Impact of Comorbidities and COVID-19 on the Survival Rate of Geriatric Patients Receiving Anesthesia Services: A Prospective Cohort Study in Indonesia

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Research Article

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Abstract

Background

As life expectancy increases, the worldwide population aged 60 years and older increases year by year. Consequently, more older people receive medical attention, especially those who undergo surgery. In addition, the COVID-19 pandemic has had a global impact on elderly patients, especially those undergoing surgery. This study aims to describe the characteristics and analyze the survival rate of elderly patients who receive anesthesia services, especially those with comorbidities and COVID-19.

Methods

A prospective cohort study at 14 central hospitals in Indonesia analyzed 1621 elderly patients (67.1 ± 6.2 years old). The variables that were recorded included patient characteristics, comorbidities, the COVID-19 status, and the survival rate, including 30-day mortality.

Results

The 30-day mortality was 4.4%. The most comorbidity was hypertension (30.0). Patients with a Charlson's Comorbidity Index Score of 3-4 had a higher death rate (15.3%). The highest mortality rates were in the patients who had dementia, rheumatologic disease, liver disease, previous myocardial infarction, and diabetes with chronic complications as comorbidities. The percent of patients with COVID-19 who died was 26.6%. Patients with several comorbidities and COVID-19 had a lower survival rate than those without (log-rank $p<0.05$)

Conclusion

Approximately four in ten elderly patients receiving anesthesia died, and the percent increased when the patients had comorbidities and COVID-19.

Background

Chronological age is defined as the actual number of years a person has lived. With increasing chronological age, physiological functions are expected to decline, which significantly contributes to older people's susceptibility to illness.[1] The alterations vary in each individual and may affect multiple organ systems. Changes in the nervous system are in the form of a diminished cognitive function. In the cardiovascular system, it presents as an increased mean arterial pressure and a decreased cardiac output. In the respiratory system, there may be a decrease in arterial oxyhemoglobin. In the digestive

system, the emptying process in the gut may decelerate due to reduced hepatic metabolism. In the renal system, older people may have a decreased glomerular filtration rate.[2]

As the global economy improves and as nations provide more higher quality healthcare, the year by year life expectancy grows as opposed to the decreased mortality worldwide, especially in Indonesia. [3–5] By 2025, the World Health Organization predicts that approximately 1.2 billion people will be 60 years or older around the globe. The Indonesian Population Projection Study in 2013 supported the idea that by 2035, the population aged 60 years and older in Indonesia will increase to nearly 14% of the population.[5–7] Consequently, the growing population of geriatric patients means that there will be an increased number of patients receiving medical and operative health services, including anesthesia. Dominguez et al. revealed that people over 65 years of age underwent surgeries more frequently than in patients who were 65 years or younger.[8]

Geriatric patients tend to have many more comorbidities due to decreased physiological and cognitive functions. These may impact the perioperative concerns and outcomes.[9] These factors will also affect the pharmacodynamics and pharmacokinetics of the anesthetic drugs, particularly during surgery when many anesthetic drugs are used. The combination of having comorbidities and a weaker drug metabolism ability causes the administration of anesthetics to become more challenging and requires more acute consideration from anesthesiologists, as anesthetics may cause undesirable adverse outcomes both intraoperatively and postoperatively.[10]

In the era of the COVID-19 pandemic, elderly patients must be highlighted because of the challenges in this population, including the frailty of the patients, and safety is a global health concern. Elderly individuals are prone to having a high risk of contracting COVID-19, suffering from worse outcomes, and being at risk of neglect from their chronic conditions.[11] In Latin America, COVID-19 infection raises the morbidity and mortality rate to 20% in surgical patients.[12] In planning a good clinical management program in this population, the anesthesiology staff needs to know the clinical characteristics and prognosis of geriatric patients who receive anesthesia services. Unfortunately, in Indonesia, there is still a lack of sufficient studies that determine the prevalence and survivability in geriatric patients receiving anesthesia services. This study described the characteristics and analyzed the survival rate of elderly patients who received anesthesia services, especially those with comorbidities and COVID-19.

Method

Study Design

This study is a prospective observational study. This research was conducted in 14 general hospitals in Indonesia, which also act as teaching hospitals for Anesthesiology and Intensive Therapy Residency Education. The data collection was carried out for four months, and every collector was briefed and had standardized training before the data collection.

Sample and Population

We analyzed the patients who underwent surgery and required anesthesia, and the patient cohort included both COVID-19 and nonCOVID-19 patients. We included all patients aged 60 years old or older in the period between February and May 2021. We excluded all patients who did not complete the follow-up between the observation periods.

Parameters

The variables included the patient characteristics, comorbidities, and COVID-19 status. The patient characteristics included age, sex, body mass index, comorbidities based on the Charlson's Comorbidity Index (CCI) score, the COVID-19 status, the American Society of Anesthesiologist (ASA) Classification, emergency or elective surgery, type of surgery, anesthesia techniques, sedation techniques, adverse outcomes in or outside the operating room, postoperative ICU care, cognitive function, and quality of life.

