Outcome After Admission in a Surgical Intensive Care Unit

Length of Stay, Mortality and Quality of Life

Fernando Abelha
Serviço de Anestesiologia, Hospital de São João, Porto

Outcome in intensive care can be categorized as mortality-related or morbidity-related. Hospital mortality is a relevant and objective endpoint. However, it is an insufficient indicator of Intensive Care unit (ICU) outcome and morbidity, disability and quality of life after discharge must also be taken into account. ICU length of stay (LOS) is often used as a surrogate for patient morbidity. Prolonged ICU stay can adversely affect prognosis by increasing the risk of complications such as infection and possibly, mortality. The study of quality of life after hospital discharge is increasingly used and accepted as a relevant measure of ICU outcome and appears as an important consideration when evaluating treatment benefits and resource allocation. It is important to understand quality of life in specific ICU subpopulations of critical ill patients and patients scheduled for elective surgery are of particular interest due to the individual risk of surgical procedures which may affect outcome.
Key-words: outcome; length of stay; mortality; quality of life.

The goals of health care are the reduction of mortality and morbidity, and the maintenance or improvement of functional capacity and quality of life.

Outcome in intensive care can be categorized as mortality-related or morbidity-related. Hospital mortality is a relevant, objective endpoint and appropriate for use. However it is an insufficient measure of intensive care unit (ICU) outcome; subsequent morbidity, disability and quality of life must also be taken into account and ICU length of stay (LOS) is often used as a surrogate outcome measure for patient morbidity.

MORTALITY

Outcome in intensive care have primarily been focused on hospital survival and resource utilisation adjusted for severity of illness. Many outcome prediction systems for ICU patients have been developed (1-4) and are routinely used in many ICU all over the world measuring severity of illness as mortality prediction models. They have been widely used and their performance well studied in large international data set (5). Predicted outcomes may also be used both for clinical decision making in individual patients and for assessing quality of care. Severity of illness in the ICU setting is typically quantified using models relating risk of death to physiologic variables within 24 hours of admission to the ICU. Such models include the *Acute Physiology and Chronic Health Evaluation* (APACHE) II (3), APACHE III (4), the *Mortality Probability Models* (6),

and the *Simplified Acute Physiology Score* (SAPS) (7).

Over the last three decades, outcome prediction and quantization of the severity of illness has become an ir-replaceable tool for the estimation of effectiveness and quality of intensive care as a supplement to structural, procedural, and outcome measurement methods, such as technology availability, staffing patterns, and patient procedures (8). In addition to predict death, investigators want to evaluate the performance of individual intensive care unit relative to international standards (9). A scoring system defines the severity scores of illness that could be used for the prediction of hospital mortality risk by applying logistic regression.

Admissions to ICU are not homogeneous and there are known differences between medical and surgical critical ill patients; so generalizing findings to all ICU admissions may be misleading. The surgical population of critical ill patients has some particular characteristics, namely those that underwent scheduled surgery. Proba-bly they already had a reduced quality of life, surgery being performed as an attempt to improve quality of life and survival.

Even simple, subjective measures such as the *American Society of Anesthesiologists* physical status score (ASA-PS) can be used to stratify patients by surgical risk (10,11). Approximately 50% of surgical deaths are in patients scoring ASA-PS IV or V. Although the case fatality is considerably lower for patients with lower ASA-PS, because more operations are performed on these patients they account for most deaths. The ASA-PS is a rating given to each patient by the anaesthesiologist before

anaesthesia. It was designed originally as a standardized way for anaesthesiologists to convey information about the patient's overall health status and allow outcomes to be stratified by a global assessment of their severity of illness. In pratice, however the score is frequently used to estimate operative risk and it correlates well with surgical mortality (12).

