HOSPITAL PHARMACOLOGY
International Multidisciplinary Journal
ISSN 2334-9492 (Online)
Hospital Pharmacology. 2014; 1(1):1-8
UDC: 615.035.2 ; 616-089:612.398
doi:10.5937/hpimj1401001V

Original article

Is 28-Day Follow-Up Period Enough for Examining the Mortality after Resuscitation with Human Albumin?

Mira H. Vuković[1], Branislav S. Gvozdenović[2], Mihajlo B. Jakovljević[3], Predrag A. Živanović[1], Dušan M. Mitrović[4], Ivana M. Plećić[5], Miodrag Ž. Ilić[6]

[1] Quality Assurance Department, City Hospital, Valjevo, Serbia;
[2] PPD Serbia, Belgrade, Serbia;
[3] Department of Pharmacology and Toxicology, Faculty of Medicine, University of Kragujevac, Kragujevac, Serbia;
[4] Department of Physiology and Applied Physiology, School of Medicine, University of Belgrade, Belgrade, Serbia;
[5] Department of Clinical Pharmacy, City Hospital, Valjevo, Serbia;
[6] Institute of Cardiovascular Surgery Dedinje, Belgrade, Serbia

SUMMARY

Objective The potential risk of mortality increase due to the use of human albumin (HA) in surgical patients has not been determined yet. The aim of the study was to evaluate the association of mortality rate of surgical patients with other indicators of the quality of health services and consumption of HA and hydroxyethyl starch (HES).

Methods The study of a time series at the surgical department analyzed monthly indicators of the quality of health services. The monthly consumption of HA and HES is shown as a number of HA or HES bottles consumed in the intensive care unit (ICU) or outside the ICU. Autoregressive integrated moving average (ARIMA) model was used for the statistical analysis.

Results For the total mortality rate, four significantly predictors in moving average model were identified. The total mortality rates for each next month were significantly directly dependent on the unobserved random error from the current and previous month. Number of operated patients showed an indirect effect on the total mortality rate. Number of HA bottles consumed in the ICU, mortality rate of operated patients and patients without operation were directly associated with the increased total mortality rate.

Conclusions Follow-up period for examination of the mortality from resuscitation with HA in a heterogeneous surgical population can not be less than two months. ARIMA can be extremely useful in determining a total period of time when all mortality due to the application of certain drug in a particular population will be manifested.

Keywords: human albumin; mortality; surgery; time series study; hydroxyethyl starch

Corresponding author:
Prim. Mira VUKOVIĆ, MD, MSc
Health Center Valjevo, Serbia; 62 Sindjelića St., 14000 Valjevo, Serbia
E-mail: vmira62@gmail.com

INTRODUCTION

Human albumin (HA) solution is non-blood plasma substitute used to treat hypovolaemia. HA is often used to correct hypoalbuminemia. Cochrane group showed the evidence that the risk of death in patients who were given albumin was 6% higher than that with other colloids [1]. An accompanying editorial suggested that HA was harmful and that restrictions should be introduced in the application of HA in critically ill patients [1, 2]. The albumin expert working party for the Committee on Safety of Medicines in the UK looked at the individual trials in the Cochrane report that compared colloids with crystalloids, and concluded that the weighted relative risks for mortality in these trials were higher for HA than for crystalloids [3]. They warn that special care is needed in diseases which are accompanied by the impaired capillary integrity. They also state that the mechanism of death due to the albumin administration might be fluid overload. Because the inflammatory response is common in most causes of critical illness, and this causes capillary leakiness, there have been recommendations that their application should be avoided in these patients. The therapeutic indications allowed by the Committee on Safety of Medicines for hyperoncotic 20% HA solution should include status where electrolyte or fluid load is contraindicated. A Consortium of hospitals in the USA has also issued guidelines for fluid resuscitation [4]. They suggest stringent restrictions for the use of HA in hemorrhagic and nonhemorrhagic shock, hepatic resection, thermal injury and cardiac surgery, where crystalloids are being the fluids of choice.

