting the length of stay in the ICU (Table 5). statistically significant factors (p-value < 0.01) that are associated with increased length of stay are age between 70 and 80 years, MV, urinary catheter, and central line insertion upon admission (Table 5). However, further regression analysis demonstrated that age does not affect the length of stay (p-value = 0.58). The factor that negatively affects the LOS is admission under surgical care (p-value < 0.01).

Table 5: Risk Factors for ICU Length of Stay

	LOS		
	No Mdn (IQR)	Yes Mdn (IQR)	P Value
Age 80 years and above	5.00 (7), (n=128)	3.00 (5), (n=76)	< 0.001 *
Bahraini nationality	4.50 (6), (n=14)	4.00 (7), (n=190)	0.634
Sex, Female	4.00 (8), (n=109)	4.00 (7), (n=95)	0.515
Diabetes	4.00 (6), (n=85)	5.00 (7), (n=119)	0.679
Hypertension	4.00 (7), (n=135)	4.00 (7), (n=69)	0.549
Heart Diseases	5.00 (9), (n=130)	4.00 (5), (n=74)	0.178
Chronic Renal Disease	4.00 (7), (n=162)	6.00 (5), (n=42)	0.314
Chronic Liver Disease	4.00 (7), (n=202)	18.50, (n=2)	0.056
Neurological Disease	4.00 (7), (n=160)	6.00 (11), (n=44)	0.108
Pulmonary Disease	4.00 (7), (n=177)	4.00 (4), (n=27)	0.261
Hematological Disease	4.00 (7), (n=190)	7.00 (9), (n=14)	0.054
Dyslipidemia	4.00 (6), (n= 150)	5.00 (9), (n=54)	0.553
Admission under Surgical care	6.00 (7), (n=111)	3.00 (6), (n=93)	< 0.001 *
MV on admission	3.00 (5), (n= 114)	7.00 (11), (n=90)	< 0.001 *
Inotropes in admission	4.00 (6), (n=148)	5.50 (8), (n= 56)	0.650
Central line on admission	3.00 (4), (n= 72)	6.00 (10), (n=132)	< 0.001 *
Urinary catheter on admission	3.00 (4), (n = 34)	5.00 (7), (n=170)	< 0.001 *
Positive Blood culture (n=186)	4.00 (7), (n=166)	7.00 (11), (n=20)	0.318
Positive DTA culture (n=132)	4.00 (7), (n=85)	6.00 (14), (n=47)	0.122
Positive Urine Culture (n=161)	4.00 (7), (n=122)	5.00 (7), (n=39)	0.913

Discussion

As the elderly population continues to grow due to increased life expectancy, the number of elderly patients admitted to intensive care units is also growing. This proportion has clinical and demographic characteristics that should be recognized [8,9,13,16,17].

This retrospective descriptive study revealed that 205 elderly patients were admitted to the non-COVID-19 ICU between January 2021 and January 2023. The mean age was 78.3 ± 1.75 years, and 62.4% (n=128) of the admissions were for patients in the age group 70-79 years old, while patients aged 90 years and above were only 10. 2% (n=21). Other studies found a mean age of 71.7 ± 6.1 years in Burkina Faso and 75.4 ± 6.8 in Brasilia [8,18].

The mortality rate over two years was 28.8% (n=59); males accounted for 47.5% (n=28), and females accounted for 52.5% (n=31), which was lessened when compared to 36.7% in a study conducted by Upparakadiyala et al. and published in 2022 [11]. However, in a study conducted by Thangam & Deepa, the mortality rate was 25%, which could be attributed to admission diagnosis as acute cardiac and COVID-19 infection cases were admitted to dedicated intensive care units. We noticed that mortality among very elderly patients ≥ 80 years old was statistically insignificant (p-value = 0.752). This is consistent with some researchers who concluded that age is not predictive of poor prognosis for ICU patients and that premorbid functional status and illness severity particularly determine their outcome [9,19,20].

In our study, 53.7% (n=110) of patients were male in comparison to 70.5% in a study by Lankoande et al, Admitted patients with medical diagnosis were higher than surgical cases (54.6% (n=112), and 45.4% (n=93) respectively), which is similar to 1,033 patients who were admitted for medical reasons, 418 for surgical emergencies and 220 for elective surgeries in a study conducted by Ball et al, [8,21].

