



Perforated Peptic Ulcer Disease: Review of History and Treatment

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ARTICLE INFO	ABSTRACT
Published Online: 15 May 2022	Based on the analysis of literature data, the authors conclude that ulcer perforation is an urgent life-threatening situation that requires an immediate complex of therapeutic and diagnostic measures. In many variants of drainage operations (for example, operations according to Heineke-Mikulicz, Finney, Judd), the pyloric sphincter is destroyed, which leads to a variety of functional disorders that significantly reduce the functional outcome of these operations. A very promising direction of research is related to the development of duodenoplasty methods while maintaining the integrity of the pyloric sphincter. The introduction of such operations seems to be anatomically and functionally justified, taking into account the enormous role of the pyloric sphincter for the physiology of digestion of the gastroduodenal zone. The development of such operations may be of great importance for improving the provision of surgical care to patients with perforated duodenal ulcers.
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INTRODUCTION

Despite a long history, to date, surgical treatment of perforated duodenal ulcer (PDU) remains the subject of discussion and numerous studies [3; 22; 29; 51]. To date, there are no clear generally accepted indications for the choice of one or another method of surgical treatment of PDU [7; 24]. When analyzing the results of treatment, it is of great importance to assess not only mortality and early complications, but also late complications, as well as indicators of the quality of life of patients [8].

Treatment of PDU can be conservative or surgical [12; 50]. Conservative treatment (Taylor's method) at the present stage includes the cessation of oral intake of food, aspiration of gastric and duodenal contents through a nasogastric tube, antisecretory and antibiotic therapy [45; 49; 50]. According to the Russian guidelines (2016), conservative treatment for PDU is not recommended and can only be used if the patient or his relatives refuse surgery or if the patient is in a serious condition that does not allow surgical treatment [12]. According to the WSES (2020) recommendations, non-surgical treatment of PDU can be used only in selected cases, if a covered perforation is confirmed by a study with a contrast agent [50].

The importance of timely surgical treatment is indicated by the results of large studies demonstrating the dependence of disease outcomes on the timing of the

operation [3; 44]. A large study of 2688 patients showed that delaying surgery by one hour resulted in an adjusted reduction in patient survival of 2.4% [44].

The main objectives of the surgical treatment of PDU are: to eliminate the source of peritonitis and to perform a pathogenetically substantiated operation for ulcer disease (UD). The choice of surgery depends on a number of factors, including the size and location of the ulcer, as well as the severity of the patient's condition [3].

There are 3 main ways of surgical treatment of PDU: suturing the perforation; excision of a perforated ulcer with additional pyloroplasty and vagotomy; resection of the stomach [12].

Both open and laparoscopic interventions are used in the treatment of PDU [50]. In recent years, there has been a clear trend towards minimally invasive laparoscopic interventions [34; 35]. According to a systematic review, the laparoscopic approach has advantages in reducing pain and infectious complications, while there were no statistically significant differences in postoperative mortality, suture failure, abdominal abscesses, and reoperation rates between laparotomic and laparoscopic approaches [45]. Contraindications for laparoscopic treatment are: peritonitis over 9 points, perforation diameter over 10 mm, infiltrative shaft over 1 cm [35].

One of the methods of surgical treatment of PDU is the suturing of the perforation by one of the methods [45]. This operation was first performed in 1880 by Johan Mikulicz for traumatic perforation of the stomach, but the operation ended in death. Starting from the 1990s, laparoscopic suturing of the perforation hole has been dominant in the treatment of most PDU [29; 35]. Among the advantages of suturing a perforated ulcer, one can note the wide availability of this method to a wide range of surgeons, as well as the absence of the need for additional equipment, which may be important in emergency medical care. An analysis of the literature shows that, to date, simple closure of the PDU is a very commonly performed intervention. So, for example, S.V. Tarasenko et al. (2021) provide extensive experience in the treatment of 693 patients with perforated gastric and duodenal ulcers, while noting that in most cases the ulcer was sutured in combination with antibacterial and antisecretory therapy, which has significantly improved the quality of life of patients over the past 5 years [32].

At the same time, it should be noted that simple suturing of a perforated ulcer creates an additional, very important problem of a sutured PDU. According to A.N. Vacheva et al. (2018), the operation of simple closure of the PDU should not be the operation of choice at the present stage [3].