In a meta-analysis of Jacob et al. [5], it was shown that, in surgery, hyperoncotic HA preserved renal function and reduced intestinal edema compared with hydroxyethyl starch (HES) administration. In trauma and sepsis, cardiac index and oxygenation were higher after the administration of HES than hyperoncotic HA, but survival was unaffected by hyperoncotic HA. Furthermore, Wiedermann et al. [6] suggested in their meta-analysis that renal effects of colloid solutions appeared to be dependent on the type of colloids. Hyperoncotic HA exerts renoprotection while hyperoncotic HES shows nephrotoxicity. The results of the cohort, multicenter, observational SOAP study in a population of critically ill patients showed that HA administration was associated with decreased 30-day survival compared to patients who did not use HA [7].

In a multi-center, randomized, double-blind trial, known as the SAFE study, the authors evaluated 28-day mortality of a heterogeneous population of 6,997 ICU patients resuscitated with 4% HA versus normal saline [8]. The primary outcome variable was 28-day mortality. The SAFE Study investigators suggested that in the whole examined population of critically ill patients who required fluid resuscitation, the use of 4% HA or normal saline for intravascular volume resuscitation resulted in equivalent rates of 28-day mortality.

The safety of application of HA or HES for intravascular volume resuscitation is mainly analyzed in the observational epidemiological case-control studies, meta analyses and randomized clinical trials. We felt it was important to examine how the consumption of HA or HES is associated with the indicators of the quality of health services, primarily with mortality rate among patients hospitalized at the surgical department in the retrospective observational study of time series.

The aims of this study were: 1) to determine the influence of individual quality indicators on HA and HES consumption at the surgical department, and 2) to estimate the form and strength of connection between total mortality rate and a total consumption of HA, HES and other indicators of the quality of health services in the surgical department.

METHODS

Study design

A retrospective observational study of time series for the indicators of quality of health services and consumption of HA and HES in adult surgical patients hospitalized at the Surgical Department of the City Hospital in Valjevo (Serbia) has been carried out. This surgical department provides inpatient treatment services for 200,000 people and has 80 hospital beds. It consists of the Intensive Care Unit (ICU), Semi-intensive Unit, Section of General Surgery and Vascular Surgery Section. ICU has 12 beds. Eleven beds are reserved for surgical patients, while one bed is available for critically ill patients from other departments. Both electively and urgently treated patients are placed in the ICU. Elective patients are those undergoing abdominal and vascular surgery, and requiring postoperative treatment in the ICU. Urgent patients are patients also undergoing the aforementioned surgeries as well as patients with polytrauma.

Indicators of quality and consumption of HA and HES solutions

Indicators of quality and consumption of HA and HES solutions were monitored monthly at the Department for Quality Assurance and the Department for Clinical Pharmacy, and the study covered the period from January 2009 until the end of May 2011.

The following quality indicators were observed: total number of hospitalized patients, number of operated patients, number of patients without operation, number of dead patients who were operated, number of dead patients without operation and the number of hospital days. Solutions used in the treatment of critically ill patients were hyperoncotic 20% HA (50 mL) or iso-oncotic 6% HES (500 mL) in the ICU, while outside the ICU, 20% HA was rarely used to correct hypoalbuminemia when the concentration of albumin in the blood was less than 2.0 g/dl [9]. HA and HES consumption was measured by the number of bottles consumed in the ICU, outside of ICU and total.

A total mortality rate was calculated as the ratio of total dead patients and total hospitalized patients. The mortality rate of operated patients was calculated as the ratio of dead operated patients and hospitalized operated patients. The mortality rate of patients without operation was calculated as the ratio of dead patients without operation and hospitalized patients without operation. All mortality rates were expressed in percentages. Hospital days rate was calculated as the ratio of the number of hospital days and number of total hospitalized patients, while monthly consumption of HA or HES rate was shown as the ratio of consumed bottles of HA or HES and total hospitalized patients.

