Effect of 6% hydroxyethyl starch and equilibrium liquid on serum and hemorheology indexes in acute myocardial infarction complicated with shock patients received emergency treatment

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Objective: To study the effect of 6% hydroxyethyl starch and equilibrium liquid on serum and hemorheology indexes in patients with acute myocardial infarction complicated with shock who underwent emergency treatment. Methods: 60 patients with acute myocardial infarction complicated with shock received emergency treatment in our hospital were enrolled and randomly divided into two groups according to types of infused liquid. Observation group was treated with 6% hydroxyethyl starch, control group was treated with equilibrium liquid. Then hemorheology indexes, blood coagulation indexes and serum index were compared. Results: (1) Hemorheology: whole blood high shear viscosity, whole blood low shear viscosity, plasma viscosity and erythrocyte aggregation index of observation group were lower than those of control group; (2) coagulation function: R value and K value of observation group were higher than those of control group; MA value and G value were lower than those of control group; (3) serological index: MDA, CK-MB, hs-cTnT content of observation group were lower than those of control group. Conclusion: 6% hydroxyethyl starch is helpful to reduce blood viscosity and erythrocyte aggregation, improve hypercoagulable state, reduce oxidative damage of myocardial cells; it’s an ideal liquid type in treating acute myocardial infarction complicated with shock.

1. Introduction

Acute myocardial infarction (AMI) complicated with shock is the key to clinical rescue. Hemorheological abnormality is important pathological and physiological characters of AMI patients, and is also an important cause for shock. In clinical practice, fluid resuscitation is needed to stabilize hemorheology, besides anti-coagulation and thrombolysis therapy are also needful[1]. At present, more attention is paid to the effect of drugs, volume and speed of fluid infusion, however, the effect of type is missed[2]. 6% hydroxyethyl starch and balanced liquid are common fluid in clinical treatment. The studies on effect of these two fluids on hemorheological and serological indexes are lacked, which is our focus in this study.

2. Materials and methods

2.1. General data

A total of 60 AMI patients admitted from April 2011 to July 2014 were selected, and all met the diagnosis of AMI complicated with shock. They were treated by fluid resuscitation, anti-coagulation and thrombolysis therapy. They were divided into two groups according to different fluids, with 30 cases in each group. Patients in observation group were treated by 6% hydroxyethyl starch, which included 19 males and 11 females, aged (67.42±6.96) years old. Patients in control group were treated by balanced fluid, which included 21 males and 9 females, aged (67.62±7.24) years old. There was no significant difference in general data between two
groups \((P>0.05)\).

2.2. Methods

Patients in observation group were treated by 6% hydroxyethyl starch \((130/0.4)\), and patients in control group by balanced fluid \((1.86\% \text{ Sodium Lactate Solution: compound sodium chloride solution}=1:2)\). The other therapies including anti-coagulation and thrombolysis therapy for two groups were the same.

2.3. Observation indexes

2.3.1. Hemorheological indexes

Whole blood highly sheared viscosity, whole blood lowly sheared viscosity, plasma viscosity and erythrocyte aggregation index were determined by SA-600 hemorheological tester before treatment and 24 h after treatment.

2.3.2 Coagulation indexes

Coagulation function was determined by thrombelastograph (TEG) before treatment and 24 h after treatment.

2.3.3. Serological indexes

Peripheral blood was collected and centrifugated. hs-cTnT was determined by electrochemiluminescence method, CK-MB by automatic biochemical analyzed, MDA by radio-immuno-precitation assay before treatment and 24 h after treatment.

2.4. Statistical analysis

All data were analyzed by SPSS18.0. Measurable data were analyzed by \(t\) test. The difference was considered as significant as \(P<0.05\).

3. Results

3.1. Hemorheological indexes

There was no significant difference in hemorheological indexes before treatment \((P>0.05)\). The whole blood highly sheared viscosity, whole blood lowly sheared viscosity, plasma viscosity and erythrocyte aggregation index were significantly lower in observation group compared with control group \((P<0.05)\).

Table 1.

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<th>Hemorheological indexes (mean±SD).</th>
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3.2 Coagulation indexes

There was no significant difference in coagulation indexes before treatment \((P>0.05)\). The R value was significantly higher, and MA and G values were significantly lower in observation group compared with control group \((p<0.05)\).

Table 2.

<table>
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<th>Coagulation indexes (mean±SD).</th>
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3.3. Serological indexes

There was no significant difference in serological indexes before treatment \((P>0.05)\). The MDA, CK-MB, hs-cTnT were significantly lower in observation group compared with control group \((P<0.05)\).

Table 3.

