Is Increasing Age Associated with Mortality in the Critically Ill Elderly

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ABSTRACT

Introduction: Age has been cited as a predictor of mortality in the intensive care unit (ICU) and suggested as a criterion for rationing resources. We investigated the association of age with both ICU mortality and hospital mortality.

Materials and Methods: Patients admitted in 1998 to our Medical ICU (MICU) were retrospectively analysed by stratifying them into four groups: the reference group (55 - 64 years), the young old (65 - 74 years), the old old (75 - 84 years) and the oldest old (more than 85 years). The statistical association of age with ICU mortality and total hospital mortality was determined whilst controlling for the APACHE II(M) score (APACHE II score modified to exclude points for age), the number of organ failures and the presence of a high risk admitting diagnosis.

Results: After controlling for disease severity, the ICU mortality and the total hospital mortality were not associated with age. The total hospital mortality was associated with the APACHE II(M) score (Odds ratio (OR), 1.08; 95% Confidence intervals (CI), 1.04 - 1.12), the number of organ failures (OR, 2.03; CI, 1.50 - 2.67) and the presence of a high risk diagnosis (OR, 3.50; CI 1.93 - 6.37). The ICU mortality was also associated with the APACHE II(M) score (OR, 1.07; CI, 1.03 - 1.11), the number of organ failures (OR, 1.63; CI, 1.26 - 2.09) and the presence of a high risk diagnosis (OR, 3.22; CI 1.81 - 5.76).

Conclusions: We did not find a statistically significant association between age and mortality. We recommend that age should not be used as a criterion for admission.

Keywords: aged, mortality, intensive care unit, prognosis, APACHE system

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INTRODUCTION

Singapore has a rapidly ageing population. The elderly, which forms 7% of the population today, would form 19% of the population by the year 2030[1]. Expenditure for health will rise to 7% of the gross domestic product by 2030[1]. As intensive care units (ICUs) are a scarce resource, it would be logical and ethical that only patients with a reasonable chance of recovery be admitted. Some workers have shown age to be an independent poor prognostic indicator[2-4] although others have refuted this[5-7]. Our objective in this study was to assess if increasing age in the elderly impacted on mortality in our Medical ICU (MICU).

PATIENTS AND METHODS

A retrospective study was conducted in the eight-bedded MICU of Tan Tock Seng Hospital, Singapore. All patients above 55 admitted in 1998 were included. They were followed up till death or discharge/transfer from the hospital.

These patients were grouped into four age strata: the reference group (aged 55 to 64 years), the young old group (65 to 74 years), the old old group (75 to 84 years) and the oldest old group (85 years and older)[8].

Demographic and illness characteristics were studied. Scores of established prognostication systems were obtained; this included the number of organ failures (based on criteria from Le Gall et al)[9] and the Acute Physiology and Chronic Health Evaluation (APACHE) II score[4].

The APACHE II score was calculated without inclusion of points for age to obtain the APACHE II(M) score[5-6]. This latter score has been shown by Wu et al to be an independent predictor of mortality and a useful way of demonstrating disease severity without the influence of age[5]. The admitting diagnosis and the indication for MICU admission were classified based on the coefficients of severity in the APACHE II system to high risk diagnosis and low risk diagnosis[5,6]. Examples of high risk diagnosis would be cardiopulmonary arrest, septic shock and respiratory failure from pneumonia.

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Table I. Relation of total mortality to different risk factors.

