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Chemical Mechanical Hemostasis in Bleeding from Varicose Veins of the Esophagus

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ABSTRACT

INTRODUCTION: Currently, the list of methods of hemostasis applicable to patients with portal hypertension at the height of bleeding from the esophageal veins, is extremely limited. There is a need for new methods that can improve the results of treatment by replacing the existing approaches or supplementing them.

AIM: To develop and test a new method for stopping bleeding from esophageal veins, applicable in the same clinical situations as compression hemostasis, but with better characteristics.

MATERIALS AND METHODS: The material for study was the results of treatment of 30 patients hospitalized in the Ryazan Emergency Care Hospital in 2022–2023 for completed bleeding from the esophageal veins, with the underlying hepatic cirrhosis and portal hypertension. In case of recurrent bleeding, patients of the study group underwent a session of chemical mechanical hemostasis (CMH) combining compression of esophageal veins and the effect of the liquid local hemostatic drug on them. All patients included in the study were surveyed to determine their subjective attitude to the treatment.

RESULTS: A single CMH session caused persistent cessation of bleeding 1.4 times less often than a classic obturator probe, but at the same time reduced the duration of the procedure from 10 hours to 5 minutes. In addition, the use of CMH was associated with 1.3 times reduction of the mortality and a lower level of distressing sensations for the patient during the procedure.

CONCLUSION: In the conducted study, CMH demonstrated the ability to save 46.7% of patients the necessity of installing a standard obturator probe for a long time and thus to radically reduce sensations experienced by the patient during treatment.

Keywords: portal hypertension; bleeding from esophageal veins; compression hemostasis; chemical mechanical hemostasis.

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Химико-механический гемостаз при кровотечениях из варикозно расширенных вен пищевода

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АННОТАЦИЯ

Актуальность. В настоящее время перечень методов гемостаза, применимых у пациентов с портальной гипертензией на высоте кровотечения из вен пищевода, крайне ограничен. Существует потребность в новых методиках, способных улучшить результаты лечения, заменив или дополнив собой имеющиеся подходы.

Цель. Разработать и апробировать новый метод остановки кровотечений из вен пищевода, применимый в тех же клинических ситуациях, что и компрессионный гемостаз, но с лучшими характеристиками.

Материалы и методы. Материалом исследования стали результаты лечения 30 пациентов, госпитализированных в Больницу скорой медицинской помощи города Рязани в 2022–2023 гг. по поводу состоявшегося кровотечения из вен пищевода на фоне цирроза печени и портальной гипертензии. При возникновении рецидива кровотечения пациентам исследуемой группы производился сеанс химико-механического гемостаза (ХМГ), сочетающего компрессию вен пищевода и воздействие на них жидкого местного гемостатического средства. Все пациенты, включенные в исследование, были подвергнуты анкетированию с целью определения их субъективного отношения к проведённому лечению.

Результаты. Однократный сеанс ХМГ в 1,4 раза реже вызывал стойкую остановку кровотечения, чем при использовании классического зонда-обтуратора, но при этом обеспечивал снижение длительности процедуры с 10 часов до 5 минут. Также применение ХМГ сопровождалось снижением летальности в 1,3 раза и меньшим уровнем тягостных для пациента ощущений при проведении процедуры.

Заключение. В условиях проведённого исследования ХМГ продемонстрировал способность избавить 46,7% пациентов от необходимости установки на длительное время стандартного зонда-обтуратора и за счёт этого радикально уменьшить страдания, переносимые пациентом во время лечения.

Ключевые слова: портальная гипертензия; кровотечение из вен пищевода; компрессионный гемостаз; химико-механический гемостаз.

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INTRODUCTION

Despite the progress in medicine in recent decades, the problem of bleeding from varicose veins (VV) of the esophagus in patients with portal hypertension still remains relevant [1–3]. A widespread introduction of such methods as endoscopic vein ligation and transjugular portosystemic shunt, has undoubtedly increased the chances of the patient for survival to several years after the first episode of bleeding [4, 5]. However, a currently established staged scheme of providing care to the patients with the pathology in question, has a weak point: *application of high-tech methods within the first hours of the hospitalization is difficult* [6, 7]. The condition of patients upon admission is often very severe and unstable and does not allow for any invasive and aggressive interventions [8, 9]. As a result, in the most severe period of the disease, doctors have only medications and compression hemostasis, which has a number of serious drawbacks, in their arsenal [10]. This fact determines the relevance of research aimed at a search for new methods applicable at the height of bleeding from the veins of the esophagus, with a minimum number of restrictions.