The type of surgical procedure can also be used to stratify patients according to cardiac risk and cardiac complications, such as myocardial infarction or congestive heart failure, represent the single most common cause of death in postoperative patients (13). A number of studies have identified an elevated cardiac risk in certain surgical types of surgery, such as vascular surgery (14-16). Eagle Ka has identified particular types of noncardiac surgery that appear to be associated with a heightened risk of perioperative death or myocardial infarction.

LENGTH OF STAY

Cost analysis studies have found that the ICU cost per day per patient is remarkably consistent across most diagnoses (17) and therefore, ICU LOS has been also used as a measure of resource utilisation in the ICU (18,19).

Despite refinements in perioperative management, prolonged intensive care unit stay is still associated with poor patient outcome and increased costs (20-22) and consumption of a considerable amount of ICU resources (23,24). In a study by Wong et al, patients with long ICU LOS accounted for only 7.3% of admissions but consumed 43.5% of total ICU days (18). Although length of stay in ICU may be affected by discharge policies, variable practice patterns and bed management (25) prolonged ICU stay can adversely affect the health status by increasing the risk of infection, complications, and, possibly, mortality (26). These have also impact upon bed availability and could result in cancellation of elective surgeries, leading to long waiting times and time spent on the ward before ICU admission.

The likely length of stay of a patient may also influence therapeutic decisions. Several recent studies have indicated that some therapeutic strategies that impact on patient outcome may only have an effect on patients with longer ICU stays (27,28).

Although the majority of patients admitted to an ICU only require admission for a few days, some have particularly complicated courses requiring admission for prolonged periods.

There is no generally accepted definition of the term 'long-term intensive care'. Because of the markedly skewed distribution of ICU LOS, no obvious cut-off exists and time periods of ≥ 7 days up to >30 days have been used to define prolonged ICU stay (9,23,29-34).

Nevertheless, prolonged ICU admission have been associated with increased risk of adverse outcomes, increased risk for infectious complications and consumption of resources (23,24,35).

QUALITY OF LIFE

Knowledge regarding the quality of life of patients treated in an ICU is fundamental for judging the benefits and human costs of intensive care. Assessing patient's quality of life is a complex and often difficult task because the process involves health status and associated variables such as social and familiar relationships, employment and financial status. *Health-Related Quality Of Life* (HRQOL) is now recognized as an important component of outcome evaluation among survivors and can improve the assessment of quality of life (36). Some authors state that outcome after ICU stay must include HRQOL measurements (37,38).

It is important to understand HRQOL in terms of specific ICU populations in order to assess the impact of specific interventions on these patients (39). Examining non-fatal post-hospital outcomes may enable us to understand the needs and problems of ICU survivors. In recent decades, quality of life outcomes have became an issue of increasing interest because they are relevant to a better knowledge of healthcare expenditure and resource utilization. Postoperative patients are of particular interest owing to the individual risk imposed by the surgical procedure and this subset of patients may differ in important ways from the general ICU population.

A large body of literature has been published in the last few years about quality of life assessment (40,41). People with the same health status may not necessarily enjoy the same quality of life. Health and well-being are multidimensional, and they include aspects such as individuals' subjective values and preferences. The study of quality of life may be generic and involving all aspects of HRQOL for a particular disease or group of patients, and several questionnaires have been validated for intensive care patients (42-48). Most of the measures that have been used for critical care are multi-item scales; that is, they are made up of several questions or items. Some multiple-item scales provide a total score as well as generating subscales that provide information on particular aspects such as mobility. The *Short-Form General Health Survey* (SF-36) was developed during the *Medical Outcomes Study* (MOS) to measure generic health concepts relevant across age, disease and treatment groups (49). It is a self-completed questionnaire covering all aspects of HRQOL (42,49,50). It is a valid instrument for measuring HRQOL. It has been used for post-discharge ICU patients and groups with other diseases, shows good reliability and validity (49,51), and is recommended for assessing outcome after critical illness (52-55). This questionnaire was culturally adapted to Portuguese and validated in a study by Ferreira (56).