Most of the admitted patients had at least one comorbidity (90.7%, n = 186), and the most common comorbidity was hypertension, which was reported by 65.9% (n=135), followed by diabetes, which was reported by 58.0% (n=119). In a study by Lankoade et al., comorbidity was found in 191 cases, of which 117 had more than two comorbidities, and 46 had none (8); moreover, history of hypertension at 50.6%, diabetes at 23.6%, and peptic ulcers at 6.3% were reported [8]. We observed a statistically insignificant correlation between the number of comorbidities from one side and mortality and length of ICU stay from the other side (p = 0.768, p = 0.77, respectively). A similar observation was reported by Upparakadiyala et al. and Thangam & Deepa [11,19].

Treatment such as invasive mechanical ventilation, vasopressors, and renal replacement therapy (RRT) are more likely to be required in critically ill patients in the ICU; our data revealed a high degr ee of clinical association among those treatments. For instance, all patients who were on inotropic support (27%, n = 57) had a central line inserted; the central

line was also inserted for most patients (95.5%), n = 86, who were on mechanical ventilation. In addition, we demonstrated that the factors correlated with increased mortality in elderly ICU patients were mechanical ventilation, urinary catheter insertion, and inotropic.

Other investigators also revealed the impact of organ dysfunction on the outcome of elderly patients. Lee et al. reported that invasive mechanical ventilation and RRT were performed more often in the non-survived group [22]. In another study, the variables associated with mortality were non-invasive ventilation, mechanical ventilation, vasopressor use, prior renal replacement therapy, and mortality prediction model II score [23].

In this study, we illustrated that the mean length of stay in ICU was 7.32 ± 7.86 days. Nonetheless, the non-survived group had higher LOS than the survived group (mean length of stay is eight and seven days). The mean length of stay in ICU was 8.3 ± 6.3 days in a study by Thangam & Deepa [19]. We noticed that the leading cause of death is bacteremia and sepsis. A similar observation was noted in the study by Roch et al., as severe sepsis and septic shock were more common in the non-survived group [24]. Patients over 80 years length of stay were shorter among other age groups (p-value < 0.001), which was identical to a study conducted by Lankonade et al, this could be explained by the elderly poor outcomes and early ICU shifting out. Additionally, elderly patients admitted under surgical care had statistically significant shorter LOS and lower mortality rates (P value < 0.001 and 0.003) [8].

Similar findings were reported in a study conducted by Ball et al, greater mortality rates in patients with prolonged ICU stay may be either because of severe illness or ICU-related complications like ventilator-associated pneumonia, central venous catheter-associated infection, urinary catheter-associated infection, venous thromboembolism and stress ulcers [11,21,25].

Limitation

The elderly are a unique population with recurrent hospital admissions, comorbidities, and unusual disease presentations, which usually take a lengthy period to diagnose. Therefore, managing geriatric patients needs an exclusive geriatric team for better outcomes [6,21].

This study has certain limitations. It was retrospective and conducted at a single institution with specific cases. The impact of pre-hospitalization status, APACHE, and SOFA scores on outcome were not assessed.

Conclusion

In conclusion, the presence of infection and organ dysfunction in critically ill elderly during their ICU stay has a significant impact on the outcome. The factors associated with the highest mortality risk are mechanical ventilation and vasopressor. Surgically admitted patients have shorter lengths of stay and better outcomes. Therefore, geriatric specialists could improve patient care standards and minimize ICU-related complications and death. Further study can explore more risks and long-term outcomes of these elderly patients.

Disclosures

Conflict of Interest

All authors have declared that there's no conflict of interest.

Financial Relationships

All authors have declared that they have no financial relationships or activities with any organization that might have influenced the submitted work.

References

[1] Bahrain Country Overview | World Health Organization, 2023. https://www.who.int/countries/bhr.

[2] Statista. Bahrain - death rate 2020, 2023. https://www.statista.com/statistics/579856/death-rate-in-bahrain/.

[3] World Bank Open Data. World Bank Open Data, 2023. https://data.worldbank.org.

[4] Death rate, crude (per 1,000 people) | Data, 2023. https://data.worldbank.org/indicator/SP.DYN.CDRT.IN?name_desc=false.

[5] Life expectancy at birth (years), 2023. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/life-expectancy-at-birth-(years).

[6] Moran JL, Bristow P, Solomon PJ, George C, Hart GK. Australian and New Zealand Intensive Care Society Database Management Committee (ADMC). Mortality and length-of-stay outcomes, 1993-2003, in the binational Australian and New Zealand intensive care adult patient database, Crit Care Med. 2008; 36: 46-61.