This study has been approved by the Ethics Board of the City Hospital Valjevo.

Statistical analysis

The mean, standard deviation and sum were used for data description. Time series analyses were carried out using the appropriate procedures of autoregressive integrated moving average (ARIMA) model [9]. Ljung–Box test [10] was used for model checking by testing whether the estimated model conformed to the specifications of stationary univariate process. The agreed level of significance was 0.05. The statistical package PASW Statistics 18 (Chicago, Illinois) was used for the statistical analysis.

RESULTS

During the study period of 29 months and in a total study population of 9,812 hospitalized patients, there was an average of 338±32 hospitalizations per month (Table 1). An average number of hospital days was 1861±328.40, while an average number of hospitalized and operated patients in surgical department was 171±44 per month. An average monthly number of hospitalized patients without operation was 160±23 with Sum=4,647. An average number of dead operated patients was 5.93±2.49 per month, while approximately 11.45±4.20 patients died without any operation. An average monthly consumption of HA in the ICU and outside the ICU was 89.72±34.42 and 28.14±19.98, respectively, while the consumption of HA per patient was 0.36±0.17. An average monthly consumption of HES in the ICU and outside the ICU was 89.33±32.84 and 2.41±5.47, respectively, while the consumption of HES per patient was 0.27±0.11. Total mortality rate, mortality rate of operated patients and mortality rate of patents without operation was 5.34±1.48%, 3.69±75% and 7.09±2.22% monthly, respectively. An average number of hospital days per patient was 5.54±0.96 per month.

The resulting two stationary regression models of ARIMA with moving averages (MA) – type (0,0,1)(0,0,0) and one model with linear constant of depending variable – type (0,0,0)(0,0,0). For dependent variable – total HES bottles consumed per total hospitalized patients (Model 1), significant predictors were identified: HES bottles consumed in the ICU (B=0.003; t=34.296; p<0.0001), HES bottles consumed ouside the ICU (B=0.004; t=6.752; p<0.0001), the number of operated patients (B=-0.001; t=-9.148; p<0.0001), the number of patients without operation (B=-0.00036; t=-2.882; p=0.008) with constant B=0.157 (t=6.951; p<0.0001).

For dependent variable – total HA bottles consumed per total hospitalized patients

(Model 2), the following significant predictors were identified: the number of operated patients (B=-0.001; t=-6.427; p<0.0001), the number of hospital days per hospitalized patient (B=0.017; t=5.598; p<0.0001), HA bottles consumed in the ICU (B=0.003; t=15.08; p<0.0001) and HA bottles consumed outside the ICU (B=0.004; t=9.835; p<0.0001). It was also shown that total consumption rate of HA for every following month was significantly indirectly dependent on the unobserved random error from the current and previous month (Lag time=1; Bfor MA=-0.491; t=-2,645; p=0.014).

For dependent variable - total mortality rate (Model 3), we also identified significant predictors: the number of operated patients (B=-0.003; t=-6.428; p<0.0001), HA bottles consumed in the ICU (B=0.003; t=3.403; p=0.002), mortality rate of operated patients (B=0.554; t =38.710; p<0.0001) and mortality rate of patients without operation (B=0.448; t=33.243; p<0.0001). It was also shown that the total mortality rate for every following month was significantly directly dependent on the unobserved random error from the current and previous month (Lag time=1; Bfor MA=0.961; t=2.366; p=0.026). The mean of the predicted value for the total mortality rate was 5.36% with 95% confidence interval from 4.97% to 5.76%.

