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Original article

The effects of fluid resuscitation according to PiCCO on the early stage of severe acute pancreatitis

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ABSTRACT

Objectives: To evaluate the therapeutic effect of early fluid resuscitation under the guidance of Pulse indicator Continuous Cardiac Output (PiCCO) on patients with severe acute pancreatitis (SAP).
Methods: Clinical data of 18 SAP patients (the study group), who had undergone fluid resuscitation under the guidance of PiCCO from October 2011 to October 2013, were analyzed prospectively. Clinical data of 25 cases (control group) who had undergone fluid resuscitation without the guidance of PiCCO from January 2009 to September 2011 were collected. Then, retrospective and prospective case–control study was carried out.
Results: During the first 6 h, 0–24 h, 24–48 h, and 0–72 h of admission, the study group received more volume of fluid than the control group. There were significantly faster decline of APACHE II score and the value of blood lactate in study group, as well as the length of ICU stay and the proportion of renal failure at 72 h of admission. According to the 2012 Atlanta classification, six cases in study group turned into moderate SAP (33.30%), significantly higher than the control group (8.00%) ($p = 0.0049$). The volume of fluid infusion and clinical parameters were linearly relative.
Conclusions: The PiCCO device may be a useful adjunct for fluid resuscitation monitoring in patients with SAP in the early stage. Early fluid resuscitation under the guidance of PiCCO can improve tissue perfusion, reduce the SIRS persistence time and the length of ICU stay. This program did not increase the risk of respiratory failure and influence the mortality.

Introduction

Severe Acute Pancreatitis (SAP) is a severe disease which has rapid progress and high mortality. Although a great progress has been made recently in diagnosis and treatment of SAP and the mortality during acute inflammation period has declined, it is also a difficult clinical issue to carry out early fluid resuscitation accurately, in the condition of ensuring the tissue perfusion and no increasing the load of heart, lung and other organs [1]. The special patho-physiological characters of SAP in the acute inflammation period determine that patients often need a large volume of fluid infusion. However, the accompanying intra-abdominal hypertension, pancreatic necrosis hemorrhage and other factors of SAP make that the conventional evaluation index of volume inaccuracy. In recent years, pulse indicator continuous cardiac output (PiCCO) is applied in volume monitoring of septic shock, cardiogenic shock and obtained satisfactory results. However, the effect of fluid resuscitation in the fluid resuscitation early stage of SAP remains unclear. Since September 2011, we applied PiCCO in early fluid resuscitation monitoring of SAP in Intensive Care Unit (ICU) of the Second Affiliated Hospital of Medical University Of Anhui. This study explored the clinical value of PiCCO in early fluid resuscitation of SAP by comparing the relevant clinical indexes to previous traditional volume monitoring indexes.

Materials

Materials

A cohort of patients (18 patients) with SAP were involved in the study group who had undergone PiCCO monitoring in ICU of the

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Second Affiliated Hospital of Medical University Of Anhui during October 2011 to December 2013. 25 Patients with SAP that did not undergo PiCCO monitoring were taken as control groups during January 2009 to September 2011. The volume indicators of this stage included: central venous pressure (CVP) dynamic monitoring, heart rate, mean arterial pressure, urine volume and red blood cell hematocrit. The select criteria of SAP referred to the digestive diseases diagnostic criteria of America society [2]. The exclusion criteria: (1) The complications of heart, lung, kidney and other organ dysfunction before the onset. (2) Non-normal fluid therapy for more than 12 h after SAP diagnosis. (3) Acute obstructive biliary pancreatitis. (4) Pregnancy with SAP.

There were no statistical differences between these two groups of patients with age, sex, body mass index, predisposing factors, initial APACHE II score data, etc. (Table 1). Other therapeutic measurements of these two groups in ICU were the same, including gastrointestinal decompression, decontamination of the digestive tract, enteral nutrition via placement of jejunum nutrition tube after stable hemodynamics.

Research methods

We used the right subclavian vein or internal jugular vein and femoral artery catheter to treat the study group after entering ICU immediately, utilizing PiCCO plus system (PiCCO catheter kit, PV2014L16N; pressure monitoring set, PV8115, Germany) to connect patient monitor (Philips IntelliVue MP60, Holland) for PiCCO monitoring and monitor once at least every 8 h.

The data were measured after injecting 20 mL 4 °C ice water rapidly through the center vein catheter. Every measurement was repeated three times and interval less than 10 min. ITBVI, GEDVI, EVWI and other indexes were obtained by taking the average to determine whether to continue the fluids or vasoactive drugs. Changes of CVP, heart rate, mean arterial pressure, urine volume and HCT index of the control group by fluids infusion test were observed to determine the fluid resuscitation. These two groups were treated by the rapid expansion of the liquid crystal and the combined administration of the 20% albumin and artificial colloid, controlling crystal colloid ratio in 1 to 2:1.