Interest in resection of the stomach (RS) in PDU then weakens, then increases again. The first resection in a patient with a perforated duodenal ulcer was performed by C.R.B. Keetley in 1889, in Russia - O.A. Yutsevich in 1906 [38]. This area of peptic ulcer surgery has developed as an alternative to suturing perforation and gastroenterostomy as the most radical method of treatment. In Russia, the active development of the RS technique for duodenal ulcers is closely related to the works of S.S. Yudin (1965). In particular, in the works of S.S. Yudin, it was shown that up to 94% of patients with PDU are completely cured of this disease after gastric cancer [41].

The main advantage of performing gastric resection is the radical nature of the operation in relation to PU, which is indicated primarily by the extremely low recurrence rate of the disease after performing this type of surgical treatment [41]. Resection allows to eliminate the acid-peptic factors of ulcerogenesis, while there is a decrease in the production of hydrochloric acid in the first phase and the second phase of digestion is actually eliminated [21]. Concerning the definition of indications and contraindications for gastric cancer in PDU, rather conflicting recommendations are presented in the literature. For example, V.S. Saveliev et al. recommends resection of the stomach under the following conditions: 1) the operation is performed within the first 12 hours after the onset of the disease in the absence of signs of diffuse purulent-fibrous peritonitis; 2) the patient has no severe somatic diseases, the patient's age is not more than 60 years; 3) sufficient qualification of the surgeon [31]. Other authors point out the need for even more rigorous selection of

patients: age up to 50 years, a short period from the moment of perforation, the absence of concomitant pathology [28; 48]. I.I. Neimark among the conditions for performing gastric cancer in PDD describes, among other things, the following: the period from the onset of perforation is not more than 6-8 hours, age from 25 to 50 years, the presence of an ulcer history before perforation (including complications - stenosis, bleeding) [22]. I.I. Bachev limits the possibility of performing resection for up to 6 hours from the onset of the disease [1]. In later works, the possibility of performing gastric cancer is considered primarily in terms of the severity of the ulcerative process, while it is believed that this intervention is possible in the presence of large and giant ulcers, with suspicion of malignancy, with double localization of ulcers (the so-called “mirror” ulcers), as well as in case of recurrence of perforation after suturing [25]. When evaluating the role of gastric cancer in the treatment of PDU, it should be taken into account that this operation is very traumatic and its implementation in conditions of peritonitis is associated with a high risk of complications [13]. Even more significant may be the functional consequences of gastric cancer in the form of post-gastroresection syndromes of varying severity. Despite the relatively high efficiency of resection in relation to the likelihood of recurrence of PU, it must be remembered that this operation itself can be considered a “disease”, as it leads to fundamental changes in the physiology of digestion. The problem of post-resection syndromes is quite well known and studied. It should only be noted that only dumping syndrome develops with a frequency of up to 40%, adductor loop syndrome - up to 42%, hypoglycemic syndrome - up to 34%. Active development and implementation of gastric cancer in perforated ulcers occurred before the modern era of highly effective antisecretory therapy. All this significantly limits the scope of this variant of intervention in PVD at the present stage. While in the middle of the 20th century (from the 1930s to the 1970s) the frequency of gastric cancer with PDU ranged from 10 to 93% in different clinics [22], now this operation is performed in single cases. A number of authors believe that this method should rather be considered as historical [28]. Now we can say that GR can be performed only in a strictly limited circle of patients with PDU [9].

Duodenal and pyloroduodenal plasty have a very special place in PDU surgery. The essence of pyloroplasty is to excise the ulcer and expand the pyloric canal by transverse dissection. To date, several dozen variants of pyloroplasty have been proposed [2; 6; 19]. All drainage operations can be divided into 2 large groups: with and without intersection of the pyloric muscle. The first group includes, for example, pyloroplasty according to Heineke-Mikulicz and its modifications, pyloroplasty according to Finney, according to Judd and others [36]. These surgical interventions are often performed in patients with perforated duodenal ulcers. A.N. Deshuk et al. (2018) showed that vagotomy with pyloroplasty is performed in 20% of patients, with Judd pyloroplasty being most often performed (70.5% of all pyloroplasties), less often

Finney pyloroplasty (20.5%) and Heineke-Mikulicz (9 %) [9]. It is important to note that with these types of interventions, a gross violation of the structure and function of the pylorus occurs, and therefore such operations can be considered pyloroplasty only very conditionally. True pyloroplasty is proposed to mean only those operations that are structurally and functionally restorative in nature [2]. These operations include various variants of gastrointestinal anastomoses and duodenoplasty proper [36].