The **aim** of this study to develop and test a novel method of stoppage of bleeding from the esophageal veins applicable in the same clinical situations as compression hemostasis, but with better characteristics.

MATERIALS AND METHODS

The material of the study included the results of treatment of 30 patients hospitalized in the Ryazan Emergency Care Hospital in 2022–2023. On admission, all the patients were diagnosed with *hepatic cirrhosis, portal hypertension syndrome, bleeding from VV of the esophagus*. Apart from this diagnosis, the criterion of inclusion in the study was bleeding recurrence in the hospital identified by endoscopy. From each patient, a written informed consent was obtained.

The patients included in the study were blindly divided into two equal groups using the envelope method: the study group and the control group. The groups were comparable in age and gender (Mann–Whitney $U_{emp.}$=7.5; p <0.01), etiology of hepatic cirrhosis, its severity, endoscopic picture, concomitant pathology (Mann–Whitney $U_{emp.}$=4.0; p <0.01), and received the same drug treatment according to the National Clinical Guidelines. Among the patients included in the study, men predominated (83.3%), the mean age was (48.1±12.0) years. Hepatic cirrhosis was alcoholic in 43.3% of patients, a consequence of viral hepatitis C in 16.7%, of mixed genesis in 26.7%, and of unknown etiology in 13.3%. In Child–Pugh classification, 1 patient (3.3%) had class A hepatic cirrhosis, 13 patients (43.3%) had class B, and 16 patients (53.3%) had class C. According to the Scherzinger classification, grade 1 varicose veins were found during endoscopy in 1 patient (3.3%), grade 2 in 8 patients (26.7%), and grade 3 in 21 patients (70.0%). Four patients (13.3% of those included in the study) had a history of hospitalization for bleeding from esophageal varicose veins.

The difference between the formed groups was as follows. Identification of recurrent bleeding required active measures. In the ***control group*** (n=15), such a measure was use of compression hemostasis with a standard Sengstaken–Blakemore obturator probe. In the ***study group*** (n=15), a method called by us chemical mechanical hemostasis (CMH) was used instead.

The CMH method consists in simultaneous action on the source of bleeding by compression from inside the esophageal lumen and a hemostatic drug. As the latter drug was used 1.0% aqueous solution of incomplete silver salt of polyacrylic acid (Gemoblock®, Pul-Sar, Russia), capable of forming a polymethacrylate film on the bleeding surface, sealing the defect of the vessel wall [11, 12]. The implementation of this technique required the use of a medical device specially developed by us a probe for CMH. Its design suggested placing a standard Sengstaken–Blakemore obturator around the esophageal cuff, spiraled and fixed with a gauze wad with an easily releasable chain suture (Figure 1).

Immediately before installing the probe, the gauze wad is impregnated with hemostatic drug. It is also possible to introduce additional amounts of the drug directly into the esophagus via a special channel. After placing the probe in the esophagus, the esophageal cuff is inflated, and, when bloating, it unfolds the wad placed around it, and presses it to the inner surface of the esophagus. The wad becomes sort of a sheet between the mucous membrane and the probe material, and the medical drug impregnating the gauze, starts its effect. Thus, on the one hand, there occurs mechanical compression of the esophageal veins, and on the other, optimal conditions are created for the formation of a polymethacrylate film on the bleeding vein. After the procedure, the wad is removed together with the probe. To prevent it from slipping and for reliable removal, a special thread is sewn into the wad and laid along the probe. Its proximal end remains outside and can be used for traction.

The algorithm of CMH used in the study group, implied installation of a modernized probe into the patient's esophagus through the mouth in case of indications for compression hemostasis. The consumption of hemostatic drug per one procedure was 30 ml. The exposure time of the probe was 5 min (recommended by the manufacturer of the drug), after which it was removed. If signs appeared that the bleeding had not stopped, a Sengstaken–Blakemore probe was installed in the patient.