We compared the total fluid resuscitation of the two groups after entering ICU 0–6 h, 0–24 h, 24–48 h, 48–72 h and 0–72 h, the proportion of vasoactive medications when reaching stable hemodynamics (discontinuation of vasoactive drugs when mean arterial pressure returns to the basal level), the proportion of requiring mechanical ventilation and blood purification when respiratory failure, renal failure occurs in the course (blood purification indicators: acute pulmonary edema, which was difficult to improve after conventional treatment; blood potassium was ≥6.5 mmol/L; sustained high catabolism, oliguria or anuria for more than 2 days and blood creatinine was ≥442 mol/L; blood urea nitrogen was ≥21.4 mmol/L. Invasive mechanical ventilation indicators: given conventional oxygen therapy or noninvasive mechanical ventilation was still difficult to correct respiratory failure. Respiratory failure indicators: pO2/FiO2 was ≤300), decreases of lactic acid, urea nitrogen of microcirculation perfusion index in the resuscitation process and changes of APACHE II score of the severity, mean ICU stay, mortality, the ratio of Moderately Severe Acute Pancreatitis (MSAP) diagnosed after 48 h. The evaluation criteria is on the basis of the "The classification of acute pancreatitis − 2012": the international consensus criteria: revised by Atlanta classification and definition ("2012 Atlanta consensus") [3].

This study was in line with the medical ethics standard and approved by the hospital ethics committee. The research on application of PiCCO monitoring was agreed and signed by the patients or their families.

Statistical analysis

Statistical analyses were performed with SAS9.2 statistical software. Quantitative data were showed by means (±) and standard deviation (±*s*), using *t* test. Qualitative data were used chi square test. Differences between groups were compared with single factor analysis of variance (One-way ANOVA). Linear correlation of fluid volumes and clinical parameters of two groups at different times were measured using statistical analysis. The difference ($p < 0.05$) of fluid volumes and clinical parameters of two groups at different time had statistics significance.

Table 1
Comparison of basic data between the study group (PiCCO monitoring group) and the control group (PiCCO non-monitoring group).

Basic parameters		The study group ($n = 18$)	The control group ($n = 25$)	p value
Diet factors (%)		17 (94.44)	23 (92.00)	0.7535
Age (year)		48.67 ± 18.23	52.60 ± 14.21	0.4314
Female (%)		10 (55.56)	11 (44.00)	0.1719
BMI (kg/m^2)		24.24 ± 4.26	24.71 ± 5.21	0.2846
HCT (%)		41.11 ± 8.43	38.60 ± 7.48	0.3092
BUN (mmol/L)		12.44 ± 5.12	12.16 ± 6.10	0.7483
Cretinine (μmol/L)		214.50 ± 172.03	217.48 ± 182.94	0.6487
Modified Marshall scores		4.61 ± 1.42	4.44 ± 1.69	0.4512
Charlson comorbidity scores		0.28 ± 0.67	0.28 ± 0.61	0.8559
In ICU	APACHE II score	19.00 ± 5.22	19.06 ± 4.45	0.9678
	Hemodiastase (u)	2738.44 ± 396.65	2696.20 ± 499.63	0.5981
	Blood lactate (mmol/L)	4.51 ± 1.09	4.49 ± 1.59	0.9635
	Blood sugar (mmol/L)	15.00 ± 2.06	14.75 ± 2.66	0.7409
	Blood calcium (mmol/L)	1.70 ± 0.13	1.68 ± 0.16	0.6649
	BNP(ng/L)	145.50 ± 9.78	147.48 ± 11.92	0.5665
	IAP (cm H_2O)	23.78 ± 3.92	22.76 ± 4.34	0.4334
	IL-6 (pg/mL)	163.00 ± 19.36	156.04 ± 22.53	0.2961
	CTSI	5.44 ± 1.34	5.44 ± 1.23	1.0000
	Oxygenation index (mmHg)	225.00 ± 32.21	211.00 ± 21.72	0.0959
Drainage ratio of abdominal puncture (%)		10 (55.56)	14 (56.00)	0.9769

BMI: body mass index; APACHE II: acute physiology and chronic health evaluation scoring system; BNP: brain natriuretic peptide; IAP: intra-abdominal pressure; IL-6: interleukin-6; CTSI: CT severity index.

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