The widespread use of pyloroplasty in combination with vagotomy has been noted since the middle of the 20th century, when the first data on the effectiveness of this area of surgical treatment of PDU were obtained [52]. Among the main positive aspects of the use of drainage operations, the following can be noted: 1) a decrease in gastric secretion in the hormonal phase due to the acceleration of the evacuation of gastric contents; 2) inhibition of the secretion of gastrin and hydrochloric acid due to irrigation of the duodenal mucosa with acidic content; 3) the possibility of intraoperative assessment to identify “mirror” ulcers and exclude the leaving of bleeding vessels [2; 28]. It is believed that pyloroplasty can lead to a decrease in gastric secretion by 17-18% [19].

Pyloroplasty according to Heineke-Mikulicz is performed in the absence of pronounced inflammatory and cicatricial changes in the duodenum, which creates favorable conditions for the consciousness of a fairly wide fistula between the stomach and duodenum. Performing this type of intervention is impossible in the presence of severe stenosis at the site of intervention, as well as the presence of “mirror” ulcers. Pyloroplasty according to Judd includes a diamond-shaped excision of the altered area and is usually performed when a perforated duodenal ulcer is located on its anterior semicircle and in the pylorus zone. Among the limitations and disadvantages of this operation, it is necessary to note the dissection of the pyloric sphincter, the risk of developing insufficiency of sutures, gastrostrasis and ulcer recurrence [33]. Pyloroplasty according to Judd has the same contraindications as pyloroplasty according to Heineke-Mikulicz. In these cases, it is possible to perform pyloroplasty according to Finney, in which a wide fistula is formed, which contributes to the evacuation of food even in the presence of severe gastroptosis and stenosis of the gastric outlet. In general, pyloroplasty according to Heineke-Mikulicz can be recommended for a perforated ulcer on the anterior wall as the final stage with excision of the ulcer, and pyloroplasty according to Finney - in the presence of pyloroduodenal stenosis [18]. In addition, Heineke-Mikulicz pyloroplasty can be performed when perforation is combined with bleeding or stenosis [30].

It has been shown that pyloroplasty has certain advantages over simple perforation closure, at least in terms of reducing mortality [3]. The following limitations of simple perforated ulcer closure compared to pyloroplasty are discussed: the risk of postoperative stenosis and deterioration of functional outcomes; lack of antiulcer effect of the

operation; risk of suture failure. The role of the last factor can be especially great in case of late surgical intervention (after more than 24 hours) due to the need for suturing the inflamed walls in conditions of diffuse peritonitis. Excision of the ulcer allows you to remove the morphological substrate of the subsequent possible development of suture failure [3; 4]. These data were confirmed in a specially conducted morphological study of 102 histological preparations obtained during the surgical treatment of perforated duodenal ulcer. It has been shown that pronounced inflammatory fibroplastic and inflammatory changes are observed at a distance of at least 0.5 cm from the ulcer, while moderate fibroplastic and minimal inflammatory changes persist at a distance of 1 cm or even more [4].

Nevertheless, the active accumulation of experience in performing drainage operations has made the emergence of a number of pathological syndromes obvious. The main reason for the development of these syndromes is the destruction of the pylorus and disruption of the pyloric sphincter [26]. Numerous studies have shown that a violation of the structural integrity and functional viability of the pylorus during drainage operations leads to the development of dumping syndrome, duodenogastric reflux (DGR) and other complications [2; 27]. Somewhat later, various authors proposed options for pylorus-preserving operations, however, these treatment options were also characterized by a large number of technical implementation difficulties [6].

Physiological and clinical studies have shown the paramount importance of the pyloric sphincter (SP) for normal digestive physiology [48]. The work of the joint venture is closely related not only to digestion in the stomach and duodenum, but also indirectly affects the liver, gallbladder, bile ducts, and pancreas. Located on the border of the acidic environment of the stomach and the alkaline environment of the duodenum, the pyloric sphincter regulates the amount of chyme entering the duodenum. At the same time, it is believed that it is the regulation of the volume of chyme coming from the stomach to the duodenum that plays an important role in protecting the mucosa from the aggressive acid-peptic factor. The rate of evacuation of chyme from the stomach, as well as its consistency (homogeneity, lack of large pieces, etc.) play an important role in the normal digestion of food in the small intestine. It should be noted that the pylorus consists of two sphincters - gastric and duodenal, while the first regulates the volume of chyme entering the duodenum, and the second prevents retrograde reflux of chyme into the stomach [2; 26].

