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Research Progress on Modified Sengstaken-Blakemore Tube Fixation and Insertion Method for the Treatment of Rupture and Bleeding of Esophagogastric Varices

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Abstract: *Esophagogastric varices rupture bleeding is a common complication of decompensated liver cirrhosis. Some patients have very heavy bleeding volume, and serious patients may endanger their lives if they are not stopped in time. As one of the important tools to save the acute massive bleeding of esophagogastric varices caused by liver cirrhosis and portal hypertension, the Sengstaken-Blakemore tube plays an irreplaceable role. For massive bleeding that cannot be controlled by drugs in time, the application of Sengstaken-Blakemore tube can better create opportunities for more effective treatments such as endoscopic therapy, surgery and transjugular intrahepatic portosystemic shunt (TIPS). However, due to the intense pain suffered by patients in the process of catheterization, there may be many complications, such as increased bleeding, tracheal obstruction, esophageal perforation, aspiration pneumonia, asphyxia and so on. In order to decrease the pain of patients, reduce complications and improve the success rate of primary catheterization, a variety of improved catheterization methods have appeared in clinic. This paper analyzes and summarizes the recent studies on the improved fixation and placement of Sengstaken-Blakemore tube in the control of esophagogastric varices bleeding in liver cirrhosis. To provide some theoretical basis and support for the application of Sengstaken-Blakemore tube in clinical emergency control of esophagogastric variceal bleeding.*

Keywords: *Sengstaken-Blakemore tube, Fixation, Insertion, Esophagogastric varices, Bleeding, Liver cirrhosis*

1. Introduction

The rupture and bleeding of esophagogastric varices is the main cause of death in patients with cirrhosis, and the main cause of bleeding is portal hypertension, continuous portal hypertension will promote the increase of blood vessels inside and outside the liver, and esophagogastric varices are one of the common collateral circulations formed by extrahepatic shunt [1]. Due to the weak wall of varices and lack of elastic contraction, it is difficult to stop bleeding after bleeding. So the death rate is high [2, 3]. In patients with liver cirrhosis, about 1/3 develop esophagogastric varices, of which 30% may develop into bleeding within 2 years. The mortality rate of patients with esophagogastric varices is about 30%, and the 5-year mortality rate is as high as 80% [4]. Esophagogastric varices bleeding can lead to hemodynamic instability, so urgent treatment is needed. First, fluid resuscitation is performed to improve microcirculation and blood perfusion of organs. Secondly, drug treatment is given, including vasopressin analogues and somatostatin analogues, which can reduce portal blood flow and portal pressure. If there is active bleeding but the amount of bleeding is relatively small, endoscopic treatment such as variceal ligation and sclerotherapy combined with drug therapy is usually the first choice. For some refractory esophagogastric venous bleeding, transjugular intrahepatic portosystemic shunt (TIPS) and various interventional treatments are included [5]. However, for some patients with active bleeding and relatively large amount of bleeding, they are still unable to control after active drug treatment and do not have the conditions for emergency endoscopy or shunt surgery, the application of Sengstaken-Blakemore tube can control the massive bleeding of most patients in time, and provides an opportunity for the rescue and further treatment or referral of patients with high-risk and extremely

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high-risk bleeding [6, 7]. However, in the process of insertion of Sengstaken-Blakemore tube, patients suffer a lot of pain, and there are many complications, such as tracheal obstruction, esophageal perforation, aspiration pneumonia, asphyxia and acute cardio-cerebrovascular disease. Therefore, many scholars have studied the improved method of insertion of Sengstaken-Blakemore tube in order to improve the success rate of intubation, reduce the pain of patients, increase the tolerance of patients and reduce the occurrence of complications [8, 9]. We summarized and analyzed a variety of improved methods of Sengstaken-Blakemore tube fixation and insertion, in order to provide some theoretical basis and support for the clinical emergency control of esophageal and gastric variceal bleeding.

