International Journal of Medical Sciences And Clinical Research

VOLUME Vol.05 Issue11 2025
PAGE NO. 205-211
DOI 10.37547/ijmscr/Volume05Issue11-39

Clinical Outcomes Of Diode Laser–Assisted Endoscopic Resection Of Superficial Neoplasms Of The Upper Gastrointestinal Tract

Yigitaliev Sardor Khusanboevich
Tashkent State Medical University, Tashkent, Uzbekistan
Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Uzbekistan

Mardonov Jamshid Normurotovich
Tashkent State Medical University, Tashkent, Uzbekistan
Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Uzbekistan

Yigitalieva Nasima Numovna
Republican Research Centre of Emergency Medicine, Tashkent, Uzbekistan

Umrzakova Iroda Ilkhomjon qizi
Republican Research Centre of Emergency Medicine, Tashkent, Uzbekistan

Received: 30 September 2025; **Accepted:** 26 October 2025; **Published:** 30 November 2025

Abstract: Superficial lesions of the upper gastrointestinal tract are frequently detected during routine endoscopy. Despite the availability of different endoscopic techniques, incomplete resection, bleeding and local recurrence remain important clinical problems. Aim: To assess the safety and clinical effectiveness of a diode laser–assisted endoscopic resection technique combined with submucosal gel injection in patients with superficial neoplasms of the upper gastrointestinal tract. Materials and Methods: A total of 252 patients with superficial upper gastrointestinal lesions were included in this comparative study. The control group consisted of 134 patients treated with conventional endoscopic techniques. The main group included 118 patients who underwent a novel procedure based on submucosal injection of a Hemoben–based gel followed by diode laser excision. The main outcomes were en bloc resection rate, intraoperative and delayed bleeding, perforation, postoperative complications (according to the Clavien–Dindo classification), hospital stay, and recurrence rate during a follow-up period of 6–18 months. Results: En bloc removal was achieved more often in the main group (82.6%) than in the control group (69.8%). Clinically significant bleeding during the procedure was observed only in the control group (6.6%), while it was not recorded in the main group. Delayed bleeding was less frequent in the main group (0.6% vs 3.3%). The overall complication rate was significantly lower in patients treated with the new technique (0.8% vs 4.5%, $p = 0.011$). The recurrence rate decreased from 17.4% in the control group to 3.1% in the main group. Patients in the main group also had a shorter hospital stay (3.1 ± 0.9 days vs 3.5 ± 1.2 days, $p < 0.05$). Conclusion: Diode laser–assisted endoscopic resection with submucosal gel injection is a safe and effective method for treating superficial neoplasms of the upper gastrointestinal tract. The technique improves the completeness of resection and reduces the risk of bleeding, postoperative complications and local recurrence compared with standard endoscopic approaches.

Keywords: Superficial neoplasms, upper gastrointestinal tract, endoscopic treatment, diode laser, submucosal injection, bleeding, recurrence.

Introduction: Superficial neoplasms of the upper gastrointestinal tract are increasingly detected due to the widespread use of diagnostic endoscopy. Most of these lesions are discovered incidentally during routine esophagogastroduodenoscopy and, although they are often benign, some may be associated with bleeding, anemia, obstruction, or malignant transformation. For this reason, timely and safe removal of such lesions remains an important clinical task [1-3].

Currently, a wide range of endoscopic techniques is used for the treatment of these pathologies, including cold snare polypectomy, electrocoagulation, endoscopic mucosal resection (EMR), and endoscopic submucosal dissection (ESD). Each of these methods has clear advantages, but none of them is free from limitations. Larger lesions are associated with a higher risk of incomplete resection, bleeding, perforation, and local recurrence. In daily practice, endoscopists often have to balance between radicality of removal and the safety of the procedure [2-9, 15-18,25].

Despite the continuous development of endoscopic technologies, postoperative complications and recurrence of superficial neoplasms remain a relevant problem. According to published data, bleeding rates after endoscopic resection may reach several percent, whereas perforation and post-polypectomy syndrome are still reported even in experienced centers. In addition, incomplete removal of lesions, especially in cases of fragmented excision, significantly increases the risk of local recurrence [2,7,10-14, 19-24].