When carrying out a number of interventions for PDU, a gross violation of the functional role of the pylorus occurs, which is expressed in the development of a number of pathological conditions - disorders of autonomic regulation, diarrhea, anemia, dumping syndrome, etc. Damage to the pylorus leads, on the one hand, to a violation of the portioned dosed evacuation of gastric contents, and on the other hand, to the development of DGR, which determines the

development of reflux gastritis. At the same time, pronounced changes in the mucous membrane of the stomach and duodenum develop, which contributes to the recurrence of ulcers and severe digestive disorders [2; 15; 27; 39].

The most indicative violations of the pyloric mechanism after pyloroduodenoplasty (PDP) according to Judd, Heineke-Mikulicz or Finney. When carrying out these variants of PP, the destruction of the pylorus occurs, which is accompanied in the postoperative period by gross violations of the motor-evacuation function of the stomach (MEFS). When carrying out the PDP according to Heineke-Mikulicz, the pyloric sphincter is dissected in the longitudinal direction with the opening of the lumen of the organs and subsequent suturing in the transverse direction. After this intervention, a pronounced deformation of the gastroduodenal junction is observed, leading to gastrostasis [39]. Finney's PP, which involves suturing the anterior walls of the gastric antrum and the initial duodenum, should be considered a gastroduodenostomy rather than a PDP. When performing PDP according to Heineke-Mikulicz, the length of the incision on the stomach is at least 3.5 cm, on the duodenum - 2.5 cm [46]. During the Finney operation, the length of the incision in the stomach and duodenum is at least 5 cm. An additional contribution to the pathogenesis of postoperative disorders is made by stem or selective vagotomy. Damage to the anterior nerve of Latarjet, which provides motor innervation to the pyloric sphincter, may play an important additional role in the development of postoperative disorders [48].

It should be noted a variety of morphological changes in the gastric mucosa (GM) after performing drainage operations. 2-3 weeks after the draining operation (PDP according to Heineke-Mikulicz or Finney), hypertrophy of the gastric mucosa develops, the phenomena of superficial and deep gastritis. With the combination of selective vagotomy with PDP according to Heineke-Mikulicz, a significant increase in the number of mucus-forming cells in the glands of the stomach is observed. It is important to note that in some patients, significant changes in the mucous membrane persist 1-2 years after surgery. In patients with impaired evacuation from the stomach, atrophy of the gastric mucosa is noted. In patients after PDP according to Heineke-Mikulicz, the development of atrophic gastritis was noted [20; 43].

When discussing the surgical treatment of PDU, one cannot but briefly mention such a method as vagotomy. The pioneer of this method is E. Bircher, who first applied it in 1912. This method became widespread in the 1940s after the publication of good results of vagotomy in extensive clinical material [47]. Among the advantages of this method, for example, in comparison with RJ, there were significant faster recovery times for patients [5]. A rather high frequency of good and excellent results of surgical treatment was described [37]. However, over time, it became clear that stem vagotomy is very often accompanied by the development of post-

vagotomy syndrome, including dumping syndrome, diarrhea, impaired motor function of the gallbladder, as well as the risk of developing so-called stasis ulcers due to increased second phase [10]. To overcome the complications of stem vagotomy, various methods of selective vagotomy have been proposed (see, for example, a very detailed classification by A.V. Shaposhnikov et al. [40]). Vagotomy as a method of surgical treatment, including for PDP, has a large number of supporters [16; 17], while it is important to note that at the present stage, new technical methods are being developed, regarding approaches to the implementation of this operation. On the other hand, sometimes very radical criticism of vagotomy is well known, due to the fact that this method is essentially non-physiological and leads to a large number of post-vagotomy disorders [26]. Currently, vagotomy retains its importance in elective PU surgery [18; 37], however, in emergency cases during surgical interventions for PDU it doesn't matter that much. This is primarily due to the technical difficulties of performing selective vagotomy and pyloroplasty in emergency surgical conditions [18; 42]. In addition, emergency intervention for health reasons does not allow for a detailed assessment of gastric secretion, which, according to some authors, must be taken into account when determining indications for vagotomy [38; 40]. Among the reasons for refusal to perform vagotomy in perforated duodenal ulcers, there is also the inability to differentiate in emergency cases of PU and symptomatic ulcers, in which vagotomy is physiologically unreasonable [17].