Another valid instrument for measuring HRQOL is the EQ-5D (EuroQol five-dimension) questionnaire, already recommended as a generic instrument to be used in the critical care setting (47,57). This questionnaire has been used both in healthy populations (58) and in a number of patients with specific diseases, including critically ill patients (59).

The ability to care for oneself and live independently has also been considered a measure of functional outcome after hospitalization and discharge from intensive care (60). Functional status refers to the level of involvement in activities and is often used as a synonym for performance in Activities of Daily Living (ADL) (61). ADL appraisal scales consider functional and instrumental activities. A patient´s ability to handle these activities has been assessed by generic or disease-specific measures of physical functional status. Katz's Activities of Daily Living Scale (62), the Karnofsky Index (63) and Hulter-Asberg´s Instrumental Index of Independence in ADL (64) have been investigated in critical care survivors. These functional status measures in themselves are useful, and provide some insight into prognosis and prospects for independence post ICU discharge. The level of dependency in ADL can be seen as a global measurement reflecting a certain level of severity, resource consumption and quality of life.

The study of the quality of life in critical ill patients tends to focus in the results after discharge and very few studies have examined the situation before the admission. Normally severity of illness and the presence of co-morbidities are parameters used to stratify patients on admission but the evaluation of the quality of life of these patients is not frequently addressed. Reasons being that quality of life has been considered an outcome not an evaluation parameter and due to difficulties in assessing quality of life before the admission.

In a systematic literature review of quality of life in adult survivors of critical illness, published by Dowdy et al (39) only five studies (57,65-68) measured pre-admission QOL domains.

Rivera-Fernandéz et al (43,69) validated an instrument to measure the quality of life in critical ill patients at the moment of ICU admission. They verified that previous quality of life influenced quality of life after discharge and hospital mortality.

CONCLUSIONS

Critical care patients may differ with respect to the reason for their admission to the ICU, and these differences mainly for those admitted after surgery, are likely to result in different expectations regarding their health.

Although traditional short-term outcomes, such as hospital mortality and length of ICU stay remain extremely important, they are unlikely to be adequate for measuring the full impact of critical illness.

During the past years, the focus of outcome studies has been in the assessment of the functional capacity, management of daily activities and in the patient's subjective opinion about his well being after surgery.

REFERENCES

1 - LeGall JR, Loirat P, Alperovitch A, et al. A simplified acute physiology score for ICU patients. Crit Care Med 1984; 12:975-7.

2 - Lemeshow S, Teres D, Klar J, Avrunin JS, Gehlbach SH, Rapoport J. Mortality probability models (MPM II) based on an international cohort of intensive care unit patients. JAMA 1993;270:2478-86.

3 - Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985;13:818-29.

4 - Knaus WA, Wagner DP, Draper EA, et al. The APACHE III prognostic system: risk prediction of hospital mortality for critically ill hospitalized adults. Chest 1991;100:1619-36.

5 - Castella X, Artigas A, Bion J, Kari A. A comparison of severity of illness scoring systems for intensive care unit patients: Results of a multicenter, multinational study. Crit Care Med 1995;23:1327-35.

6 - Lemeshow S, Teres D KJ, Avrunin JS, Gehlbach SH, Rapoport J. Mortality probability models (MPM II) based on an international cohort of intensive care unit patients. JAMA 1993;270:2478-86.

7 - Le Gall JR, Lemeshow S, Saulnier F. A new simplified acute physiology score (SAPSII) based on a European/North American multicenter study. JAMA 1993, 270:2957-2963.

8 - Teres D, Lemeshow S: When to customize a severity model. Intensive Care Med 1999;25:140-2.

9 - Civetta JM, Hudson-Civetta JA, Nelson LD. Evaluation of APACHE II for cost containment and quality assurance. Ann Surg Oncol 1990;212:266.

10 - Cullen DJ, Apolone G, Greenfield S, Guadagnoli E, Clearly P. ASA Physical Status and age predict morbidity after three surgical procedures. Ann Surg Oncol 1994;220:3-9.