All models of time series were obtained by high R2, for Model 1 – R2=0.986, Model 2 – R2=0.981 and Model 3 – R2=0.986. The model fit statistics and the Ljung–Box statistics were presented in Table 2. Time series observed val-

Table 1. Descriptive statistics per monthly quality health services indicators and monthly human albumin solution consumption for January 2009 – May 2011

Variables	Mean	SD	Sum
Total hospitalized patients	338.34	42.08	9812
Hospital days	1861.24	328.40	53976
Operated patients	170.90	44.38	4956
Patient without operation	160.24	22.90	4647
Dead operated patients	5.93	2.49	172
Dead without operation	11.45	4.20	332
HA bottles consumed in the ICU	89.72	34.42	2602
HA bottles consumed outside the ICU	28.14	19.98	816
Total HA bottles consumed (in the ICU + outside the ICU)	117.86	51.39	3418
HES bottles consumed in the ICU	89.31	32.86	2590
HES bottles consumed outside the ICU	2.41	5.77	70
HES bottles total (in the ICU + outside the ICU)	91.72	34.88	2660
Hospital day per total hospitalized patients	5.54	0.96	
Total HES bottles consumed per total hospitalized patients	0.27	0.11	
Total HA bottles consumed per total hospitalized patients	0.36	0.17	
Total dead ×100 per total hospitalized patients (total mortality rate)	5.34	1.48	
Dead operated ×100 per operated hospitalized patients (mortality rate of operated patients)	3.69	1.75	
Dead without operation ×100 per hospitalized patients without operation (mortality rate of patients without operation)	7.09	2.22	

HA – human albumin solution; ICU – intensive care unit; HES – hydroxyethyl starch solution

Table 2. ARIMA model fit statistics for dependent variables total HES bottles consumed per total hospitalized patients, HA bottles consumed per total hospitalized patients and total mortality rate

ARIMA Model		Number of predictors	Model Fit statistics		Ljung–Box Q(18)		
			Stationary R2	MAE	Statistics	DF	p
1	Total HES bottles consumed per total hospitalized patients	4	0.986	0.010	17.497	18	0.489
2	Total HA bottles consumed per total hospitalized patients	4	0.981	0.018	10.644	17	0.874
3	Total mortality rate*	4	0.986	0.141	15.322	17	0.572

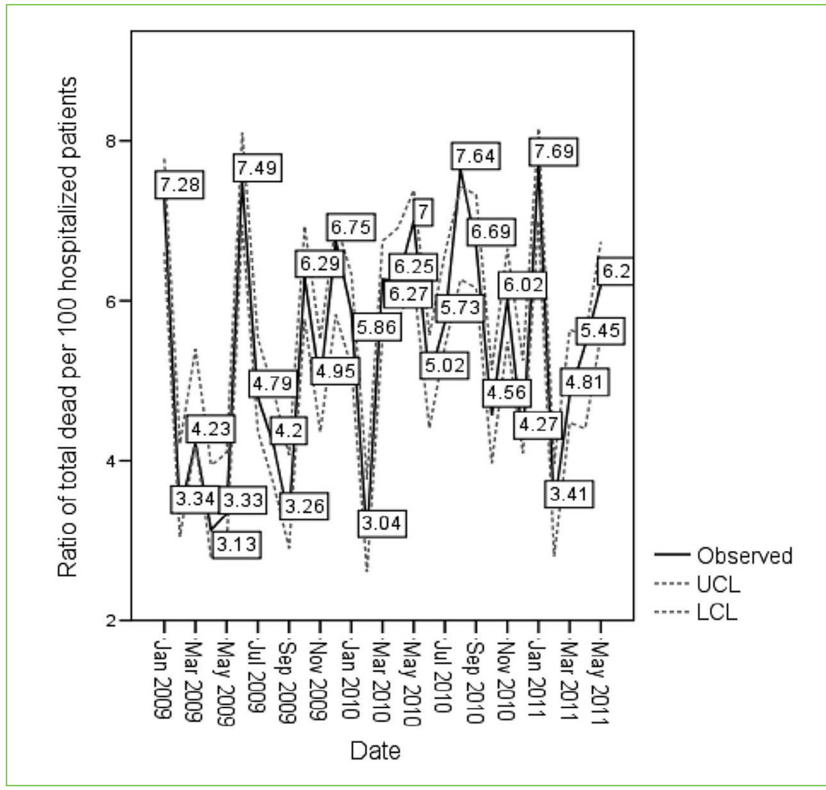
* Total dead patients ×100 per total hospitalized patients

MAE – mean absolute error; DF – degree of freedom; HA – human albumin solution; HES – hydroxyethyl starch solution ues of total dead patients rate with the upper and lower 95% confidence intervals were shown graphically (Graph 1).