The important role of preserving the pyloric mechanism is also indicated by the data of studies assessing the quality of life of patients in the long-term period after surgery. N.N. Krylov et al. (2016) performed an assessment of the quality of life of patients with PDU after various surgical treatment options based on extensive clinical material. The study included 110 patients; examination of all patients with an assessment of the quality of life was carried out 5-10 years after various options for surgical treatment. Among the RJ methods, the results of resection in the modification of Roux, Balfour, Hofmeister-Finsterer were analyzed in the work. Lower indicators of quality of life compared with the control group were identified after all options for surgical treatment. When comparing the results of radical operations, it was found that the highest quality of life indicators are observed after proximal stem vagotomy. According to the authors of the study, the preservation of the pyloric mechanism is of primary importance for higher quality of life in this category of patients. This is indicated by the fact that, in fact, the only unifying factor for stem vagotomy and various options for resection of the stomach is a violation of the pyloric mechanism as a result of either its removal or pyloroplasty. It is important to note that after selective proximal vagotomy, the subsection score for assessing the symptoms of the disease in patients operated on for PDU does not differ from that in the group of healthy individuals [14].

Thus, the violation or removal of the pylorus and the resulting disturbances in the normal functioning of the stomach are an extremely significant factor in reducing the quality of life in the long-term periods after surgery. The second most important factor is probably the presence of pronounced GHD, which develops during resection in the Hofmeister-Finsterer modification [14].

Attempts to overcome the limitation of pyloroplasty with the destruction of the pyloric mechanism led to the development of a new direction in abdominal surgery - duodenoplasty (DP). One of the first proposed operations is DP in the Tanner-Kennedy modification, which is also called palliative DP, since this intervention does not excise the ulcer. This intervention makes it possible to preserve the pyloric region as an integral link in the regulation of digestion in the gastroduodenal zone and prevent severe complications of drainage operations (dumping syndrome, DGR, diarrhea, vomiting, etc.). Nevertheless, this intervention is also characterized by a large number of disadvantages: the ulcer persists, all the risks associated with relapses remain, the blood supply and innervation of the peripyloric zone are disturbed, etc. Subsequently, intervention options were proposed aimed at radical removal of the ulcer focus, for example, the operation of Heiwing and Neumann, in which subpyloric resection of the duodenum with extraduodenization of the edges of the ulcer and in combination with selective proximal vagotomy (SPV) is performed. In fact, this operation is a resection of the duodenum, and not duodenoplasty [9; 36]. Other intervention options have also been proposed [11; 16]. It is especially necessary to note such an operation as radical DP, which is actively promoted by the school of V.I. Onoprieva [11; 26]. Radical DP is aimed at complete excision of the ulcerative field, elimination of the area of perforation and deformation of the duodenum while maintaining the structural and functional integrity of the gastroduodenal junction and the pyloric sphincter. Restoration of normal anatomical relationships of the gastroduodenal zone during this operation allows the maximum preservation of normal functioning, secretion and motor function [9; 36; 41]. At the same time, it should be noted that according to a study with an analysis of 645 case histories conducted by V.N. Chernov and S.V. Dolgarev (2013), a good long-term result of radical DP was noted in 7% of cases, satisfactory - in 48.8% of cases, unsatisfactory - in 17.2% of cases, poor - in 27%, including 1.7% of cases in which fatal outcome. A high frequency of ulcer recurrence was noted when observing patients for 5 years - 27%. In addition, in 11% of cases, the development of early postoperative complications was noted. According to the authors of the study, unsatisfactory long-term results are largely due to the lack of preoperative assessment of anatomical and functional changes in the gastroduodenal zone. In addition, it is noted that radical DP is, from a technical point of view, a rather complicated operation that must be performed in specialized surgical centers [9; 36].

The high relevance of the development of new highly effective PDU methods in patients with PDU is indicated by the appearance in recent years of a number of publications that offer new options for the technical execution of operations. For example, V.R. Nikitin et al. (2019) proposed an original method of pyloroplasty with a continuous two-level suture for giant circular PDU. The authors note that there were no complications leading to death. In another work, the same group of authors tested the method of radical DP in giant ulcers penetrating into the hepatoduodenal ligament. It was shown that the use of this technique is not accompanied by the development of cases of suture failure in the area of the sutured intestinal wound and deformation of the intestinal lumen after surgery. [23].

Conclusion. Thus, ulcer perforation is an urgent life-threatening situation that requires an immediate complex of diagnostic and treatment measures. In many variants of drainage operations (for example, operations according to Heineke-Mikulicz, Finney, Judd), the pyloric sphincter is destroyed, which leads to a variety of functional disorders that significantly reduce the functional outcome of these operations. A very promising direction of research is related to the development of DP methods while maintaining the integrity of the pyloric sphincter. The introduction of such operations seems to be anatomically and functionally justified, taking into account the enormous role of SP for the physiology of digestion of the gastroduodenal zone. The development of such operations may be of great importance for improving the provision of surgical care to patients with PDU.

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