In recent years, increasing attention has been paid to techniques that can improve the safety profile of endoscopic interventions. The creation of a submucosal “cushion” using injection solutions before resection has been shown to reduce thermal injury of deeper layers and to improve visualization of tissue planes. Laser-assisted technologies are also considered promising due to their precise cutting ability and controlled depth of tissue penetration [1-5,15,22,24].

However, the clinical effectiveness of combining submucosal gel injection with diode laser excision for the treatment of superficial lesions of the upper gastrointestinal tract has not been sufficiently studied. There are still limited data regarding the impact of this approach on complication rates, radicality of resection, and long-term outcomes [15-17,20-25].

Therefore, the aim of the present study was to evaluate the safety and clinical effectiveness of a diode laser–assisted endoscopic resection technique using submucosal gel injection in patients with superficial neoplasms of the upper gastrointestinal tract [7,9,15,19].

METHODS

Study design and patients. This comparative clinical study included 252 patients with superficial neoplasms of the upper gastrointestinal tract who underwent endoscopic treatment at the State Institution “Republican Specialized Scientific and Practical Medical Center for Surgery named after Academician V. Vakhidov” (Tashkent, Uzbekistan). Patients were examined and treated in the endoscopy department of the above-mentioned center during routine clinical practice. The patients were divided into two groups. The control group consisted of 134 patients who were treated with conventional endoscopic techniques, including cold biopsy forceps removal, cold snare polypectomy, thermal electroexcision, endoscopic mucosal resection (EMR), and submucosal dissection. The main group included 118 patients who underwent endoscopic removal using a novel technique based on submucosal gel injection followed by diode laser excision. The study was conducted in accordance with institutional ethical standards. Written informed consent was obtained from all patients before the procedures.

Characteristics of lesions. The average size of the lesions was 0.9 cm in the control group and 1.0 cm in the main group. The morphological type of the lesions was determined according to the Paris Endoscopic Classification of Superficial Neoplastic Lesions.

Most lesions were polypoid (types 0-Ip and 0-Is):

- 93.4% in the control group
- 89.2% in the main group

Non-polypoid, slightly elevated lesions (type 0-IIa) were observed in:

- 6.6% of patients in the control group
- 10.8% in the main group

Description of the novel technique. In the main group, a novel endoscopic method was used. It consisted of submucosal injection of a gel prepared from Hemoben powder mixed with 20 ml of methylene blue solution into the base of the lesion, creating a visible submucosal cushion.

After adequate elevation of the lesion, excision was performed using a diode laser (Gbox system). The lesion was removed together with a rim of visually normal surrounding mucosa at the level of the submucosal layer.

In cases where high-energy laser equipment was not available, the same gel injection technique could be combined with standard cold or thermal excision methods.

Outcome measures. The following clinical outcomes

were analyzed:

- Rate of en bloc resection
- Frequency of intraoperative and delayed bleeding
- Occurrence of perforation
- Postoperative complications according to the Clavien–Dindo classification
- Duration of hospital stay
- Rate of local recurrence during follow-up

Patients were followed for 6 to 18 months after the procedure using scheduled endoscopic examinations. Recurrence was defined as the appearance of a new lesion in the area of the previous resection scar.

Statistical analysis. Statistical analysis was performed using standard biomedical methods. Quantitative variables were expressed as mean ± standard deviation. Group comparisons were performed using the chi-square test (χ^2) for categorical variables and the Student's t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Analysis of endoscopic procedure protocols showed clear differences between the study groups. In the comparison group, 69.8% of polyps were removed en bloc, while 55 lesions required fragmented resection. In the main group, where the new excision technique was applied, en bloc resection was achieved in 82.6% of cases, and only 17.4% of lesions were removed in fragments.

For polyps measuring up to 1 cm, en bloc removal was possible in 112 of 149 lesions (75.2%) in the comparison group and in 114 of 128 lesions (89.1%) in the main group. For lesions larger than 1 cm, these rates were lower but remained more favorable in the main group (45.5% vs 61.5%).

Bleeding remains the most frequent complication of endoscopic removal of mucosal lesions. The use of the proposed technique, which includes a hemostatic component, allowed a significant reduction in bleeding rates. Clinically significant intraoperative bleeding requiring additional hemostatic measures occurred in 12 patients (6.6%) in the comparison group and was not observed in the main group. Delayed bleeding in the early postoperative period developed in 6 patients (3.3%) in the comparison group and in only 1 patient (0.6%) in the main group.