DISCUSSION

The results of this study suggest that there is a significant relationship between the quality indicators of health services and monthly consumption of HA or HES for hospitalized patients in our surgical department. Monthly consumption of HES bottles per hospitalized patients was directly dependent on the number of bottles consumed in the ICU and outside the ICU, and the number of patients without operation. Number of operated patients was indirectly related to the monthly consumption of HES. This indicates that serious health problems on what account our hospitalized patients had been administered HES, were successfully eliminated by surgical intervention. Such situations were severe internal or external hemorrhages and polytraumas. As the number of well-planned surgical procedures in the above situations was increased, so the HES consumption was reduced, while increasing the number of patients without operation had the opposite effect. It is worth mentioning here that a small number of patients from other hospital departments who are in need of ventilation support or of continuous hemodynamic monitoring are also hospitalized in the ICU.

HA consumption by hospitalized patients was also indirectly associated with the number of operated patients, and was directly associated with the number of bottles consumed in the ICU and outside the ICU, and the number of hospital days per hospitalized patient in the current month. Patients with longer ICU stay are those with severe postoperative complications that lead to development of the systemic inflammatory response syndrome (SIRS) with or without sepsis and severe sepsis or septic shock. The results also show that there is a persistent tendency to less consumption of HA per hospitalized patient in each successive month as compared to an average consumption in the current and previous month. This means that our ICU patients receive HA at the beginning rather than at the end of hospitalization. This tendency of monthly time series consumption of HA in our population suggests the possibility that patients in the ICU should be receiving HA in the early post-operative period. However,



Graph 1. Total mort ality rate from January 2009 to May 2011

application of HA in the early postoperative period is not recommended until hemodynamic stabilization of patients is completed with crystalloid or non-protein colloids [11]. On the other hand, there is a speculation that the application of HA in the early postoperative period due to the appearance of SIRS may result in the increased permeability of tissue capillaries, the passage of albumin from the intravascular to the interstitial compartment, as well as difficult lymphatic drainage of albumin, all of which lead to cell dehydration and organ dysfunction [12].

Our results (see Model 3 in results) indicate that there is a latent lag time for a minimum of one month to a maximum period of two months from the application of HA solution to all lethal outcomes associated with its application. This could be explained by the following example: if we would like to explain the increase in total mortality rates in July, we had to look at the latent (unobserved) stationary effects on mortality rates in May and June, along with the observed influence of HA bottles consumption in June in the ICU. The number of hospitalized patients in monthly total mortality rate is presented as a denominator, so it is clear that patients whose treatment resulted in the increase of total mortality rate in July, could be hospitalized at the beginning or the end of May. Their high mortality in July was associated with HA treatment carried out in June (also at the beginning or the end of June). Accordingly, the follow-up period from the introduction of HA treatment to the fatal outcome of patient should be up to 60 days. Therefore, all unobserved effects (random error) on total mortality rate in our population were included (with MA regression coefficient) in the MA model. With the MA regression coefficient, the correction in the equation of the time series was performed with quantification of the impact of random error, which was originated from the current and prior periods. This is particularly important because only when we determine the basic tendency of the time series of total mortality rates, then we can look at all other influences of independent variables on this time series, such as consumption of HA bottles in the ICU. In our MA model (Model 3), we included a large portion of the latently (unobserved) and manifestly (observed) effects on the total mortality rate. The total explained variance for the time series of total mortality rate was 98.6% (Table 2). In our study, we showed that every 100 HA bottle consumed in the ICU contributed 30% to total monthly mortality rate, on average, 5.34%±1.48% of the observed data. There are reports describing the difference between 28-day mortality and 60-day mortality in patients with severe sepsis and septic shock, and it may be up to 23% [13]. This difference varies due to many factors among which the most important are: time from diagnosis and initiation of resuscitation, resuscitation methods, ways of implementation of hemodynamic monitoring, the way we conduct ventilation support, etc. It appears that the latest reports about the mortality reduction in the resuscitation process with HA solution versus crystalloids, with the mortality follow-up period of 28 days in the randomized clinical design, have to be taken with a grain of salt [14]. We also point out the risks of uncritical adherence to the recommendations for early postoperative application of HA in patients with massive bowel resection in order to prevent hypoalbuminemia [11]. This is of the utmost importance for the survival of surgical patients. In a number of critics of studies applying HA solution in critically ill surgical patients, a little is discussed about the informativeness of these studies related to parameters of surgical work that also affect the mortality of these patients. Objections were related solely to the choice of studies in meta-analysis [15, 16, 17], lack of information about methods of hemodynamic monitoring [18, 19], or insufficiency of data on other accompanying therapeutic procedures in critically ill patients [20].