The Charlson Comorbidity Index (CCI) score was divided into four categories: 0, 1-2, 3-4, and >5.[13] The adverse outcomes that occurred in or outside the operating room were divided into intraoperative adverse outcomes and adverse outcomes in the recovery room, ICU room, and ward. The cognitive functions of the patients were measured with the Mini-Mental State Exam (MMSE) score. The MMSE score consists of five domains: orientation, registration, attention and calculation, recall, and language.[14] The quality of life was measured with the World Health Organization Quality of Life (WHOQOL)-BREF. The WHOQOL-BREF score has four domains: physical health, psychological, social relationships, and environment.[15] For the MMSE score and WHOQOL-BREF, we calculated the average score of each participant.

Outcome measure

The output variables in this study included the mortality within 30 days after surgery. The participants were followed prospectively for 30 days, and whether the participants had died or not and the survival rate were recorded.

Statistical Analysis

The statistical tests were performed in the SPSS Statistics software program. Numerical variables with a normal distribution are shown as the mean ± deviation or otherwise as the median (minimum-maximum). Categorical variables are displayed in the form of a number (percentage). Next, we summarized the data in the form of tables and narratives. After that, we used a Kaplan-Meier survival analysis to describe the survival rate. If $p<0.05$, it was displayed in figure form.

Ethical Feasibility

Overall, this study was granted an approval by the local ethics committees and institutional review boards Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada – Dr. Sardjito General Hospital with approval number

KE/FK/1381/EC/2020. Written informed consent from all subjects, a legal surrogate or the parent was waived by the ethics committee.

Results

A total of 2091 patients were recruited into this study, 470 patients were excluded due to incomplete data, and 1621 patients were analyzed (see Figure 1). The average age of the patients was 67.1 ± 6.2 years, and most of them were male. On average, the patients had an ideal body mass index, and ninety percent of the patients had an elective surgery, with the most of them having an ASA classification of II. The most common type of surgery was oncological (17.2%), with general anesthesia being the most commonly used technique. Sedation techniques were most commonly used for therapy (see Table 1).

Table 1
Patient characteristics.

Characteristics	Total	Survival	Non-Survival
Total patients	1621 (100%)	1549 (95.6%)	72 (4.4%)
Age, years old	67.1 ± 6.2	66.9 ± 6.1	68.9 ± 7.1
Gender			
Male	878 (54.2%)	837 (95.3%)	41 (4.7%)
Female	743 (45.8%)	712 (95.8%)	31 (4.2%)
Body Mass Index, kg m^{-2}			
Weight, kg	23.0 ± 3.6	23.0 ± 3.6	22.2 ± 3.4
Height, cm	58.8 ± 10.6	58.8 ± 10.6	57.3 ± 10.1
	160.8 ± 34.3	160.8 ± 35.0	160.9 ± 14.5
CCI Score			
Score 0	909 (56.1%)	887 (97.6%)	22 (3.4%)
Score 1-2	588 (36.3%)	554 (94.2%)	34 (5.6%)
Score 3-4	85 (5.2%)	72 (84.7%)	13 (15.3%)
Score >5	39 (2.4%)	36 (92.3%)	3 (7.7%)
COVID-19 Status			
Non-COVID	1606 (99.1%)	1538 (95.8%)	68 (4.2%)
COVID-19	15 (0.9%)	11 (73.3%)	4 (26.6%)

Characteristics	Total	Survival	Non-Survival
ASA Classification			
ASA I	62 (3.8%)	62 (100.0%)	0 (0.0%)
ASA II	1063 (65.6%)	1032 (97.1%)	31 (2.9%)
ASA III	427 (26.3%)	409 (95.8%)	18 (4.2%)
ASA IV	19 (1.2%)	9 (47.4%)	10 (52.6%)
ASA IE	0 (0.0%)	-	-
ASA IIE	14 (0.9%)	12 (85.7%)	2 (14.3%)
ASA IIIE	27 (1.7%)	23 (85.2%)	4 (14.8%)
ASA IVE	9 (0.6%)	2 (22.2%)	7 (77.8%)
Emergency or Elective Surgery			
Elective	1460 (90.1%)	1412 (96.7%)	48 (3.2%)
Emergency	124 (7.6%)	103 (83.1%)	21 (17.9%)
Nonsurgery	37 (2.3%)	34 (91.9%)	3 (8.1%)
Type of Surgery			
Oncological	293 (17.2%)	279 (95.2%)	14 (4.8%)
Orthopedic	283 (16.6%)	279 (98.6%)	4 (1.4%)
Digestive	241 (14.1%)	224 (92.9%)	17 (7.1%)
Urology	217 (12.7%)	214 (98.6%)	3 (1.4%)
Ophthalmologic	133 (7.8%)	132 (99.2%)	1 (0.8%)
Gynecologic	95 (5.6%)	92 (96.8%)	3 (3.2%)
ENT	80 (4.7%)	77 (96.3%)	3 (3.8%)
Vascular	70 (4.1%)	64 (91.4%)	6 (8.6%)
Obstetric	7 (0.4%)	7 (100.0%)	0 (0.0%)
Neurological	60 (3.5%)	48 (80.0%)	12 (20.0%)
Trauma	44 (2.6%)	42 (95.5%)	2 (4.5%)
Cardiothoracic	44 (2.6%)	43 (97.7%)	1 (2.3%)
Plastic	36 (2.1%)	34 (94.4%)	2 (5.6%)