11 - Prause G, Ratzenhifer-Comenda B, Pierer G, Smolle-Juttner F, Glanzer H, Smolle J. Can ASA grade or Goldman's cardiac risk index predict peri-operative mortality? Anaesthesia 1997;52:203-6.

12 - Tiret L, Hatton F, Desmonts JM, Vourc'h G. Prediction of outcome of anaesthesia in patients over 40 years: a multifactorial risk index. Stat Med 1988;7:947-54.

13 - Hertzer NR. Basic data concerning associated coronary disease in peripheral vascular patients. Ann Vasc Surg 1987;1:616-20.

14 - L'Italien GJ, Cambria RP, Cutler BS, et al, procedures Cealcmaprdvs. Comparative early and late cardiac morbidity among patients requiring different vascular surgery procedures. J Vasc Surg 1995;21:935-44.

15 - Ashton CM, Petersen NJ, Wray NP, et al. The incidence of perioperative myocardial infarction in men undergoing noncardiac surgery. Ann Intern Med 1993;118:504-10.

16 - Krupski WC, Layug EL, Reilly LM, JH R, Mangano DT. Comparison of cardiac morbidity rates between aortic and infrainguinal operations: two-year follow-up: study of Peri-operative Ischemia Research Group. J Vasc Surg 1993; 18:609-15.

17 - Noseworthy TW, Konopad E, Shustack A, Johnston R, Grace M. Cost accounting of adult intensive care: methods and human and capital inputs. Crit Care Med 1996;24:1168-72.

18 - Wong DT, Gomez M, McGuire GP, Kavanagh B. Utilization of intensive care unit days in a Canadian medical-surgical intensive care unit. Crit Care Med 1999;27:1319-24.

19 - Knaus WA, Wagner DP, Zimmerman JE, Draper EA. Variations in mortality and length of stay in intensive care units. Ann Intern Med 1993;118:753-61.

20 - Hammermeister KE. Risk, predicting outcomes, and improving care. Circulation 1995;91:899-900.

21 - Bucerius J, Gummert JF, Walther T, et al. Predictors of prolonged ICU stay after on-pump versus off-pump coronary artery bypass grafting. Intensive Care Med 2004; 30:88-95.

22 - Tu JV, Jaglal SB, Naylor CD. Multicenter validation of a risk index for mortality, intensive care unit stay, and overall hospital length of stay after cardiac surgery. Steering Committee of the Provincial Adult Cardiac Care Network of Ontario. Circulation 1995;91:677-84.

23 - Lipsett PA, Swoboda SM, Dickerson J, et al. Survival and functional outcome after prolonged intensive care unit stay. Ann Surg Oncol 2000;231:262-8.

24 - Higgins TL, McGee WT, Steingrub JS, Rapoport J, Lemeshow S, Teres D. Early indicators of prolonged intensive care unit stay: impact of illness severity, physician staffing, and pre-intensive care unit length of stay. Crit Care Med 2003;31:45-51.

25 - Suter P, Armaganidis A, Beaufils F, et al. Predicting outcome in ICU patients. 2nd European consensus conference in intensive care medicine. Intensive Care Med 1994; 20: 390-7.

26 - Gilio AE, Stape A, Pereira CR, Cardoso MF, Silva CV, Troster EJ. Risk factors for nosocomial infections in a critically ill pediatric population: a 25-month prospective cohort study. Infect Control Hosp Epidemiol 2000;21:340-2.

27 - van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in the critically ill patients. N Eng J Med 2001;345:1359-67.

28 - Corwin HL, Gettinger A, Rodriguez RM, et al. Efficacy of recombinant human erythropoietin in the critically ill patient: a randomized, double-blind, placebo-controlled trial. Crit Care Med 1999;27:2346-50.