Serbia has not adopted an official national guideline to sepsis yet. Bearing in mind the results of our study, and due to the cost and mortality rate reduction in the surgical department, we recommend resuscitation with the crystalloid solutions in septic patients for their hemodynamic stabilization. This recommendation may be found in the Guideline of the German Sepsis Society [21]. Moreover, our recommendation is to avoid HA application in the early postoperative period as well as in patients with the massive bowel resection.

The limitation of our study is the lack of an explicit assessment of the relationship between the patients' deaths and the severity of their illness or types of surgical interventions or monitoring parameters related to resuscitation. It is well known that the degree of hypoalbuminemia in critically ill patients shows a strong direct correlation with the severity of disease and mortality, but paradoxically the correction of hypoalbuminemia in these patients slightly impacts their survival [22, 23, 24]. It is well documented that, in the contemporary ICU practice, HA is reserved for salvage treatment of a small number of patients with severest conditions. In the SOAP study of European ICU practice, only 11% of 3,147 patients received HA [7] compared with 34% receiving HES. Yet, at baseline HA recipients had significantly higher Sequential Organ Failure Assessment (SOFA) score and New Simplified Acute Physiology Score (SAPS II) and significantly more frequent cancer, cirrhosis, infection, severe sepsis or septic shock, need for mechanical ventilation and renal replacement therapy, and respiratory, cardiovascular, coagulation and hepatic failure. Similarly, in the CRYCO international study of 1013 ICU patients requiring fluid resuscitation, only 13% of patients received 20%–25% HA [25]. However, ARIMA provides the additional information about the lag time and total time when we can observe all fatal outcomes associated with the independent variables that are not mutually correlated. This study primarily estimates mortality rate tendency over time in the surgical patient population, and the prediction of mortality rate is mainly based on the impact of the resulting indicators of quality of the surgery treatment and HA or HES consumption.

CONCLUSIONS

Our conclusion is that the influence of HA vs. HES on mortality rate of critically ill patients can be correctly investigated only in well-designed randomized clinical studies with the follow-up mortality of patients not less than two months. ARIMA is extremely useful in quality control of health services and pharmacovigilance in various treatment regimes that are carried out at the surgical department.

Conflict of Interest Statement

The authors certify that there are no potential conflicts of interest.