2. The basic principle, traditional usage and background development of Sengstaken-Blakemore tube

2.1. Basic principle

The Sengstaken-Blakemore tube is composed of two air bags and three lumens. The two-bag refers to the two air bags at the front end, the round gastric air bag, which presses the bleeding site of the gastric fundus after inflation, and the cylindrical esophageal bag that presses the bleeding site of the lower esophagus after inflation. The three cavities refer to the official cavity separated from each other in the tube, which leads to the gastric air bag, the esophageal air bag and the gastric cavity respectively [10].

2.2. Traditional method

First of all, it is confirmed that there is no air leakage in all the gasbag and tubes in the Sengstaken-Blakemore tube, and the gasbag does not move after inflation. Fully smear the Sengstaken-Blakemore tube with liquid paraffin gauze or liquid paraffin cotton balls. The Sengstaken-Blakemore tube is inserted through one side of the nasal cavity, and when it arrives at the pharynx, the patient is told to swallow and cooperate, insert it into 50-65cm, inject gas into the gastric sac (the pressure in the bag is 50-70mmHg), draw outward, tie the traction rope at the end, and then use the 0.5kg heavy sandbag or salt water bottle to oppress the gastric fundus through the pulley fixed on the bedstead; if you fail to stop bleeding, inject gas into the esophageal sac (the pressure in the bag is 35-45mmHg) to oppress esophageal varicose veins. In order to prevent mucosal erosion, the general continuous compression time should not exceed 24 hours. After deflating and relieving compression for a period of time, it can be used repeatedly if necessary [11].

2.3. Background development

In 1950, Sengstaken and Blakemore first reported the application of esophageal and gastric double balloon tamponade to control variceal bleeding [12]. In 1968, Edlich and his colleagues improved it to inflate esophageal gasbag when the stomach balloon could not stop bleeding alone [13]. In the case of hemodynamic instability in patients, endoscopic examination cannot be carried out, or in grass-roots hospitals with limited conditions, the application of Sengstaken-Blakemore tube can control bleeding in time and act as a bridge for follow-up effective hemostatic measures [14].

With the rapid development of endoscopic hemostatic technology and the upgrading of hemostatic drugs, many patients with esophagogastric varices bleeding have been treated. But the strange thing is that the mortality rate of esophageal and gastric variceal bleeding in liver cirrhosis is still as high as 30%, which is closely related to the failure to control bleeding and the amount of bleeding in the early stage of the disease [15]. Lack of gastroscope equipment or poor proficiency in the application of gastroscope technology in grass-roots hospitals, in the face of patients with fast bleeding speed and relatively large amount of bleeding, the endoscopic visual field will be seriously affected because of the large amount of blood in the stomach. This makes the treatment effect of emergency gastroscope is poor [16]. The European Society of Hepatology recommends that in the treatment of patients with esophagogastric varices bleeding, the Sengstaken-Blakemore tube can be used as a transitional treatment to create conditions for follow-up treatment [17]. At present, because of its simple operation and obvious hemostatic effect, Sengstaken-Blakemore tube can be used as a transitional treatment for effective hemostatic treatment, and can become the initial treatment for patients with acute esophagogastric variceal bleeding [18].

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3. Research progress on modified fixation methods

3.1. Mask fixing method

The traditional fixation method of Sengstaken-Blakemore tube is easy to damage the nasal mucosa of patients because of the imprecise angle and direction of traction. In order to improve patients' intolerance to traditional traction and reduce the occurrence of complications, some scholars have designed a mask-type Sengstaken-Blakemore tube traction device, which is drawn and fixed on a special mask. While maintaining the best traction angle, the patient's head can still move independently, and there are accurate gravity control systems and alarm devices. If the gasbag is deflated, it can give an alarm in time. Wang et al found that the average traction time and hemostatic time of the mask fixed Sengstaken-Blakemore tube were significantly less than those of the traditional fixation, and the patients with mask traction were more easily tolerated. There were no complications such as local mucosal injury, balloon slip and aspiration pneumonia [19]. Jiang et al and Tang have also done the same research, and think that the mask fixed Sengstaken-Blakemore tube can improve the comfort of patients and reduce the psychological pressure of patients, which is a recommended method of fixation [20, 21].

