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Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity and modified Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity for the mortality prediction among nonagenarians undergoing emergency surgery

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ABSTRACT

Background: The aims of this study were to determine the outcomes of emergency abdominal surgery in patients aged ≥90 y and to analyze the role of Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) and modified POSSUM in predicting their morbidity and mortality.

Materials and methods: Patients aged ≥90 y who underwent emergency abdominal surgery from January 2011 to December 2014 were enrolled in this study.

Results: A total of 36 patients satisfied the inclusion criteria. The mortality and morbidity rates in the study group were 8.3% and 61.1%, respectively. Overall observed-to-expected morbidity ratio calculated by POSSUM and modified POSSUM were 0.83 ($\chi^2 = 32.189$, $P = 0.6045$) and 0.97 ($\chi^2 = 33.915$, $P = 0.7398$), respectively. Both models demonstrated a good fit for prediction of morbidity. Overall observed-to-expected mortality ratios calculated by POSSUM and modified POSSUM were 0.26 ($\chi^2 = 12.217$, $P = 0.2013$) and 0.20 ($\chi^2 = 12.217$, $P = 0.0936$), respectively.

Conclusions: Both POSSUM and modified POSSUM accurately predicted morbidity in the setting of emergency abdominal surgery in nonagenarians.

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Introduction

Owing to an increase in nonagenarian patients secondary to a general increase in longevity, studies have attempted to reclassify older people on the basis of their age, as the third-age or young-old (65-84 y) and fourth-age or oldest-old (≥85 y).[1,2] In Japan, average life expectancy of 90-y-olds was 4.26 y for men and 5.53 y for women, suggesting that age can no longer be considered as a criteria to avoid surgery in the elderly.[3] Advances in perioperative care, including anesthesia, intensive care, rehabilitation, and nutritional management, for the elderly patients, have resulted in emergency operations being frequently performed in them, when indicated. Both the surgeons and the patients are aware of the risks involved, and operations are performed with informed consent. However, elderly patients have lower physiological reserves and also have comorbid conditions or complications associated with the cardiovascular, respiratory, cerebral, and nervous systems. The frailty is a state of vulnerability to poor resolution of homeostasis after a stress and is a consequence of cumulative decline in multiple physiological systems over a lifespan.[4,5]

Evaluation of the frailty before emergency operations in the elderly is often not performed or inadequately performed.[6] This coupled with the debilitating effects of the surgical emergency may lead to excessive complications or death. The risk of morbidity and mortality is high in the elderly patients undergoing emergency surgery.[7] Nonagenarians, including those who are apparently healthy, are at a higher risk of death than the relatively younger population.[8] The decision to consider emergency surgery in nonagenarians is difficult because there are no validated tools to audit surgical outcomes in them or to assess their morbidity and mortality risks.

The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) was developed in 1991 by Copeland *et al.* as a representative method for evaluating the risk of surgery in patients.[9] It includes two components, physiological score (PS) and operation severity score (OSS), to calculate individual risks for morbidity and mortality. However, studies have claimed that the POSSUM may overestimate the risks for morbidity and mortality, especially in low-risk scenarios.[10-13] The POSSUM was recently modified age for age coefficient by Pelavski *et al.*, resulting in the modified POSSUM. This score has been validated and demonstrated as accurately predicting postoperative mortality in nonagenarians undergoing emergency surgery.[14] However, the ability of modified POSSUM to predict morbidity was not confirmed by this study.

The aims of this study were to determine the outcomes of emergency abdominal surgery in patients aged ≥90 y and to examine the role of POSSUM and modified POSSUM in predicting their morbidity and mortality risks.

Materials and methods

A total of 2980 patients underwent digestive surgery in our department between January 2011 and December 2014. Of these, 36 (1.2%; six males and 30 females) were patients of age ≥90 y, who underwent emergency abdominal surgery. Surgery performed within 24 h of admission was defined as emergency surgery.

According to the original POSSUM,[9] the items included for calculating PS were age, chest radiograph findings, heart disease, respiratory disease, white blood cell count, hemoglobin level, serum urea nitrogen level, serum sodium (Na) level, serum potassium (K) level, Glasgow Coma Scale score, systolic blood pressure, pulse rate, and electrocardiogram findings. The OSS was calculated based on length of surgery, single or multiple surgeries, intraperitoneal contamination, total blood loss, malignancy, and mode of surgery (emergency or elective). The equation of the POSSUM for morbidity was $\ln[R/(1-R)] = -5.91 + (0.16 \times PS) + (0.19 \times OSS)$, and the equation for mortality was $\ln[R/(1-R)] = -7.04 + (0.13 \times PS) + (0.16 \times OSS)$.[9]

The equation for modified POSSUM was similar to the original POSSUM, except for the use of a coefficient of eight for patients aged ≥85 y in calculating PS.[14]

Postoperative complications were evaluated by using the Clavien–Dindo classification.[15] The disease was classified as grade II or higher if complications were present. Delirium was assessed by psychiatrists according to the Diagnostic and Statistical Manual of Mental Disorders published by the American Psychiatric Association.[16] Surgical site infection was diagnosed according to the Guideline for Prevention of Surgical Site Infection.[17] Predictive values of morbidity and mortality (events) were assessed by calculating observed (O)-to-expected (E) ratios (O/E). "O" referred to the actual observed events or the number of patients who had an event during the study period. "E" was the number of expected or predicted events, calculated by multiplying the average risk of an event, with the number of patients expected to have that event. O/E ratios were recorded for both models, in each decile of risk, calculated from the model (POSSUM or modified POSSUM). An O/E ratio more than 1.0 was taken to indicate that the risk model underestimated the outcome, whereas a ratio <1.0 indicated overestimation of the outcome.

To assess the calibration of both the POSSUM and modified POSSUM equations, data were analyzed using the linear method of analysis described by Whiteley *et al.*[10] The exponential analysis originally adopted for studying the validity of POSSUM was not used in this study because it is not a standard statistical technique unlike linear analysis, and it has been criticized for the complexity in attributing a risk score to an individual.[12] The linear method, which is based on Hosmer–Lemeshow's goodness-of-fit test, stratifies the sample according to the risk level using deciles, and the O/E ratio is analyzed within each band separately. Data were assessed by using χ^2 test, wherein values of $P > 0.05$ indicate that observed and expected outcomes are similar, and $P < 0.05$ indicate that the differences between observed and expected events are statistically significant, thus rendering the score to be a poor fit.[18]

Results

The average age of these 36 patients was 93.2 y (range, 90-104 y). Thirty-three patients (91.7%) had co-existing medical