29 - Madoff RD, Sharpe SM, Fath JJ, Simmons RL, Cerra FB. Prolonged surgical intensive care: A useful allocation of medical resources. Arch Surg 1985;120:698.

30 - Buchman TG, Kubos KL, Seidler AJ, Siegforth MJ. A comparison of statistical and connectionist models for the prediction of chronicity in a surgical intensive care unit. Crit Care Med 1994;22:750-62.

31 - Stricker K, Rothen HU, Takala J. Resource use in the ICU: short- vs. long-term patients. Acta Anaesthesiol Scand 2003;47:508-15.

32 - Groeger JS, Guntupalli KK, Strosberg M, et al. Descriptive analysis of critical care units in the United States: Patient characteristics and intensive care unit utilization. Crit Care Med 1993;21:279-91.

33 - Becker GJ, Strauch GO, Saranchak HJ. Outcome and cost of prolonged stay in the surgical intensive care unit. Arch Surg 1984;119:1338-42.

34 - Goins WA, Reynolds HN, Nyanjom D, Dunham CM. Outcome following prolonged intensive care unit stay in multiple trauma patients. Crit Care Med 1991;19:339-45.

35 - Heyland DK, Konopad E, Noseworthy TW, Johnston R, Gafni AJ. Is it 'worthwhile' to continue treating patients with a prolonged stay (>14 days) in the ICU? An economic evaluation. Chest 1998;114:192-8.

36 - Rubenfeld GD, Angus DC, Pinsky MR. Outcomes research in critical care: Results of the American Thoracic Society Critical Care Assembly Workshop on Outcomes Research. Am J Respir Crit Care Med 1999, 160:358-67.

37 - Heyland DK, Guyatt G, Cook DJ, et al. Frequency and methodologic rigor of quality-of-life assessments in the critical care literature. Crit Care Med 1998;26:591-8.

38 - Hennessy D, Juzwishin K, Yergens D, Noseworthy T, Doig C. Outcomes of Elderly Survivors of Intensive Care. A Review of the Literature 2005;127:1764-74.

39 - Dowdy DW, Eid MP, Sedrakyan A, et al. Quality of life in adult survivors of critical illness: a systematic review of the literature. Intensive Care Med 2005;31:611-20.

40 - Heyland DK, Konopad E, Noseworthy TW, Johnston R, Gafni A. Is it 'worthwhile' to continue treating patients with a prolonged stay (> 14 days) in the ICU? An economic evaluation. Chest 1998:192-8.

41 - Kerridge R, Brooks R, Hillman K. Quality of life after intensive care. Yearbook of Intensive Care 1994:827-838.

42 - Ware JE, Snow KK, Kosinski M, Gandek B. SF-36 health survey: Manual and interpretation guide. The Health Institute, Boston 1993.

43 - Fernandez RR, Cruz JJ, Mata GV. Validation of a quality of life questionnaire for critically ill patients. Intensive Care Medicine 1996, 22:1034-42.

44 - Niskanen M, Ruokonen E, Takala J, Rissanen P, Kari A. Quality of life after prolonged intensive care. Crit care Med 1999;27:1132-9.

45 - Hunt SM, McKenna SP, McEwen J, Williams J, Rapp E. The Nottingham Health Profile:subjective health status and medical consultations. Soc Sci Med 1981;15A:221-9.

46 - Patrick DL, Danis M, Southerland LI, Hon G. Quality of life following intensive care. J Gen Intern Med 1988;3:218-23.

47 - The EuroQol Group. EuroQol - a new facility for the measurment of health-related quality of life. . Health Policy 1990;16:199-208.

48 - Bergner M, Bobbit RA, Carter WB, Gilson BS. The Sicness Impact Profile: development and final revision of a health status measure. Med Care 1981;19:787-805.

49 - McHorney CA, Ware JE, Raczek AE. The MOS 36 Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care 1993;(31):247-63.

50 - Ware JE, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36). I. Conceptual framework and item selection. Med Care 1992;30:473-83.