REFERENCES

1. Cochrane Injuries Group. Human albumin administration in critically ill patients: systematic review of randomized controlled trials. BMJ. 1998; 317: 235-40.
2. Offringa M. Excess mortality after human albumin administration in critically ill patients. Clinical and pathophysiological evidence suggests albumin is harmful. BMJ. 1998; 317:223-4.
3. Roberts I, Herxheimer A. Albumin and the Medicines Control Agency. Lancet. 1999; 354(9179):686.
4. Vermeulen Jr LC, Ratko TA, Erstad BL, Brecher ME, Matuszewski KA. A paradigm for consensus. The University Hospital Consortium guidelines for the use of albumin, nonprotein colloid, and crystalloid solutions. Arch Intern Med. 1995; 155:373-9.
5. Jacob M, Chappell D, Conzen P, Wilkes MM, Becker BF, Rehm M. Small-volume resuscitation with hyperoncotic albumin: a systematic review of randomized clinical trials. Crit Care. 2008; 12:R34.
6. Wiedermann CJ, Dunzendorfer S, Gaioni LU, Zaraca F, Joannidis M. Hyperoncotic colloids and acute kidney injury: a meta-analysis of randomized trials. Crit Care. 2010; 14:R191.
7. Vincent JL, Sakr Y, Reinhart K, Sprung LC, Gerlach H, Ranieri MV. Is albumin administration in the acutely ill associated with increased mortality? Results of the SOAP study. Crit Care. 2005; 9:R745-54.
8. Finfer S, Bellomo R, Boyce N, French J, Myburgh J, Norton R. A comparison of albumin and saline for fluid resuscitation in the intensive care unit. N Engl J Med. 2004; 350:2247-56.
9. Box G, Jenkins G. Time Series Analysis: Forecasting and Control. San Francisco: Holden-Day; 1970.
10. Ljung GM, Box GEP. On a measure of a lack of fit in time series models. Biometrika. 1978; 65:297-303.
11. Liumbruno G, Bennardello F, Lattanzio A, Piccoli P, Rossetti G. Recommendations for the use of albumin and immunoglobulins. Blood Transfus. 2009; 7:216-34.
12. Pulimood TB, Park GR. Debate: Albumin administration should be avoided in the critically ill. Crit Care. 2000; 4:151-5.
13. Rivers E, Nguyen B, Havstad S, Ressler J, Muzzin A, Knoblich B, et al. Early goal-directed therapy in the treatment of severe sepsis and septic shock. N Engl J Med. 2001; 345:1368-77.
14. SAFE Study Investigators, Finfer S, Bellomo R, McEvoy S, Lo SK, Myburgh J, Neal B, et al. Impact of albumin compared to saline on organ function and mortality of patients with severe sepsis. Intensive Care Med. 2011; 37:86-96.
15. Bunn F, Lefebvre C, Li Wan Po A, Li L, Roberts I, Schierhout G. Human albumin solution for resuscitation and volume expansion in critically ill patients: the albumin reviewers. Cochrane Database Syst Rev. 2000; 2:CD001208.
16. Alderson P, Bunn F, Lefebvre C, Li WP, Li L, Roberts I, et al. Human albumin solution for resuscitation and volume expansion in critically ill patients. Cochrane Database Syst Rev. 2002; 1:CD001208.
17. SAFE Study Investigators, Finfer S, Bellomo R, McEvoy S, Lo SK, Myburgh J, Neal B, et al. Effect of baseline serum albumin concentration on outcome of resuscitation with albumin or saline in patients in intensive care units: analysis of data from the saline versus albumin fluid evaluation (SAFE) study. BMJ. 2006; 333:1044-9.
18. Cook D. Is albumin safe? N Engl J Med. 2004; 350: 2294-6.
19. Caironi P, Gattinoni L. The clinical use of albumin: the point of view of a specialist in intensive care. Blood Transfus. 2009; 7:259-67.
20. Ball J. Recently published papers: What not to do and how not to do it? Crit Care. 2005; 9:419-21.
21. Reinhart K, Brunkhorst FM, Bone HG, Bardutzky J, Dempfle CE, Forst H, et al. German Sepsis Society; German Interdisciplinary Association of Intensive Care and Emergency Medicine. Prevention, diagnosis, therapy and follow-up care of sepsis: 1st revision of S-2k guidelines of the German Sepsis Society (Deutsche Sepsis-Gesellschaft e.V. (DSG)) and the German Interdisciplinary Association of Intensive Care and Emergency Medicine (Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin (DIVI). Ger Med Sci. 2010; 8:Doc14.
22. Apelgren KN, Rombeau JL, Twomey PL, Miller RA. Comparison of nutritional indices and outcome in critically ill patients. Crit Care Med. 1982; 10:305-7.
23. Bradley JA, Cunningham KJ, Jackson VJ, Hamilton DN, Ledingham IM. Serum protein levels in critically ill surgical patients. Intensive Care Med. 1981; 7:291-5.
24. Goldwasser P, Feldman J. Association of serum albumin and mortality risk. J Clin Epidemiol. 1997; 50:693-703.
25. Schortgen F, Girou E, Deye N, Brochard L; CRYCO Study Group. The risk associated with hyperoncotic colloids in patients with shock. Intensive Care Med. 2008; 34:2157-68.