[7] Docherty AB, Anderson NH, Walsh TS, Lone NI. Equity of Access to Critical Care Among Elderly Patients in Scotland: A National Cohort Study, Crit Care Med. 2016; 44: 3.

[8] Lankoandé M, Bonkoungou P, Simporé A, Somda G, Kabore RAF. Inhospital outcome of elderly patients in an intensive care unit in a Sub-Saharan hospital, BMC Anesthesiol. 2018; 18: 118.

[9] Fuchs L, Chronaki CE, Park S, Novack V, Baumfeld Y, et al. ICU admission characteristics and mortality rates among elderly and very elderly patients, Intensive Care Med. 2012; 38: 1654-1661.

[10] Nguyen YL, Angus DC, Boumendil A, Guidet B. The challenge of admitting the very elderly to intensive care, Ann Intensive Care. 2011; 1: 29.

[11] Upparakadiyala R, Singapati S, Sarkar MK. U S. Clinical

Profile and Factors Affecting Outcomes in Elderly Patients Admitted to the Medical Intensive Care Unit of a Tertiary Care Hospital, Cureus. 2022; 14: e22136.

[12] Le Borgne P, Maestraggi Q, Couraud S, Lefebvre F, Herbrecht JE, et al. Critically ill elderly patients (≥ 90 years): Clinical characteristics, outcome and financial implications, PLoS ONE. 2018; 13: e0198360.

[13] Garrouste Orgeas M, Tabah A, Vesin A, Philippart F, Kpodji A, et al. The ETHICA study (part II): simulation study of determinants and variability of ICU physician decisions in patients aged 80 or over, Intensive Care Med. 2013; 39: 1574-1583.

[14] Ling L, Ho CM, Ng PY, Chan KCK, Shum HP, et al. Characteristics and outcomes of patients admitted to adult intensive care units in Hong Kong: a population retrospective cohort study from 2008 to 2018, J Intensive Care. 2021; 9: 2.

[15] Kim J, Lee J, Choi S, Lee J, Park YS, et al. Trends in the Use of Intensive Care by Very Elderly Patients and Their Clinical Course in a Single Tertiary Hospital in Korea, Acute Crit Care. 2016; 31: 25-33.

[16] Fowler RA, Adhikari NK, Bhagwanjee S. Clinical review: Critical care in the global context – disparities in burden of illness, access, and economics, Crit Care. 2008; 12: 225.

[17] Bagshaw SM, Webb SA, Delaney A, George C, Pilcher D, et al. Very old patients admitted to intensive care in Australia and New Zealand: a multi-centre cohort analysis, Crit Care. 2009; 13: R45.

[18] Stein F de C, Barros RK, Feitosa FS, Toledo DO, Silva Junior JM da, et al. Prognostic factors in elderly patients admitted to an intensive care unit, Rev Bras Ter Intensiva. 2009; 21: 255-261.

[19] Thangam D, Deepa S. Factors Associated with the Outcome of Older Patients Admitted in Geriatric Intensive Care Unit, J Indian Acad Geriatr. 2019; 15: 53-58.

[20] Nathanson BH, Higgins TL, Brennan MJ, Kramer AA, Stark M, et al. Do Elderly Patients Fare Well in the ICU?, Chest. 2011; 139: 825-831.

[21] Ball IM, Bagshaw SM, Burns KEA, Cook DJ, Day AG, et al. Outcomes of elderly critically ill medical and surgical patients: a multicentre cohort study, Can J Anaesth J Can Anesth. 2017; 64: 260-269.

[22] Lee SI, Koh Y, Huh JW, Hong SB, Lim CM. Characteristics and prognostic factors of very elderly patients admitted to the intensive care unit, Acute Crit Care. 2022; 37: 372-381.

[23] Mukhopadhyay A, Tai BC, See KC, Ng WY, Lim TK, et al. Risk Factors for Hospital and Long-Term Mortality of Critically Ill Elderly Patients Admitted to an Intensive Care Unit, BioMed Res Int. 2014; 2014: e960575.

[24] Roch A, Wiramus S, Pauly V, Forel JM, Guervilly C, et al. Long-term outcome in medical patients aged 80 or over following admission to an intensive care unit, Crit Care. 2011; 15: R36.

[25] Wollschlager CM, Conrad AR. Common complications in critically ill patients, Dis Mon. 1988; 34: 225-293.