51 - Ware JE, M K, Keller SD. SF-36 Physical and Mental Healthg Summary Scales: A User Manual. Boston, The Health Institute, New England Medical Center. 1994.

52 - Jones C HR, Griffiths RD. A tool to measure the change in health status of selected adult patients before and after intensive care. Clin Intensive Care 1993;4:160-5.

53 - Jones C GR, Macmillan R. Psychological problems occurring after intensive care. Br J Intensive Care 1994;4:46-53.

54 - Graf J, Koch M, Dujardin R, Kersten A, Janssens U. Health-related quality of life before, 1 month after, and 9 months after intensive care in medical cardiovascular and pulmonary patients. Crit Care Med 2003;31:2163-9.

55 - Kvale R, Flaatten H. Changes in health-related quality of life from 6 months to 2 years after discharge from intensive care. Health Qual Life Outcomes 2003;1:2.

56 - Ferreira PL. Development of the Portuguese version of MOS SF-36. Part I. Cultural and linguistic adaptation. Acta Med Port 2000;13:55-66.

57 - Badia X, Diaz-Prieto A, Gorriz MT, et al. Using the EuroQol-5D to measure changes in quality of life 12 months after discharge from an intensive care unit. Intensive Care Med 2001;27:1901-7.

58 - Badia X, Schiaffino A, Alonso J, Herdman M: Using the EuroQol 5-D in the Catalan general population: feasibility and construct validity. Qual Life Res 1998;7:311-22.

59 - Granja C, Teixeira-Pinto A, Costa-Pereira A.Quality of life after intensive care-Evaluation with EQ-5D questionnaire. Intensive Care Med 2002;28:898-907.

60 - Weinert CR, Gross CR, Kangas JR, Bury CL, Marinelli WA. Health-related quality of life after acute lung injury. Am J Respir Crit Care Med 1997;156:1120-8.

61 - Katz S. Assessing self-maintenance: Activities of daily living, mobility, and instrumental activities of daily living. J Am Geriatr Soc 1983;31:721-7.

62 - Katz S, Ford AB, Moskowitz RW, Jackson BA, Jaffe MW. Studies of illness in the aged. The Index of ADL: a standardized meassure of biological and psychosocial function. JAMA 1963;185:914-9.

63 - Crooks V, Waller S, Smith T, TJ H. The use of the Karnofsky Performance Scale in determining outcomes and risk in geriatric outpatients. J Gerontol 1991;46:M139-M144.

64 - Sonn U, Asberg KH. Assessment of activities of daily living in the elderly. A study of a population of 76-year-olds in Gothenburg, Sweden. Scand J Rehabil Med 1991;23:193--202.

65 - Graf J KM, Dujardin R, Kersten A, Janssens U. Health-related quality of life before, 1 month after, and 9 months after intensive care in medical cardiovascular and pulmonary patients. Crit Care Med 2003;31:2163-9.

66 - Kleinpell R. Exploring outcomes after critical illness in the elderly. Outcomes Manag 2003;7:159-69.

67 - Ridley SA CP, Scotton H, Rogers J, Lloyd D. Changes in quality of life after intensive care: comparison with normal data. Anaesthesia 1997;52:195-202.

68 - Wehler M, Geise A, Adzionerovic D, et al. Health-related quality-of-life of patients with multiple organ dysfunction: individual changes and comparison with normative population. Crit Care Med 2003;31:1094-101.

69 - Rivera-Fernandez R, Sanchez-Cruz JJ, Abizanda-Campos R, Vazquez-Mata G. Quality of life before intensive care unit admission and its influence on resource utilization and mortality rate. Crit Care Med 2001;29:1701-9.

Correspondência:
Dr. Fernando Abelha
Serviço de Anestesiologia
Hospital de São João
Alameda Prof. Hernâni Monteiro
4200-319 Porto

e-mail: abelha@mail.telepac.pt