Characteristics	Total	Survival	Non-Survival
Dental and Oral	11 (0.6%)	11 (100.0%)	0 (0.0%)
Nonsurgery	92 (5.4%)	83 (90.2%)	9 (9.8%)
Anesthesia Techniques			
General	1096 (61.7%)	1039 (94.8%)	57 (5.2%)
Spinal	403 (22.7%)	393 (97.5%)	10 (12.7%)
Epidural	168 (9.5%)	163 (97.0%)	5 (5.8%)
Procedural Sedation	52 (2.9%)	51 (98.1%)	1 (1.9%)
Peripheral Nerve Block	26 (1.5%)	25 (96.2%)	1 (16.7%)
Monitored anesthesia care	15 (0.8%)	14 (93.3%)	1 (6.7%)
Others	15 (0.8%)	15 (100.0%)	0 (0.0%)
Sedation Technique			
Therapeutic	453 (50.2%)	434 (95.8%)	19 (4.2%)
Diagnostic	338 (37.4%)	266 (78.7%)	72 (21.3%)
Nonsedation	112 (12.4%)	106 (94.6%)	6 (5.4%)
Intraoperative adverse outcome			
None	1326 (78.2%)	1280 (96.5%)	46 (3.5%)
Hypotension	215 (12.7%)	196 (91.2%)	19 (8.8%)
Hemorrhage more than EBV	58 (3.4%)	53 (91.4%)	5 (8.6%)
Prolonged surgery time	50 (2.9%)	44 (88.0%)	6 (12.0%)
Others	29 (1.7%)	27 (92.1%)	2 (6.9%)
Oxygen desaturation	11 (0.6%)	8 (72.7%)	3 (27.3%)
Anesthesia awareness	3 (0.2%)	2 (66.7%)	1 (3.3%)
Anesthesia technique conversion	2 (0.2%)	2 (100.0%)	0 (0.0%)
Prolonged block	1 (0.1%)	1 (100.0%)	0 (0.0%)
Adverse outcome in the recovery room			
None	1490 (89.9%)	1432 (96.1%)	58 (3.9%)
Hypotension	67 (4.0%)	58 (86.6%)	9 (13.4%)

Characteristics	Total	Survival	Non-Survival
Shivering	34 (2.1%)	34 (100.0%)	0 (0.0%)
Delayed emergence	17 (1.0%)	14 (82.4%)	3 (17.6%)
Hemorrhage more than EBV	14 (0.8%)	10 (71.4%)	4 (28.6%)
PONV	10 (0.6%)	9 (90.0%)	1 (10.0%)
Pain	7 (0.4%)	7 (100.0%)	0 (0.0%)
Oxygen desaturation	5 (0.3%)	3 (60.0%)	2 (40.0%)
Hypothermia	3 (0.2%)	3 (100.0%)	0 (0.0%)
Postoperative ICU care			
No	1405 (86.7%)	1363 (97.0%)	42 (3.0%)
Yes	216 (13.3%)	186 (86.1%)	30 (13.9%)
Adverse outcome in the ICU			
None	139 (64.4%)	93 (66.9%)	46 (33.1%)
Prolonged length of stay in ICU	39 (18.1%)	30 (76.9%)	9 (23.1%)
Unexpected ventilation used	18 (8.3%)	14 (77.8%)	4 (22.2%)
Nosocomial infection	6 (2.8%)	2 (33.3%)	4 (66.7%)
Others	14 (6.5%)	11 (78.6%)	3 (21.4%)
Adverse outcome in ward			
None	1516 (92.2%)	1455 (96.0%)	61 (4.0%)
Pain	60 (3.6%)	59 (98.3%)	1 (1.7%)
Others	23 (1.4%)	19 (82.6%)	4 (17.4)
Hypotension	19 (1.2%)	11 (57.9%)	8 (42.1%)
PONV	14 (0.9%)	14 (100.0%)	0 (0.0%)
Hemorrhage	7 (0.4%)	7 (100.0%)	0 (0.0%)
Oxygen desaturation	5 (0.3%)	1 (20.0%)	4 (80.0%)

Based on the place where adverse outcomes occurred, hypotension was observed in the intraoperative and recovery rooms (12.7% and 4.0%), a prolonged length of stay was observed in the ICU (18.1%), and pain was observed in the ward (3.6%). Thirteen percent of the geriatric patients after surgery were admitted to the ICU (see Table 1).