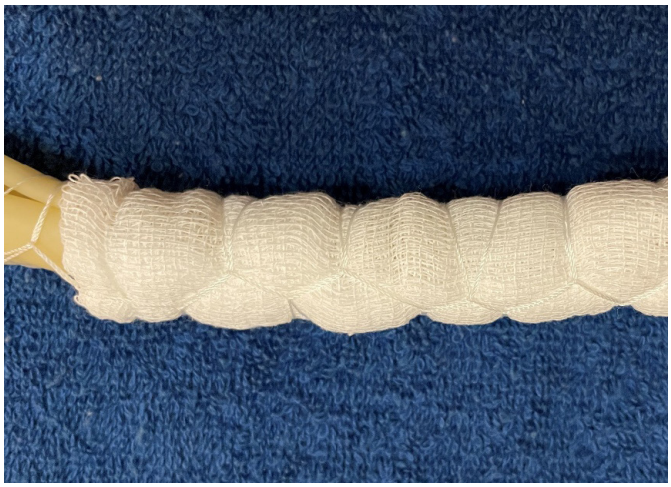

Fig. 1. A probe for chemical and mechanical hemostasis developed by the author's team: a gauze wad fixed with a chain suture on the esophageal cuff of the obturator probe.

In the control group, compression hemostasis was achieved by installation of a Sengstaken–Blakemore probe through the nasal passages with inflation of its cuffs for at least 10 hours.

The key instrumental examination conducted in all patients was video esophagogastroduodenoscopy using the Evis Exera III endoscopic video system (Olympus, Japan) and the GIF-HQ190L video gastroscope (Olympus, Japan). All patients were also surveyed to assess subjective sensations associated with the use of both a standard obturator probe and a probe for CMH. Patients were asked a number of questions that implied 'yes' or 'no' answers, characterizing certain sensations and attitudes toward the procedure.

Statistical processing of the study results was performed on a computer using the Statistica 6.0 program (Stat Soft Inc., USA). Due to the lack of signs of normal data distribution, Mann–Whitney U-test was used.

RESULTS

The results of the study obtained using the compared methods can be divided into three categories:

1. Effectiveness of bleeding arrest. The criterion of the effectiveness of hemostasis with any method was accepted to be the absence of signs of ongoing bleeding or of its recurrence within 4 hours of the termination of the procedure. In the study group, with installation of a CMH probe with 5 min exposure, bleeding was stopped in 7 cases (46.7%). In 8 cases (53.3%), the ongoing bleeding was stated, and a classic obturator probe was installed. Among the patients of the control group, bleeding was stopped using a Sengstaken–Blakemore obturator probe with exposure from 10 to 24 hours in 10 patients (66.7%). In 5 patients (33.3%), ongoing bleeding was stated within 4 hours of termination of esophageal vein compression, and the obturator probe balloons were re-inflated.

2. Mortality. Of the 15 patients in the study group, 6 (40%) died during the present hospitalization, 9 (60%) were successfully treated and discharged for outpatient observation. Of the 15 people in the control group, 8 (53.3%) died and 7 (46.7%) were discharged.

3. Subjective assessment of the treatment by patients. The results of the questionnaire survey of patients included in the study are presented in Table 1.

DISCUSSION

The results obtained in the study were ambiguous and needed a thorough interpretation.

One of the key parameters — the proportion of patients with stable hemostasis — was significantly lower in the study group than in the control group — 46.7% and 66.7% respectively. However, these figures cannot fully reflect the compared methods. Additional factors must be taken into account.

Firstly, the compared methods worked within different time intervals: 5 minutes in one case and minimum 10 hours in the other. Accordingly, a direct comparison is not entirely correct. The probe for CMH solved the problem in almost half of the patients in 5 minutes, which would have required 10 to 24 hours to solve with a standard obturator probe. Such a reduction in the duration of the procedure can be used for earlier

Table 1. Results of the patient survey for subjective assessment of the treatment

Question	Study group, n=15		Control group, n=15	
	Yes, %	No, %	Yes, %	No, %
Did you experience any pain during introduction of the probe?	6.7	93.3	86.7	13.3
Did you experience any pain when the probe balloons were inflated?	33.3	66.7	33.3	66.7
Did you feel any pain while the inflated probe was in your body?	6.7	93.3	20.0	80.0
Did you feel discomfort in the chest while the probe was in your body?	26.7	73.3	86.7	13.3
Did you feel lack of air while the probe was in your body?	0	100.0	13.3	86.7
Did you feel any discomfort because of impossibility to swallow saliva while the probe was in your body?	0	100.0	20.0	80.0
Did you want to accelerate removal of the probe?	46.7	53.3	93.3	6.7
Would you agree to repeat the procedure of inserting the probe in case of indications?	100.0	0	86.7	13.3

Note: the differences between the study and control groups revealed in the survey, were statistically significant (Mann–Whitney $U_{emp.}$=18.5; p <0,05)

endoscopic ligation of esophageal varices for secondary prevention of bleeding.