3.2. Nasal plug fixation method

The traditional method of fixing the Sengstaken-Blakemore tube will cause the retraction-traction process of the Sengstaken-Blakemore tube due to the change of posture and other activities, which can easily lead to the damage of nasal skin and balloon rupture, and then lead to the pain of suffocation or re-intubation. Some scholars have studied the use of small bottle rubber plugs with smooth surface and soft texture to fix the Sengstaken-Blakemore tube, which can not only effectively oppress the bleeding point and prevent rebleeding, but also maintain the constant traction pressure to make the fixation firm, reduce the occurrence of complications and improve the comfort of patients. The nasal plug fixation method has been widely used because of its convenient material selection, simple operation and easier acceptance by patients, and has achieved satisfactory results in clinic [22, 23].

3.3. Table tennis fixation method

Due to the limitation of the posture of patients with Sengstaken-Blakemore tube fixed by traditional methods, patients are prone to limb numbness and backache, and patients often feel irritable and anxious and prone to insomnia. Some scholars have designed the table tennis method to fix the Sengstaken-Blakemore tube. Because the contact surface between table tennis and the tip of the nose is smooth, the skin tissue around the nasal cavity can be avoided damage, and the incidence of skin damage around the nostrils is significantly reduced, thus reducing the pain of the patients. At the same time, patients can move on the bed at will, improve the comfort of patients, increase the tolerance of patients, and reduce the occurrence of related complications of chest tightness and chest pain [24–26]. Li et al studied the use of the improved table tennis method for fixing the Sengstaken-Blakemore tube for compression hemostasis. This method not only improved the comfort after catheterization and increased the patients' sense of respect, but also effectively improved the relationship between nurses and patients. Additionally, it reduced nursing working hours and nursing costs. [27].

3.4. Reduction of traction force fixation method

The traditional method of continuous traction gravity is 500g. Because of the high traction pressure, it is easy to lead to frequent nausea, throat pain, nasal discomfort, retrosternal pain and so on. Some patients are extremely irritable and extubation, and at the same time, due to the high traction pressure, continuous compression of gastro fundus and esophageal mucosa can easily lead to erosion and ulcer. In order to alleviate the pain of patients and ensure the hemostatic effect, some researchers try to reduce the traction force of Sengstaken-Blakemore tube. Tao et al reduced the traction force of the Sengstaken-Blakemore tube to 300g, which is easier to accept than traditional tension patients, and ensures a good hemostatic effect [28]. The study of Li and Wang reduced the traction force to 250g. The results showed that the hemostatic effect was rapid and effective, which played an important role in controlling hemostasis, alleviating the disease and reducing the mortality of patients, and the short-term success rate of hemostasis was similar to that of the traditional control group. With the decrease of pulling force, the pressure of esophagus and gastric fundus mucosa is also reduced, which reduces the adverse reactions and pain of patients, and the incidence of rebleeding after extubation is significantly reduced [29, 30].

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4. Research progress on modified insertion methods

4.1. Combined drug insertion method

In order to improve the success rate of Sengstaken-Blakemore tube catheterization, reduce the occurrence of complications, reduce the discomfort of patients and increase the tolerance of patients, some researchers combined with drug-assisted catheterization in the process of catheterization. For example, oral paraffin oil can lubricate the esophagus, make the catheterization process smoother, and reduce the discomfort of patients caused by traction friction; oral lidocaine can reduce digestive tract stimulation and reflex vomiting through local anesthesia; combined with ice saline and norepinephrine, by stimulating vasoconstriction, can speed up hemostasis. Liu performed 46 cases of patients with esophageal and gastric variceal bleeding, while performing compression and hemostasis with a Sengstaken-Blakemore tube, combined with oral 2% lidocaine and paraffin oil lubrication and 20mL of normal saline + 4000U of thrombin to stop hemorrhage. The success rate was as high as 97.8%, and no complications occurred [31]. Qin et al found that in patients with esophagogastric varices bleeding, the success rate of taking gastroscope lubricating glue 2-3 minutes before catheterization was significantly higher than that of traditional catheterization, and the complications such as aspiration, chest tightness and chest pain were also significantly reduced [32]. Some scholars use simple oral paraffin oil, combined application of paraffin oil and ice distilled water or noradrenaline saline at the same time. The results show that the combined drug insertion method can shorten the intubation time and reduce the irritation of the pharynx and larynx. Improve patients' symptoms such as reflex vomiting, accelerate the speed of intubation, the success rate of intubation is significantly higher than the traditional intubation, increase the tolerance of patients, reduce the pain of patients [33–38].