The cognitive function was measured with the MMSE score. Before surgery, the mean MMSE score was 25.9 ± 3.5, and the mean had increased to 26.3 ± 3.5 thirty days later. Therefore, the quality of life measured with the WHOQOL-BREF had an average score before surgery of 86.7 ± 63.1 and had a decreased mean of 68.9 ± 19.2 thirty days later.

The 30-day mortality rate was 4.4%, and the mean time of death was 15.3 ± 8.8 days after surgery (see Table 1). The most common comorbidity was hypertension, which was found in approximately 30% of the patients. The patients with CCI scores of 3-4 had a higher mortality rate (15.3%). The percent of patients with COVID-19 who died was 26.6%. The comorbidities with the highest mortality were dementia, rheumatologic disease, liver disease, previous myocardial infarction, and diabetes with chronic complications (Table 2).

Table 2
Comorbidities.

Comorbidities	Total	Survival	Non-Survival
Hypertension	487 (30.0%)	22 (4.52%)	465 (95.48%)
Malignancy without metastasis	219 (13.5%)	11 (5.02%)	208 (94.98%)
Diabetes	211 (13.0%)	12 (5.69%)	199 (94.31%)
Congestive heart failure	92 (5.7%)	12 (13.04%)	80 (86.96%)
Moderate-to-severe renal disease	92 (5.7%)	5 (5.43%)	87 (94.57%)
Cerebrovascular disease	62 (3.8%)	8 (12.90%)	54 (87.10%)
Previous myocardial infarction	54 (3.3%)	8 (14.81%) [a]	46 (85.19%)
Peripheral vascular disease	50 (3.1%)	2 (4.00%)	48 (96.00%)
Chronic pulmonary disease	33 (2.0%)	3 (9.09%)	30 (90.91%)
Diabetes with chronic complications	27 (1.7%)	4 (14.81%)[a]	23 (85.19%)
Metastatic solid tumor	25 (1.5%)	3 (12.00%)	22 (88.00%)
Dementia	13 (0.8%)	5 (38.46%)[a]	8 (61.54%)
Mild liver disease	10 (0.6%)	1 (10.00%)	9 (90.00%)
Cerebrovascular (hemiplegia) event	9 (0.6%)	1 (11.11%)	8 (88.89%)
Peptic ulcer disease	6 (0.4%)	0 (0.00%)	6 (100.00%)
Moderate or severe liver disease	6 (0.4%)	1 (16.67%)[a]	5 (83.33%)
Rheumatologic disease	5 (0.3%)	1 (20.00%) [a]	4 (80.00%)
Lymphoma	3 (0.2%)	0 (0.00%)	3 (100.00%)
Leukemia	2 (0.1%)	0 (0.00%)	2 (100.00%)
Acquired immunodeficiency syndrome (AIDS)	0 (0.0%)	-	-

[a]Top five comorbidities with the highest mortality rate

The Kaplan-Meier survival analysis showed that the patients with any of six comorbidities had a lower survival rate compared to the patients without comorbidities ($p<0.05$) (Fig. 2). The six comorbidities were cerebrovascular events (28.4 vs. 29.5, long rank p=0.001), dementia (26.5 vs. 29.5, log-rank p=0.001), rheumatologic disease (24.8 vs. 29.4, log-rank p=0.032), moderate-to-severe renal disease (28.1 vs. 29.5, log-rank p=0.000), diabetes with chronic complications (28.7 vs. 29.4, log-rank p=0.033), and tumor metastases (28 vs. 29.5, log-rank p=0.024). The patients with COVID-19 also had a lower survival rate than those without COVID-19 (26.5 vs. 29.5, log-rank p=0.001) (see Figure 3).

Discussion

In this study, the average age of the patients was 67 years old, which is lower than the estimated life expectancy in Indonesia, which is approximately 72 years according to the World Health Organization.[16] Age-related diseases such as cerebrovascular disease, coronary heart disease, and diabetes are significant causes of death in geriatric patients in Indonesia.[17] The increasing number of aging demographies has caused a significant obstacle to anesthetic services because as the number of older people increases, more surgical cases will be performed. Unfortunately, the problem is exacerbated by limited healthcare facilities.

Our study shows that the most common surgeries conducted are oncological, orthopedic, and digestive surgery. Elective surgery was the most common type of surgery, with the most frequently practiced technique being general anesthesia. Our result is in line with Deiner et al.18, who claimed that orthopedic, digestive, eye, and gynecology surgeries are the most common geriatric surgeries. It is unclear why Deiner et al.'s study found that oncological and cardiac surgeries were uncommon. They insisted that surgeries in geriatric patients were associated with a perceived high-risk of surgery and the preference for palliative care.[18] Similarly, Tao et al. [19] revealed that the most common types of surgeries performed on elderly patients in Cambodia were abdominal (52.0%), orthopedic (27.6%), and urological (14.7%). In addition, Tao et al. found that general anesthesia, spinal anesthesia, and brachial plexus blocks were performed in 54.3%, 28.2%, and 9.4% of geriatric patients, respectively. This finding indicates that general anesthesia is routine for anesthesia services. However, it also indicates that the provider from the anesthesia service was limited in implementing the concept of balancing anesthesia based on the anesthetic safety.

