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TECHNICAL FEATURES OF THE KIDNEY LAPAROSCOPIC RESECTION WITH SUPER-SELECTIVE BALLOON EMBOLIZATION OF THE RENAL ARTERY

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ABSTRACT

The article is devoted to the study of the results in the surgical treatment of patients with renal neoplasms using a new method of kidney resection, which has its own technical features.

Their essence lies in the temporary superselective embolization of the renal artery, which allows turning off the affected part of the kidney from the circulation. Embolization allows minimizing the blood loss that occurs as well as preserving blood flow in the unaffected areas of the kidney, thereby protecting the remaining part of the kidney from ischemia. As a result, the postoperative period proceeds with a more rapid recovery of kidney function.

Objective: to improve the results of renal neoplasms surgery.

Materials and methods. Laparoscopic resection of the kidney with superselective balloon embolization from October 2015 to October 2017 was performed in 14 patients. The average age of the operated was 54.5 (from 29 to 72) years, among them 3 men and 11 women.

Conclusion. The proposed method of superselective balloon embolization of the renal artery intraorganic branches has its peculiarities which make it possible to perform a complete intraoperative hemostasis of the renal parenchyma segment in which the tumor-like formation is located. At the same time, the functional state of the rest of the kidney does not decrease, transluminal temporary embolization of the segmental or lobar artery of the kidney reliably blocks the blood flow, preventing massive uncontrolled bleeding. Maintaining blood flow to the intact parenchyma is an important factor in preventing acute kidney damage during organ-sparing operations. No need for skeletonization of the kidney arteries for their temporary clipping allows laparoscopic resection of the kidney to mid-level urological endosurgeon physicians without the help of highly skilled experts, which implies massive use of this technique in multidisciplinary clinics.

Keywords: selective renal artery embolization, kidney resection, kidney neoplasms, minimally invasive kidney surgery.

Introduction. Over the past decade, an increase in the number of patients with kidney cancer has been recorded worldwide. This is undoubtedly due to the wide spread of various methods of early diagnosis, which, in turn, leads to the fact that in 60-70% of patients a localized form of the disease is revealed [1, 5, 8, 10, 15, 23]. In 2014, Schiffmann et al showed that open radical nephrectomy was still the method of choice for stage T1 kidney

cancer [19]. However, the initial stages of T1-T2 are increasingly becoming indications for resection of the kidney [6, 8, 9, 12, 17, 18]. Kidney resection is comparable to a total nephrectomy for oncologic outcomes [13]; overall survival of patients [21] is higher and long-term renal and cardiovascular function [11, 22] is better. Thus, according to the principles of the European Association of Urology [7], nephron-sparing surgery is shown for

kidney cancer stage T1 [4, 14, 19].

Kidney resection for tumors with a size of less than 4 cm with the improvement of laparoscopic technology is increasingly performed by laparoscopic access [8].

Resection of a malignant tumor of the kidney is only possible while observing the principles of ablatics, for which an adequate hemostasis in the surgical wound is necessary for visual control of the surgical edge. Bleeding can be avoid-

ed, as a rule, by carefully isolating the kidney vessels with an en-block clamping (artery and vein together) or by isolating and shutting off the blood flow in the renal artery or in its segments.

Skeletonization of the renal artery individual segments is a laborious and very complex process, not always feasible due to the anatomical features of the blood supply to the kidney. Clamping of the vascular pedicle or an isolated renal artery to achieve hemostasis threatens ischemic damage to the renal tubules, which are acutely responsive to hypoxic conditions [16, 20].

Currently, a method has been proposed of laparoscopic kidney resection with superselective balloon embolization of the segmental branches of the renal artery during renal parenchyma formations [2]. An assessment was made of the functional state of the operated kidney in the early postoperative period [3].

Objective: to improve the results of renal formations' surgery.

Aims:

1. To evaluate technical features of a kidney tumor laparoscopic resection method with preliminary superselective balloon embolization of the segmental branches of the renal artery.
2. To study the surgical treatment results at patients with kidney tumors after using organ-preserving resection of the kidney.

Materials and methods of the research. Laparoscopic resection of the kidney with superselective balloon embolization from October 2015 to October 2017 was performed in the Urology Department RH No. 1- National Center of Medicine in 14 patients, 3 men and 11 women. The average age of the operated was 54.5 (from 29 to 72) years.

In 6 cases the tumor was located on the right, in 8 - on the left; in 7 cases the lower segment was affected, in 3 - the upper segment, in 4 - the middle segment. The size of the neoplasm ranged from 0.9 to 3.8 cm, averaging 2.2 cm. All patients underwent routine studies in the preoperative period: ultrasound of the urinary system, multispiral computed tomography (MSCT) with contrast enhancement, rentographic examination, separate assessment of renal functions. The degree of difficulty of the proposed kidney resection was assessed according to the R.E.N.A.L scale. on the basis of MSCT data, the average score made up 5.3 points, which corresponds to a mild degree of resectability of the tumor.