4.2. Combined guide wire placement method

The Sengstaken-Blakemore tube is prone to twists and turns during intubation because the tube is soft, in order to insert it more smoothly, some researchers combine the guide wire to increase the hardness of the tube, and it is not easy for patients to slip out of the tube due to vomiting, because the front end of the guide wire is designed as a safety spring, round and smooth, even if it is pierced through the side hole of the Sengstaken-Blakemore tube, it will not damage the esophagus and gastric mucosa. This method is safe and makes the operation more simple [39]. Peng used the combined guide wire method to place the tube, and found that the success rate of placing the tube at one time was 93.3%, which was significantly higher than that of 70% in the control group, and the complications of vomiting and rebleeding of the tube were significantly reduced [40]. Sun et al, Ren et al and Li et al used Sha's guide wire to guide the placement of Sengstaken-Blakemore tube. The study found that this method can significantly increase the hardness of the tube, improve the success rate of one time catheterization, reduce the catheterization time, and reduce the pain of patients [26, 41, 42]. Deng et al uses emergency guide wire to assist Sengstaken-Blakemore tube catheterization to stop bleeding in patients with acute esophagogastric varices, and the success rate of one time catheterization was significantly higher than that of conventional catheterization. And it is considered that in grass-roots hospitals where emergency endoscopic hemostasis is unable to carry out or endoscopic hemostatic equipment is unable to carry out is limited, it can be combined with guide wire to assist Sengstaken-Blakemore tube catheterization, and the hemostatic effect is more obvious than traditional catheterization, and the operation is simple. The secondary damage during operation is reduced [43].

4.3. Combined endoscopic insertion method

The placement of Sengstaken-Blakemore tube under endoscope can effectively reduce the risk of traditional blind placement of Sengstaken-Blakemore tube, such as the displacement of Sengstaken-Blakemore tube and the inflation of gastric sac in esophagus. Jiang et al placed a Sengstaken-Blakemore tube under endoscopic guidance in patients with rebleeding after endoscopic variceal ligation. Studies have shown that this method significantly improves the success rate of primary catheterization and reduces the incidence of complications [44]. Wee et al combined with using sutures and endoscope assisted insertion of Sengstaken-Blakemore tube successfully treated a patient with uncontrollable esophageal and gastric variceal bleeding and difficult catheterization [45]. In a retrospective study, Ortiz et al believed that patients with failed endoscopic treatment could timely control massive bleeding from esophagogastric varices by endoscopic insertion of a Sengstaken-Blakemore tube [46].

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5. Summary and Prospect

Due to the acute and severe condition, large amount of bleeding and poor prognosis, timely and effective treatment of esophageal and gastric variceal bleeding in patients with liver cirrhosis is particularly important. Although the success rate of hemostasis has been improved due to the development of endoscopic technology, endoscopic equipment and endoscopic technology have not been fully popularized in grass-roots hospitals. For patients with acute esophagogastric variceal rupture and massive bleeding, Sengstaken-Blakemore tube compression hemostasis can be used as the first choice for initial treatment. In this paper, through the summary of various improved catheterization methods studied in clinic, it is concluded that the improved combined catheterization method has greatly improved the tolerance of patients in the process of intubation and reduced the pain of patients. it also reduces the occurrence of complications, and significantly improves the success rate of primary catheterization. The application of Sengstaken-Blakemore tube is very important in rescuing patients with esophageal and gastric variceal bleeding, so it is very necessary and urgent to study how to stop bleeding more quickly and effectively during tube placement and fixation, and it is more acceptable to patients.

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