When clinically significant complications were analyzed according to the Clavien–Dindo classification (grades II–IIIb), the following results were observed. In the comparison group, delayed bleeding occurred in 6 patients (4.5%), while in the main group this complication was recorded in 1 patient (0.8%). One case of duodenal perforation (0.7%) was observed in the comparison group on the first postoperative day. In addition, 3 patients (2.2%) in the comparison group developed post-polypectomy electrocoagulation syndrome. The vast majority of patients had an uncomplicated course: 92.5% in the comparison group and 99.2% in the main group (p = 0.011) (tab.1).

Table 1.

Frequency of complications after endoscopic removal

Complication	Comparison group (n=134)	%	Main group (n=118)	%
Bleeding	6	4.5	1	0.8
Perforation	1	0.7	0	0.0
Post-polypectomy electrocoagulation syndrome	3	2.2	0	0.0
No complications	124	92.5	117	99.2
Total	134	100.0	118	100.0

**** $\chi^2 = 6.578$; df = 1; p = 0.011*

In the comparison group, accurate morphological verification was not possible in 57 cases, whereas in the main group the proportion of morphologically unidentified polyps was significantly lower (15.6%), which can be explained by better tissue preservation after laser-assisted excision combined with submucosal

lifting.

The frequency of complications was significantly lower in the main group compared with the comparison group (Fig.1).

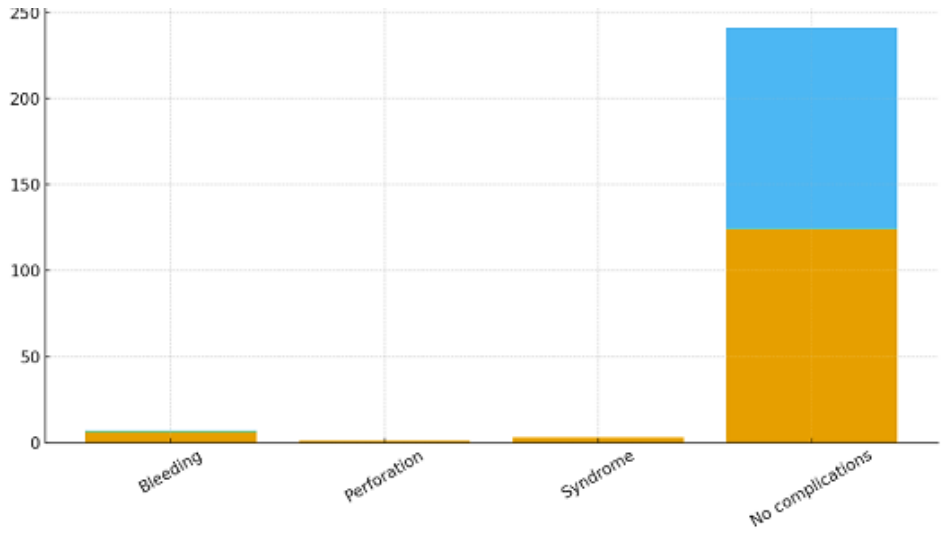

Figure 1. Complications after endoscopic removal of superficial neoplasms of the upper gastrointestinal tract.

Hyperplastic polyps were identified in 64.8% of cases in the comparison group and 61.7% in the main group. Fundic gland polyps accounted for 18.4% and 19.9%, respectively. Adenomatous polyps were found in 16.8% and 18.4% of cases. Malignancy was confirmed in 4 cases in the comparison group and in 6 cases in the main group.

Different grades of epithelial dysplasia were detected in 16.8% of cases in the comparison group and 17.7% in the main group. Although surgical treatment was recommended to patients with confirmed malignancy, only 3 patients underwent subtotal gastric resection, while the remaining patients refused surgery and were followed up dynamically.

Assessment of resection margins has been performed over the last 1.5 years and was therefore available only for 71 patients in the main group. Histological analysis showed R0 resection in 91.5% of cases, while R1 resection was detected in 8.5%.

For polyps up to 1 cm, R0 resection was confirmed in 26 of 27 cases, whereas for lesions larger than 1 cm, R0 resection was achieved in 88.6% of cases.