Risk Factors	Hospital Mortality (row percentage) Survivors, n=139	Non-survivors, n=143
Age group	**No.(%)**	**No. (%)**
Control group	39 (54.2)	33 (45.8)
Young old	64 (52.9)	57 (47.1)
Old old	26 (40.0)	39 (60.0)
Oldest old	10 (41.7)	14 (58.3)
Gender		
Male	79 (45.4)	95 (54.6)
Female	60 (55.6)	48 (44.4)
Number of organ failures		
0	7 (87.5)	1 (12.5)
1	82 (73.9)	29 (26.1)
2	35 (44.9)	43 (55.1)
3	7 (19.4)	29 (80.6)
4 and more	8 (16.3)	41 (83.7)
APACHE II score		
0-19	68 (69.4)	30 (30.6)
20-26	49 (52.7)	44 (47.3)
27 and above	22 (24.2)	69 (75.8)
Diagnostic group		
Low risk diagnosis	106 (67.5)	51 (32.5)
High risk diagnosis	33 (26.4)	92 (73.6)

Table II. Statistical association of age, APACHE II(M) score, diagnostic category and the number of organ failures to total hospital mortality.

Age groups	Odds ratio for Hospital Mortality	95% Confidence Intervals
Control	1	
Young old	1.29	0.61 - 2.72
Old old	2.09	0.91 - 4.79
Oldest old	2.28	0.73 - 7.02
Risk Factor		
APACHE II(M) score*	1.08	1.04 - 1.12
High risk diagnosis	3.50	1.92 - 6.37
Number of organ failures**	2.00	1.50 - 2.67

* Odds ratios are for every point increase in the APACHE II(M) score.
**Odds ratios are for every organ failure above zero.

Table III. Statistical association of age, APACHE II(M) score, diagnostic category and the number of organ failures to ICU mortality.

Age groups	Odds ratios for ICU Mortality	95% Confidence Intervals
Control	1	
Young old	1.12	0.55 - 2.31
Old old	1.23	0.55 - 2.75
Oldest old	1.82	0.61 - 5.38
Risk Factor		
APACHE II(M) Score*	1.07	1.03 - 1.11
High Risk Diagnosis	3.23	1.81 - 5.76
Number of organ failures**	1.63	1.26 - 2.09

* Odds ratios are for every point increase in the APACHE II(M) score.
**Odds ratios are for every organ failure above zero.

Examples of low risk diagnosis were respiratory failure from chronic obstructive lung disease, respiratory failure from acute pulmonary oedema and seizure disorders.

An organ failure was considered present if it occurred at any time during the MICU admission. The primary outcomes measured in this study were mortality in the intensive care unit (ICU mortality) and the hospital mortality (which included mortality in the ICU or in the general ward).

Results were considered statistically significant when $p<0.05$. The Chi-square test was used for analysis of the proportion of patients who had died during hospitalisation in relation to various factors: age, sex, APACHE II scores, number of organ failures and the diagnostic category.

Logistic regression was used to study the independent statistical association of age with mortality (ICU mortality and hospital mortality). Age and known predictive factors affecting mortality (the APACHE II(M) score, the number of organ failures, the diagnostic category) were entered in one step during the logistic regression analysis. Odds ratios and their 95% confidence intervals were reported.

RESULTS

A total of 282 patients aged 55 and above were recruited in the study. Sixty-one percent were males. There were 72 patients in the reference group, 121 young old patients, 65 years old old patients and 24 oldest old patients. The mean APACHE II score was 23.4 ± 8.8. The mean number of organ failures was 2.1 ± 1.3. Forty-five percent of patients had a high risk admitting diagnosis.

The hospital mortality for this group was 50.7%, of which 110 (39.0%) died in the MICU and 33 (11.7%) died in the general medical wards. Table I summarises the relation of hospital mortality to various risk factors. The difference in mortality between age groups was not significant ($p = 0.08$). The difference in mortality was statistically significant with increasing APACHE II scores ($p<0.005$), increasing number of organ failures ($p<0.005$) and a high risk diagnosis ($p<0.005$). None of the patients ($n = 13$) with five or more organ failures survived.

Using multivariate analysis, the statistical association of age, APACHE II(M) score, the number of organ failures, the presence of a high risk diagnosis with total hospital mortality are presented in Table II. Similar variables for ICU mortality are presented in Table III. The results indicate that age was not a significant predictor of ICU and total hospital mortalities, while other risk factors were.