Traditional preoperative risk assessments may often neglect geriatric-related syndromes, which can increase the morbidity and mortality in older patients.[20] According to Nayak and Varghese[20], patients that are categorized as ASA IV and ASA V have worse morbidity and mortality than patients categorized as ASA I but that there is no difference in the outcomes compared to patients categorized as ASA II and ASA III. Meanwhile, the outcomes in patients categorized as ASA I, ASA II, and ASA III were not significantly different after surgery.[20] This result is in line with this study, which shows that patients with a higher ASA score have an increased mortality proportionally. This result also applies to the ASA score in patients in an emergency setting.

The Charlson’s Comorbidity Index is associated with all-cause mortality after discharge.[21] Initially, the CCI was performed to classify comorbid conditions in patients and to determine the effects of the comorbidities on the risk of 1-year and 10-year mortality rates.[13] Today, the CCI is used for several outcomes in surgery or in intensive care settings.[21,22] The CCI may predict surgical outcomes such as 30-day mortality, 1-year mortality, 30-day readmission, complications, and failure to rescue. An increasing CCI score can increase the mortality by 16.9% 21 months after surgery.[21] In our study, we classified the patients’ scores into four groups: group 1 (score 0), group 2 (score 1-2), group 3 (score 3-4), and group 4 (score >5). An increase in the group is associated with an increased mortality rate, but the mortality rate

decreases from group 3 to group 4. Huang et al. [23] found a decreasing mortality rate in type 2 diabetic neuropathy patients with scores of 3-4 to 5 (56.7–22.3%), but the survival rate decreased with an increasing CCI score. Several studies have shown that an increasing mortality is associated with patients with increasing CCI scores for 30-day mortality. However, longer follow-up periods, such as periods of 1 year and 10 years, are more commonly used to identify the risk for mortality in postoperative patients.[24–27] If we extend our study follow-up time, the mortality rate could increase, which could align with an increasing CCI group.

In our study, a higher CCI score did not indicate a higher mortality rate. For example, dementia and rheumatologic disease (score 1) have a higher mortality rate than moderate or severe liver disease (score 3).[13] Many studies that have used the CCI to predict postoperative mortality in the short term have used an average CCI score rather than just using a single score.[25,26,28] Many studies have explained how the CCI should be interpreted using average or categorical data, but a single component of the CCI score is rarely used to predict the outcomes.[13,22, 25–27] The CCI score is used not only to predict the mortality risk but also to predict a prolonged length of hospital stay, and it can predict an increased number of complications that may occur or patient readmission after surgery.[21,29]

The postoperative care begins at the end of surgery, from the discontinuation of the anesthetic agent to recovery, from the operating room to the ward, and from the ward to hospital discharge.[30] Several complications can occur, such as respiratory depression, hypoxia, hypotension, hypertension, myocardial infarction, dysrhythmias, hypothermia, postoperative pain, and PONV.[30] In this study, we found that the most common incidents in the ward after surgery were postoperative pain, followed by hypotension, PONV, hemorrhage, and oxygen desaturation. Oxygen desaturation was the most significant cause of mortality. According to Almayrac and Sache[30], the incidence of respiratory distress was 70% in the ward versus 23% in the operating room.

In 1950, anesthesiologists began to document changes in the cognitive function of patients after surgery and anesthesia. These changes include delirium and postoperative cognitive dysfunction (POCD).[31] The postoperative delirium can be measured with the preoperative and postoperative MMSE. An increase in age causes an increase in the postoperative delirium events. The cutoff MMSE score of predicted postoperative delirium is much lower in patients aged 80 or younger than in those patients who are older than 80 years old. It has been proposed that the younger the geriatric patients are, the more severe the impairment that is needed to cause postoperative delirium.[32] Our study found that the MMSE score after surgery (26.3 ± 3.5) was higher than before surgery (25.9 ± 3.5). This result may be because our participants were much younger, 67.1 ± 6.2 (<80 years old). Liu et al. explained in their systematic review that the administration of phencyclidine hydrochloride might increase the incidence of POCD in geriatric patients, based on its dose during anesthesia. Giving phencyclidine hydrochloride at a minimal dose has a similar incidence of POCD as the administration of scopolamine. Furthermore, a dose of 0.01 mg kg^{-1} of phencyclidine hydrochloride could diminish the cognitive function of patients after surgery to a significant degree. They also claimed that the patients who underwent general anesthesia for orthopedic

surgeries tended to experience POCD 30 days after the surgery compared with the other types of anesthesia (39% vs. 4%). Prolonged anesthesia, defined as anesthesia that takes more than 5 hours, could increase the incidence of POCD in elderly patients compared to those patients who had anesthetic events that were less than 5 hours.[33]

As people reach 70 years of age or older, the morbidity and death due to surgery also increase. The preoperative risk factors are significantly increased with an increasing age and certainly increase the morbidity and mortality. The renal system, cardiovascular system, and respiratory system are significantly associated with morbidity and mortality.[34] According to the study conducted by Turrentine *et al*. [34], geriatric patients who underwent surgery had a 28% morbidity rate and 2.3% mortality rate. Morbidity and mortality occurred more frequently in people older than 80 years of age. In addition, this study found that 4.4% of patients had died 30 days after surgery.