Postoperative rehabilitation protocols were similar in both groups. However, after the introduction of the new technique, a reduction in hospital stay was observed. Early discharge (within 3 days) was possible in 55.2% of patients in the comparison group and in 69.5% of patients in the main group. Hospitalization for 4–5 days was required in 38.8% and 29.7% of cases, respectively. More than 5 days in hospital were needed in 6.0% of patients in the comparison group and in only 0.8% in the main group ($p = 0.017$).

The mean length of hospital stay was 3.5 ± 1.2 days in the comparison group and 3.1 ± 0.9 days in the main group ($p < 0.05$).

Follow-up data were available for 109 patients in the comparison group and 98 patients in the main group, with an observation period of 6–18 months. In the comparison group, 82.6% of patients remained recurrence-free, whereas 19 patients (17.4%) developed recurrent superficial neoplasms. In the main group, recurrence was detected in only 3 patients (fig.2).

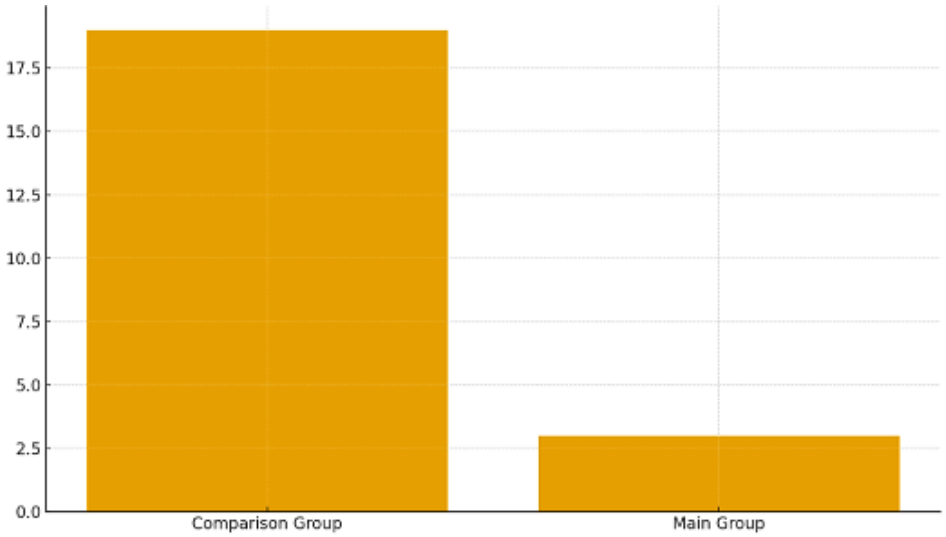

Figure 2. Recurrence rate of superficial neoplasms after endoscopic treatment.

Recurrence rates depended strongly on the initial size of the lesions. For polyps up to 1 cm, recurrence occurred in 7.8% of cases in the comparison group and in 0.9% in the main group. For lesions measuring 1–2 cm, recurrence rates were 33.3% and 4.5%, respectively. For lesions larger than 2 cm, the recurrence rate was 60.0% in the comparison group and 8.3% in the main group (tab.2).

Table 2.

Recurrence rate by initial polyp size

Polyp size	Comparison group (n)	Recurrence n (%)	Main group (n)	Recurrence n (%)	p value
≤1 cm	128	10 (7.8%)	109	1 (0.9%)	0.012
1.0–2.0 cm	18	6 (33.3%)	22	1 (4.5%)	0.018
>2.0 cm	5	3 (60.0%)	12	1 (8.3%)	0.023
Total	151	19 (12.6%)	143	3 (2.1%)	<0.001

The technique of lesion removal also influenced recurrence risk. In the comparison group, recurrence after en bloc resection was observed in 5.0% of cases, compared to 0.9% in the main group. Fragmented resection markedly increased recurrence rates to 28.0% in the comparison group and 7.7% in the main group. These findings confirm that the proposed method significantly improves the overall effectiveness of endoscopic treatment.

CONCLUSION

Summarizing the overall results of treatment, it can be stated that the introduction of a new technique for endoscopic excision of upper gastrointestinal tract polyps led to a general improvement in clinical outcomes. When all initially treated and subsequently followed patients were considered, the new approach demonstrated clear advantages in terms of safety and long-term effectiveness.