DISCUSSION

In our study, increasing age in the elderly was not associated with hospital and MICU mortalities. Scores of illness severity (number of organ failures, APACHE II(M) score and a high risk diagnosis) were consistently predictive of a poor outcome. This is also one of the few papers, to our knowledge, that have studied the subset of the "oldest old" and shown there to be no increase in mortality for this age group when compared to a younger control group[10,11].

Age forms an integral part of some widely accepted ICU prognostication systems like the APACHE systems and the Simplified Acute Physiology scores. However in our study, age was not associated with ICU mortality, although there is a trend towards so. This may be the result of a type II error; however post-hoc analysis suggests it would take five years of patient recruitment before there would be a significant difference. This brings to question whether the statistical difference so found would be meaningful clinically. Papers published on the relation of age to mortality in critical illness have not shown a clear predictive relation. In the APACHE II validation study by Knaus et al[4], age was described as "a well-documented risk factor of death from acute illness that is independent of the severity of disease." Campion et al has also found a relationship between age and poor outcome[2]. However, Wu et al demonstrated that age was not an independent risk factor for mortality when it was taken out from the APACHE II calculations (APACHE II(M))[5]. Rockwood et al concluded in their study that only 5% of the variance in mortality could be accounted for by age[7]. Nicolas et al found that the effect of age diminished with increasing disease severity[21]. A reason for this discrepancy in previous studies may be an age-related difference in treatment intensity after controlling for disease severity. Castilo-Lorente et al reported that elderly patients with a more severe illness, as demonstrated by a higher APACHE II score, had a lower Therapeutic Intervention Scoring System score (TISS), suggesting that the treatment intensity was less[20]. Although this may not be the practice worldwide, it may be a reflection of the more "conservative" attitudes towards treating the elderly in certain ICUs.

Our paper did not show a statistically significant increased mortality in the oldest old. Firstly, it is known that the chronological age of a patient may not be equivalent to the biological age. The biological age would be the sum of age-related deterioration in organ function (primary ageing), the effects of medical illnesses and the effects of the environment on the organism (secondary ageing)[12]. The biological age cannot be quantified by any severity scoring scales routinely used in the intensive care setting. The premorbid functional capacity has been proposed as one possible measure of the biological age. Function as a predictor for outcome after ICU stay has been studied. Mayer-Oakes et al found that although patients 75 years and older were at increased risk of death, when this was coupled with functional capacity, the increased risk was only in patients with functional limitation rather than those with normal function[6]. Zaren et al found a similar age-function relationship[13]. McClish et al[14] and Roche et al[15] have also reported a similar lack of influence of age in predicting mortality once function has been put into the multivariate analysis. Thus far, the functional status scales used in studies of ICU mortality have been relatively simplistic, mostly a three- to five- point scale, which hardly reflects the complexity of a patient's functional status. Further studies should be done using more widely accepted functional scoring systems such as the Lawton scale for instrumental activities of living[16] and the Katz scale for the activities of daily living[17]. It is likely that patients who are 85 and above would be a more functionally independent group as selection bias would tend not to have selected this group for more aggressive treatment[18].

Secondly, patients who are aged 85 years and above, who would be 10 years more than the local life expectancy may represent the biological elite rather than the frail elderly. They may therefore have a lower biological age than some younger patients, who may be approaching their expected biological demise.

Thirdly, as the number of patients above 85 were few (n = 24), there may have been a type II error in the analysis. Post-hoc analysis suggests that it would take five years of patient recruitment to show a statistically significant difference in mortality between those who are more than 85 and those who are less than that.

CONCLUSION

Our paper showed no statistical relationship between age and hospital mortality or ICU mortality. Instead, markers of illness severity, such as the APACHE II(M) score, a high risk diagnosis and the number of organ failures were better indicators for mortality. We would not advise using age as a criteria in gatekeeping ICU admissions.

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