Secondly, in the patients of the study group, CMH at the time of the procedure was in fact the only action aimed at stoppage of bleeding. At the same time, during a long time of stay of the obturator probe in the esophagus of the patients of the control group, they, as a rule, were transfused several doses of fresh frozen plasma, and the introduced vasoconstrictors and antienzyme drugs began to realize their effect. Accordingly, it is not possible to attribute successful hemostasis only to the obturator tube.

Thirdly, CMH spared 46.7% of the patients the introduction of an obturator probe for several hours, which was indicated for them. Why this is important, becomes clear from the analysis of subjective assessment of the treatment by the patients.

A survey conducted among the patients included in the study showed the following. Compression hemostasis was associated with many distressful sensations of the patient. Most patients experienced pain while the device was being introduced (86.7%) or during its presence in the body (20.0%), 86.7% felt discomfort in the chest. The overwhelming majority of the patients (93.3%) were waiting the procedure to be terminated as soon as possible, and 13.3% claimed they would never agree to this procedure again, even for the vital indications. Upon that, the data of the same survey in the study group presented a sharp contrast with the results of the control group. This is probably associated with two main factors: the probe for CMH is introduced into the patient's body through the mouth, and not through the nasal passages, and is left for only 5 minutes, and not for several hours. It is significant that none of the patients in the study group refused to undergo a repeat CMH session if necessary. Thus, it can be stated that *CMH is tolerated much better than compression hemostasis, which can compensate for its lower effectiveness in a number of situations*.

Attempts to elucidate factors reducing the effectiveness of the new method did not give results. No statistically significant difference was found between patients with a successful CMH session and unsuccessful use of it in the key clinical parameters characterizing the underlying disease and the patient's condition (etiology of hepatic cirrhosis, its Child-Pugh stratification, the extent of esophageal varices, the initial level of anemia and hyperbilirubinemia). These factors determined the mortality rate, but not the effectiveness of bleeding stoppage. This is probably due to the mechanism of action of the used methods. The key factor in them, affecting the work, is the blood pressure in the esophageal veins, which has no linear dependence on the clinical parameters considered by us.

The proportion of deceased patients in the study group was 1.3 times less than in the control group. Unfortunately, this figure cannot be an ambiguous evidence of the positive properties of the tested method. The fact is that, because of the peculiarities of the design of the work, patients of the 'less than 24-hour mortality' category, that is, the most severe ones, were not included in the study group. Nevertheless, the obtained

figure shows that CMH used by us for the treatment of patients, at least did not reduce their chances for a positive outcome of hospitalization.

CONCLUSION

The study showed that the modification of a standard obturator probe combining compression of esophageal veins and the effect of a hemostatic drug, in 46.7% of cases allows for reduction of exposure time of the probe in the patient's esophagus from several hours to 5 minutes. This, in turn, allows to reduce the level of discomfort and pain sensations experienced by the patient during the procedure, and to obtain the opportunity for earlier endoscopic ligation of veins for secondary prevention of bleeding. Also, under the conditions of the study, the use of chemical-mechanical hemostasis was accompanied by a 1.3 times reduction of mortality. These facts confirm the prospects of using the proposed technique at the height of bleeding from varicose veins of the esophagus in patients with portal hypertension with the underlying hepatic cirrhosis.

ADDITIONAL INFORMATION

Author contributions. A.V. Fedoseev — concept of study, editing; V.N. Budarev — collection and analysis of material, writing the text. The authors confirm the correspondence of their authorship to the ICMJE International Criteria. All authors approved the manuscript (the publication version), and also agreed to be responsible for all aspects of the work, ensuring proper consideration and resolution of issues related to the accuracy and integrity of any part of it.

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