In this study, treatment outcomes were classified as good when no immediate procedural complications and no recurrence of polyp formation were observed. Outcomes were considered satisfactory in cases without recurrence but with clinically significant complications that were successfully managed conservatively, such as post-polypectomy coagulation syndrome, or treated with repeat endoscopic intervention for delayed bleeding (Clavien–Dindo grades II–IIIa). Unsatisfactory outcomes were defined as cases requiring emergency surgical intervention

(perforation, Clavien–Dindo grade IIIb) or long-term development of recurrent neoplasms.

Among patients who were followed in the long-term period, good outcomes were observed in 73.4% (80 of 109) of patients in the comparison group, satisfactory outcomes in 8.3% (9 of 109), and unsatisfactory outcomes in 18.3% (20 of 109). In contrast, in the main group, good outcomes were achieved in 95.9% (94 of 98) of cases, satisfactory outcomes in 1.0% (1 of 98), and unsatisfactory outcomes in 3.1% (3 of 98), with a statistically significant difference between the groups ($\chi^2 = 19.562$, df = 2, $p < 0.001$).

It should also be noted that among ten patients with histologically verified malignancy, three underwent surgical treatment shortly after diagnosis, and four more were operated on within the following six months, mainly due to increased oncological concern. The remaining three patients did not demonstrate tumor recurrence during long-term follow-up. These cases were characterized by the absence of deep tumor invasion, which was one of the exclusion criteria of the study. The outcomes of endoscopic treatment in this subgroup were classified as good in eight cases (five in the main group and three in the comparison group) and satisfactory in two cases (one in each group).

Overall, the obtained data indicate that diode laser–assisted endoscopic resection with submucosal gel injection is an effective and safe technique that significantly improves both short-term and long-term clinical outcomes compared with conventional endoscopic treatment methods.

REFERENCES

1. Lesur G. Gastric polyps: how to recognize? Which to resect? Gastroenterol Clin Biol. 2009;33(4):233–239. doi: 10.1016/j.gcb.2009.02.001.
2. Voutilainen M, Mantynen T, Kunnamo I, Juhola M, Mecklin JP, Farkkila M. Impact of clinical symptoms and referral volume on endoscopy for detecting peptic ulcer and gastric neoplasms. Scand J Gastroenterol. 2003;38(1):109–113. doi: 10.1080/00365521.2018.12027894.
3. Barbosa SHB, Lazaro GCF, Franco LM, Valenca JTJ, Nobre SMA, Souza M. Agreement between different pathologists in histopathologic diagnosis of 128 gastric polyps. Arq Gastroenterol. 2017;54(3):263–266. doi: 10.1590/s0004-2803.201700000-29.
4. Elhanafi S, Saadi M, Lou W, Mallawaarachchi I, Zuckerman AM, Othman MO. Gastric polyps: a association with Heli-cobacter pylori status and the pathology of the surrounding mucosa, a cross sectional study. World J Gastrointest Endosc. 2015;7:995–1002. doi: 10.4253/wjge.v7.i10.995.
5. Stolte M. Clinical consequences of the endoscopic diagnosis of gastric polyps. Endoscopy. 1995;27:32–37. doi: 10.1055/s-2007-1005629.
6. ZHU Haizhen, CHEN Zhifen. Clinicopathological features of 2 178 cases of gastric polyps [J]. Medical Journal of Wuhan University, 2016, 37(1): 145-148.
7. Evans JA, Chandrasekhara V, Chathadi KV, Decker GA, Early DS, Fisher DA, et al. ASGE guideline: the role of endoscopy in the management of premalignant and malignant conditions of the stomach. Gastrointest Endosc. 2015;82:1–8. doi: 10.1016/j.gie.2015.03.1967.
8. QIN Shumei, XU Yang. Progress in clinical diagnosis and treatment for gastric polyps[J]. Journal of Central South University. Medical Science, 2020, 45(1): 74-78. DOI : 10. 11817/j.issn.1672-7347.2020.180521.
9. Choi CW, Kang DH, Kim HW, et al. Endoscopic submucosal dissection as a treatment for gastric adenomatous polyps: predictive factors for early gastric cancer[J]. Scand J Gastroenterol, 2012, 47(10): 1218-1225.
10. Jiang Q, Yan X, Wang D, Zhang S, Zhang Y, Feng Y, Yang A, Wu D. Endoscopic mucosal resection using cold snare versus hot snare in treatment for 10-19 mm non-pedunculated colorectal polyps: protocol of a non-inferiority randomised controlled study. BMJ Open. 2023 May 22;13(5):e070321. doi: 10.1136/bmjopen-2022-070321. PMID: 37217262; PMCID: PMC10230935.
11. Sumeyye Yilmaz, Emre Gorgun, Endoscopic Mucosal Resection and Endoscopic Submucosal Dissection, Clinics in Colon and Rectal Surgery, 10.1055/s-0043-1770941, (2023).
12. Kim SY, Sung JK, Moon HS, et al. Is endoscopic mucosal resection a sufficient treatment for low-grade gastric epithelial dysplasia?[J]. Gut Liver, 2012, 6(4): 446-451.
13. Yacoub H, Bibani N, Sabbah M, Bellil N, Ouakaa A, Trad D, Gargouri D. Gastric polyps: a 10-year analysis of 18,496 upper endoscopies. BMC Gastroenterol. 2022 Feb 19;22(1):70. doi: 10.1186/s12876-022-02154-8. PMID: 35183117; PMCID: PMC8857847.
14. Pimentel-Nunes P, Libânio D, Marcos-Pinto R et al. Management of epithelial precancerous conditions and lesions in the stomach (MAPS II): European Society of Gastrointestinal Endoscopy (ESGE), European Helicobacter and Microbiota Study Group (EHMSG), European Society of Pathology (ESP), and Sociedade Portuguesa de Endoscopia