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4. Discussion

Patients with AMI complicated with shock always have hemorheological abnormality. The objective of fluid resuscitation is not only coronary recanalization and recovery of myocardial blood supply, but also correction of hemorheological abnormality. Nowadays, the type of fluid has drawn more and more attention. Some researchers have recognized that different fluid type can affect the therapeutical effect. The relative molecule weight of 6% hydroxyethyl starch is 130 kD, the colloid osmotic pressure is 4.788 kPa, replace rate is 0.4, and its dilatation effect can last 4-6 h[6]. It is believed that because of higher relative molecule weight, and higher replace rate, 6% hydroxyethyl starch is valuable in fluid replacement therapy for patients with hemorheological abnormality[4-7]. Firstly, 6% hydroxyethyl starch can stabilize osmotic pressure, improve microcirculation perfusion and oxygen supply and prevent endothelial injury; secondly, it can reduce viscosity by dilating blood to improve local hemorheological status; thirdly, it can increase negative charge of erythrocyte, block erythrocyte rouleaux formation to reduce local aggregation and maintain suspend stability. AMI patients complicated with shock are in severe abnormal hemorheological status, which are characterized as increased blood viscosity, reduced blood flow speed, and poor local tissue perfusion. When fluid resuscitation is performed at this time, we should pay attention to anticoagulation and thrombolysis effect of drugs, at the same time, we also should concern about the effect of fluid on hemorheological indexes. Our study show that whole blood highly sheared viscosity, whole blood lowly sheared viscosity, plasma viscosity and erythrocyte aggregation index are significantly lower in observation group, indicating that 6% hydroxyethyl starch is helpful in improving hemorheological indexes, reduce blood viscosity and erythrocyte aggregation.

The most important pathological change of myocardial infarction (MI) patients is thrombogenesis in coronary artery and break off of blood flow, which is caused by coagulation hyperfunction. Although anticoagulation and thrombolytic drugs can produce effective artery recanalization and inhibit coagulation hyperfunction, but inappropriate fluid would affect the therapeutical effect of drugs[8]. TEG is common method for monitoring coagulation process and coagulation function. R and K value can reflect coagulation function via coagulation time. R value is the time for first formation of fibrin clot by blood sample, while K value is the time for formation of some clots with specific strengths. The higher these values are, the longer the blood clotting time is, and the weaker the coagulation function is; otherwise, it indicates coagulation hyperfunction[9]. MA value and G value can reflect coagulation function via mechanical strength of blood clot. MA value is the maximum amplitude, and refers to the ultimate strength, which is produced by combination of fibrin and platelet via GPIIb/IIIa; G value refers to clot strength in real-time measurement. The higher these two values are, the higher the ultimate physical strength of clot is, and the higher the platelet and fibrin levels are, which can reflect coagulation hyperfunction indirectly[10]. Our study show that R and K values are significantly higher, while MA and G values are significantly lower in observation group, indicating that 6% hydroxyethyl starch can help improve hypercoagulability of MI patients.

It is found that hydroxyethyl starch has dilation and fluid infusion effect, and it also has anti-inflammation effect by inhibiting activation and adhesion of leukocyte[11]. Hydroxyethyl starch can block activation of inflammation reaction to reduce the injury of endothelial cells and myocardial cells[12]. Besides, newest researched show that hydroxyethyl starch can inhibit aggregation of nuclear transcription factor in myocardium, then relieve the injury of myocardial cell due to anoxia[13]. Injury of myocardial cell due to MI is due to injury mediated by oxygen radical[13]. Mass production of oxygen radical can result in excessive consumption of GSH-Px and Cu-Zn SOD, then lead to peroxidation of lipid and protein in myocardial cytomembrane and mitochondrial membrane, bring about myocardial injury. MDA is ultimate production after oxygen radical attacking polyunsaturated fatty acid, and the level can reflect the degree of oxidative damage directly[14]. As oxidative damage, a large number of proteins in cytoplasm are released into blood circulation. CK-MB is a specific myocardial isozyme, and cTnT is a specific structural myocardial protein. They have high levels in myocardial cells, and will be released into blood circulation only when cell injury occurs. Therefore, they can specifically reflect myocardial injury[15]. We found in this study that MDA, CK-MB and hs-cTnT levels were significantly lower in observation group, indicating that 6% hydroxyethyl starch can help reduce myocardial oxidative damage.

In conclusion, 6% hydroxyethyl starch is helpful in decreasing blood viscosity and erythrocyte aggregation, improving hypercoagulability, and reducing myocardial oxidative damage. It is ideal fluid for rescuing AMI patients complicated with shock.

References


[10] Akay MO, Bilir A, Oge T, Kus G, Mutlu FS. the evaluation of hydroxyethyl starch (6% hes 130/0.4) solution's potential preventive effects on coagulation status in women with gynecologic malignancies using rotation thromboelastography. Turk J Haematol 2014; 31(3): 261-265.