We found that several factors impacted the 30-day survival mortality rate in our study. Some of these factors include the COVID-19 status and several comorbidities. This study aligns with a previous study, which showed that the COVID-19 status was also associated with mortality, with a 23% mortality rate among hospitalized geriatric patients with COVID-19.[35] The six comorbidities that affected the mortality rate in this study were in concordance with a previous study that showed that cerebrovascular disease, hemiplegia, and tumor metastases have significantly caused death in emergency abdominal surgery patients.[21]

We found several limitations in our study. First, there were obstacles during the preoperative data collection, such as incomplete or missing records. Second, most hospitals were general hospitals with adequate anesthesiologists, and these hospitals served as education hospitals where they hosted residents and higher-level consultants. Nevertheless, apart from the limitations mentioned above, our results may sufficiently represent the general geriatric patients who receive anesthetic services in Indonesia, especially during the era of the COVID-19 pandemic.

Conclusion

The findings of this study provide important information regarding the comorbidities that are important for the treatment of geriatric patients receiving anesthesia services. In addition, the impact of COVID-19 on elderly patients showed that these patients had an increased mortality rate and a decreased survival rate in Indonesia.

Abbreviation

AIDS, Acquired immunodeficiency syndrome; ASA, American Society of Anesthesiology; CCI, Charlson's Comorbidity Index; COVID, Coronavirus disease; ICU, Intensive care unit; MMSE, Mini-mental state examination; PONV, Postoperative nausea, and vomiting; POCD, Postoperative cognitive dysfunction; WHOQOL, World Health Organization Quality of Life,

Declarations

Ethical approval and consent to participate

This study was approved by the local ethics committees and institutional review boards Medical and Health Research Ethics Committee (MHREC), Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada - Dr. Sardjito General Hospital (KE/FK/1381/EC/2020). All methods were carried out following National Guidelines on ethical standards and procedure for research with a human being.

Consent for publication

Every subject had consent for publication using our institutional consent form.

Availability of data and materials

Not applicable

Competing interests

The authors declare they have no competing interests.

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Authors' contributions

NMR, SC, DS, MIL, TGAS, and HN contributed to modelling the design of the study, analyzed and interpreted data, and wrote the manuscript. BW, BP, APP, I, NA, KMS, RAH, ZKJ, AHN, M and P contributed to the concept of the study, collected the data from the patients, and interpreted the data. All members of the authorship group read and approved the final manuscript.