Digestiva (SPED) guideline update 2019. Endoscopy. 2019;51(4):365-388.

15. Pattarajierapan S, Takamaru H, Khomvilai S. Difficult colorectal polypectomy: Technical tips and recent advances. World J Gastroenterol. 2023 May 7;29(17):2600-2615. doi: 10.3748/wjg.v29.i17.2600. PMID: 37213398; PMCID: PMC10198056.

16. Yanai Y, Yokoi C, Watanabe K, Akazawa N, Akiyama J. Endoscopic resection for gastrointestinal tumors (esophageal, gastric, colorectal tumors): Japanese standard and future prospects. Glob Health Med. 2021 Dec 31;3(6):365-370. doi: 10.35772/ghm.2020.01116. PMID: 35036617; PMCID: PMC8692093.

17. LI Xiaofang, XU Junrong, NIU Jian. Clinicopathological characteristics and risk factors of postoperative recurrence of different types of gastric polyps [J]. Journal of Gastro-enterology and Hepatology, 2016, 25(10): 1156-1160.

18. ZHU Ming, NING Shoubin, Bu Xiaohua, et al. Clinicopathological features and endoscopic treatment of gastric polyps[J]. Gastroenterology, 2009, 14(12): 751-753.

19. ZHONG Xuhui, XU Angao. Endoscopic treatment and follow-up of adenomatous gastric polyps[J]. Journal of Practical Medicine, 2002, 18(6): 635-636.

20. Kim SY, Sung JK, Moon HS, et al. Is endoscopic mucosal resection a sufficient treatment for low-grade gastric epithelial dysplasia?[J]. Gut Liver, 2012, 6(4): 446-451.

21. Belderbos TD, Leenders M, Moons LM, Siersema PD. Local recurrence after endoscopic mucosal resection of nonpedunculated colorectal lesions: systematic review and meta-analysis. Endoscopy. 2014;46:388–402.

22. Kang DH, Choi CW, Kim HW, et al. Predictors of upstage diagnosis after endoscopic resection of gastric low-grade dysplasia[J]. Surg Endosc, 2018, 32(6): 2732-2738.

23. QIN Shumei, XU Yang. Progress in clinical diagnosis and treatment for gastric polyps[J]. Journal of Central South University. Medical Science, 2020, 45(1): 74-78. DOI : 10. 11817/j.issn.1672-7347.2020.180521.

24. Yakubov F.R., Sadykov R.A., Mardonov J.N., Erniyazov E.A., Sapaev D.S. Evaluation of Hemostatic Efficacy of Hemoben Gel in Ruptures Of The Gastric Mucosa in An Experiment. Bull. Env. Pharmacol. Life Sci., Vol 12 [8] July 2023: 56-66.

25. 25. Yakubov, F., Ruzibaev, R., Erniyazov,E., & Sapaev, D. (2023). Improvement of methods of endoscopic hemostasis in Mallory-Weiss syndrome. International Bulletin of Medical Sciences and Clinical Research, 3(10), 26–32. https://researchcitations.com/index.php/ibmscr/article/view/2762