Da li je posle reanimacije humanim albuminima za ispitivanje mortaliteta dovoljno 28 dana?

Mira H. Vuković[1], Branislav S. Gvozdenović[2], Mihajlo B. Jakovljević[3], Predrag A. Živanović[1], Dušan M. Mitrović[4], Ivana M. Plećić[5], Miodrag Ž. Ilić[6]

[1] Odeljenje za obezbeđenje kvaliteta, Bolnica Valjevo, Valjevo, Srbija;
[2] PPD Serbia, Beograd, Srbija;
[3] Odeljenje za farmakologiju i toksikologiju, Fakultet medicinskih nauka Univerziteta u Kragujevcu, Kragujevac, Srbija;
[4] Odeljenje za fiziologiju i primenjenu fiziologiju, Medicinski fakultet Univerziteta u Beogradu, Beograd, Srbija;
[5] Odeljenje bolničke farmacije, Bolnica Valjevo, Valjevo, Srbija;
[6] Institut za kardiovaskularnu hirurgiju „Dedinje“, Beograd, Srbija

KRATAK SADRŽAJ

Cilj rada Mogući rizik od povećanja mortaliteta zbog primene humanih albumina (HA) kod operisanih bolesnika još nije utvrđen. Cilj ove studije bio je procena udruženosti stope mortaliteta operisanih bolesnika sa drugim pokazateljima kvaliteta zdravstvenih usluga, potrošnjom HA i hidroksietil-skroba (HES).

Metode rada U studiji vremenskih serija na hirurškom odeljenju analizirani su mesečni indikatori kvaliteta zdravstvenih usluga. Mesečna potrošnja HA i HES izražena je brojem utrošenih boca HA i HES u i van jedinice intenzivnog lečenja (JIL). Za statističku analizu korišćen je autoregresioni model integrisan pokretnim prosecima (*ARIMA*).

Rezultati Za ukupnu stopu mortaliteta utvrdili smo četiri značajna prediktora u modelu pokretnih proseka. Ukupna stopa mortaliteta za svaki sledeći mesec direktno je zavisila od neopservirane slučajne greške iz aktuelnog i prethodnog meseca. Broj operisanih bolesnika indirektno je uticao na ukupnu stopu mortaliteta. Broj utrošenih boca u JIL, stopa operisanih i stopa neoperisanih bolesnika bili su direktno povezani s povećanjem stope mortaliteta.

Zaključak Period kliničkog praćenja u heterogenoj grupi operisanih bolesnika posle reanimacije sa HA ne može da bude kraći od dva meseca. *ARIMA* može da bude izuzetno efikasna za utvrđivanje ukupnog vremenskog intervala u okviru kojeg će se manifestovati ukupan mortalitet zbog primene nekog leka u određenoj populaciji bolesnika.

Ključne reči: humani albumin; mortalitet; studija vremenskih serija; hidroksietil-skrob

Received: March 12, 2013
Accepted: April 9, 2013