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Figures

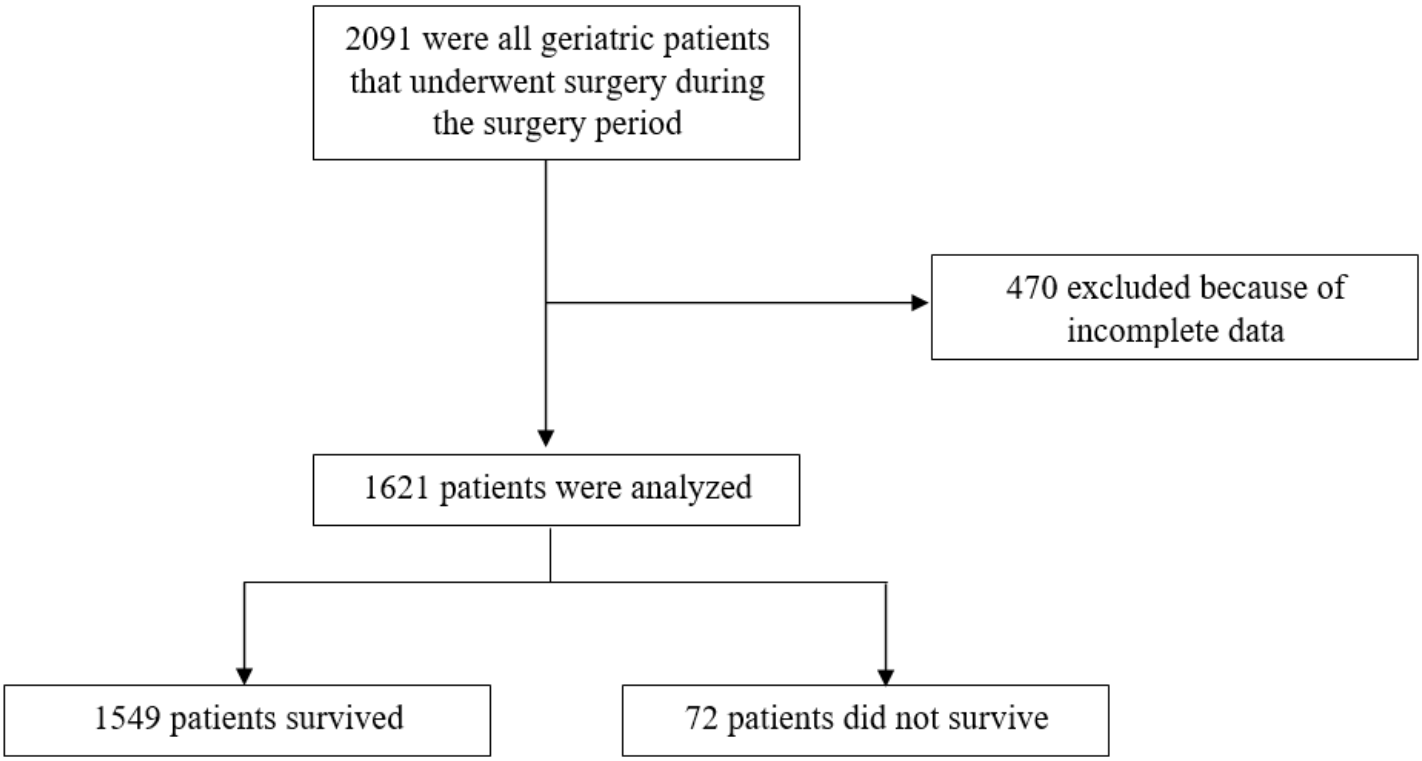

Figure 1

Study Flowchart.

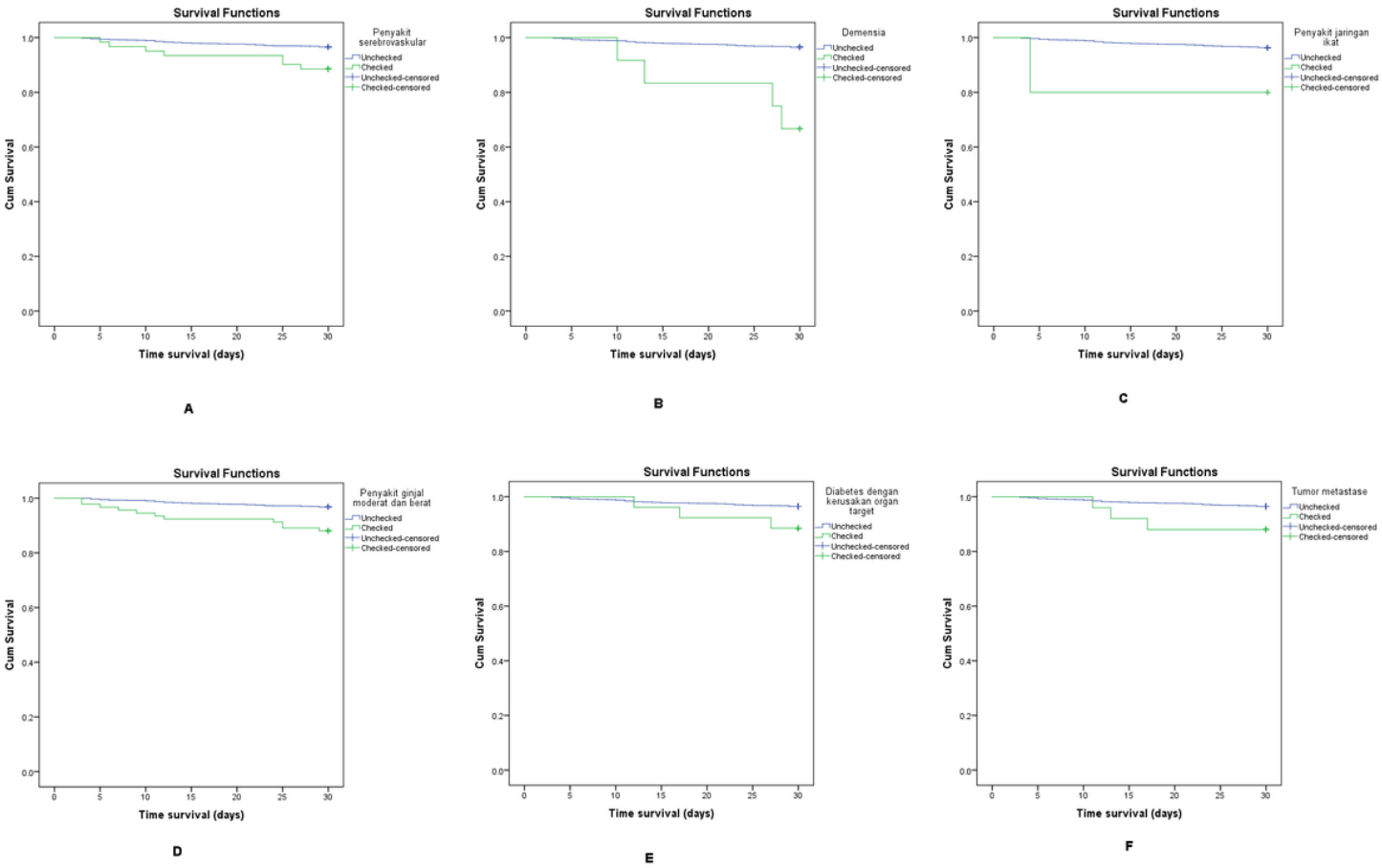

Figure 2

Comorbidities and survivability. The blue line indicates patients with no comorbidities, and the green line indicates patients with comorbidities. (a) Cerebrovascular (hemiplegia) event, (b) dementia, (c) rheumatologic disease, (d) moderate-to-severe renal disease, (e) diabetes with chronic complications, and (f) tumor metastases.

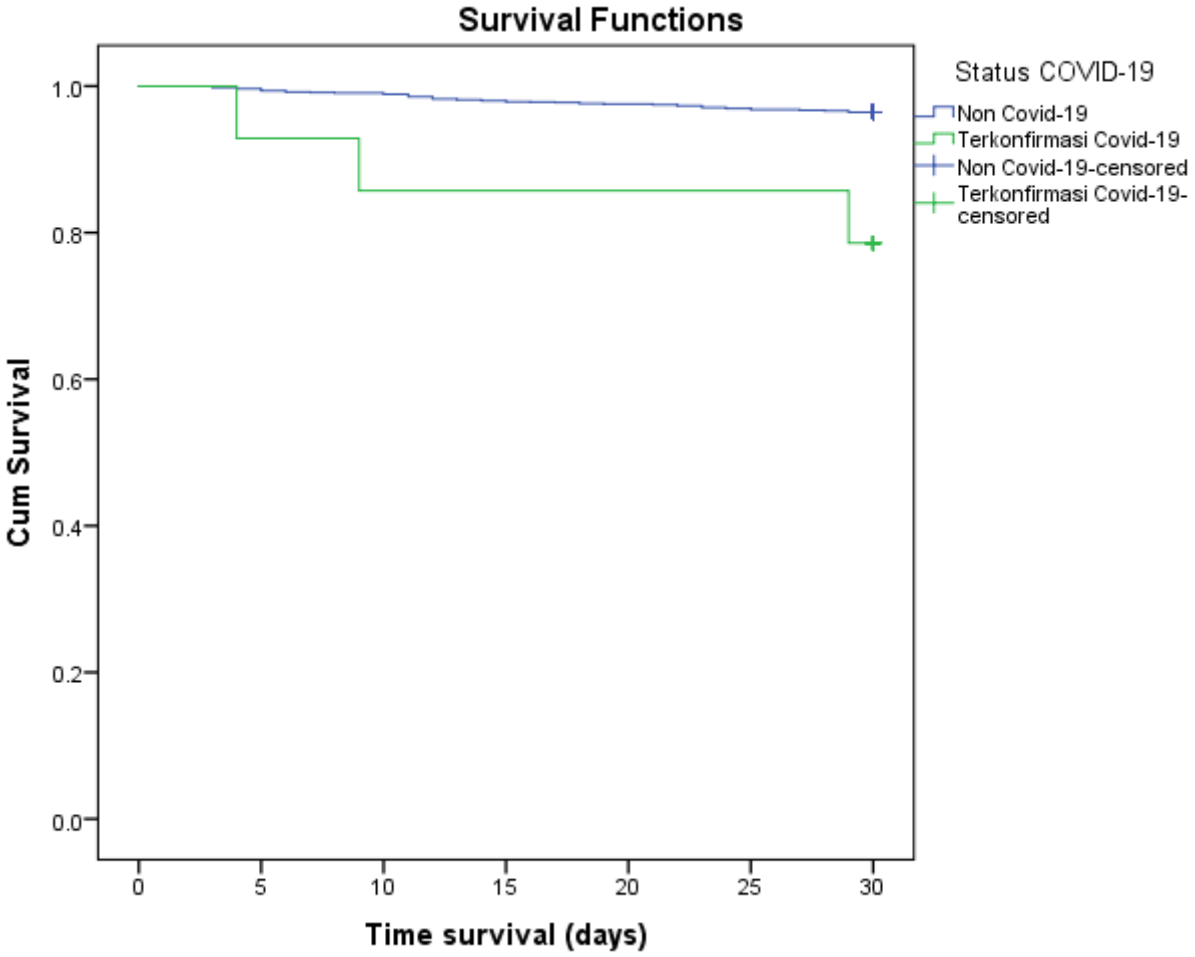

Figure 3

The COVID-19 status of the patients. The blue line is patients without COVID-19 and the green line is patients with COVID-19.

Supplementary Files

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