Embolization of the segmental renal

artery supplying the segment of the kidney with a tumor was performed by the first stage, immediately before the laparoscopic stage of surgical treatment. After performing aortography and determining the localization of the renal artery orifice, a catheter was brought into the renal artery, then a microconductor was installed in the renal artery under the control of fluoroscopy and a coronary balloon 2.5-3.5 mm in diameter was inserted through it. On selective renal angiography, the diameter of the segmental vessel to be embolized was preliminarily measured to select the optimal size of the coronary balloon. Inflating it under pressure up to 20 atmospheres to achieve occlusion and cessation of blood flow in the parenchyma led to reliable hemostasis, which was controlled by performing a control renal angiography. Immediately after reaching a reliable occlusion of the segmental artery, the patient was transferred to the operating room and proceeded to the 2nd stage of surgical treatment. Standard laparoscopic access was performed to the retroperitoneal space by transperitoneal access. After opening the fascia of Gerot, the surface of the kidney with a tumor was isolated from the perirenal fiber. The resection was made with cold scissors, some 3-5 mm from the edge of the tumor. Minor venous bleeding was dried with an electroaspirator. After resection and closure of the kidney wound, the balloon was immediately blown off, causing blood flow to the ischemic area.

Results and discussion. According to the results of a postoperative histological study, 7 patients were diagnosed with a clear cell variant of renal cell carcinoma, in 3 - papillary, in 3 - angiomyolipoma, in 1 - lymphangioma.

Selective renal angiography in an X-ray surgery room is a standard procedure that can be performed by a X-ray surgeon of any qualification (Fig. 1). In carrying out this study, the fact that the presence and participation of the operating surgeon, who will subsequently carry out the operational manual, deserves special attention. Real-time angiography data provide additional and very valuable information about the topography of the kidney, its blood supply, localization of the pathological formation, its vascularization and exact dimensions. The possibility of 3-D visualization of the vessels architectonics gives a clear idea of the nature of the blood supply to the kidney.

Then, with the direct participation of the operating surgeon, a selection is made of the segment of interest of the



Fig. 1. Selective renal angiography. A tumor of the lower segment of the left kidney is determined.

common artery that feeds the segment with formation and is subject to embolization. In this case, the surgeon clearly understands the entire volume of the ischemic parenchyma to prevent uncontrolled bleeding.

The X-ray features of this procedure are to accurately set the embolization balloon in the right place and to ensure reliable arterial hemostasis. To carry out this crucial step, it is more convenient to use arterial catheters with insertion into the lumen of the renal artery, for more precise control over the manipulation of the conductor with balloon. Control angiography with a bloated balloon is required to control the quality of embolization and determine the volume of the ischemic parenchyma (Fig. 2).

The implementation of balloon embolization is preferable to coronary spherical balloons due to the possible complex course of intraorgan vessels not capable of extension. In this case, installation of an elongated cylinder with a length of 2

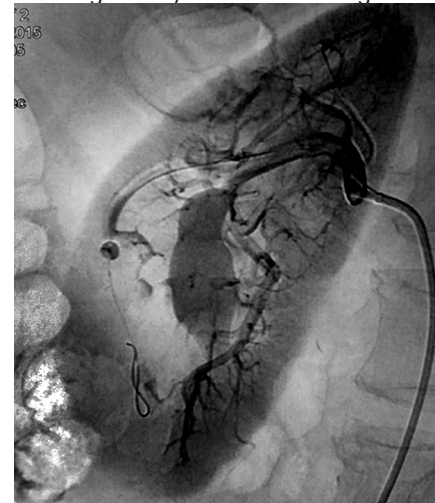


Fig. 2. Control angiogram. The occlusion balloon and the site of the ischemic parenchyma are determined.

cm is difficult.

The laparoscopic stage of this technique has its own characteristics. Access to the operated kidney is possible through any of the standard approaches: transperitoneal, through the abdominal cavity with the imposition of carboxyperitoneum, or at certain locations of the tumor (the back surface of the kidney) - lumbo-scopic. The latter is less convenient due to the small amount of operational space, but with the appropriate skill and level of skill of the surgeon is quite acceptable.

An important advantage of this technique at this stage is that there is no need to isolate the entire kidney and the vascular pedicle for clamping or temporary clipping of the entire kidney vessels, only the renal artery or lobar arteries to achieve intraoperative hemostasis. In the usual practice of kidney resection, this procedure is technically difficult: the isolation of the kidney vessels requires a high level of operator skill, is fraught with hemorrhagic complications and thereby inevitably lengthens the time of surgery. Skeletonization of the lobar arteries is sometimes completely impossible due to the different features of the anatomical structure of the renal vessels. All these difficulties can be avoided when intraoperative he-

mostasis is performed by the endovascular method. The surgeon can only access the surface of the kidney with the formation, expose a small, but sufficient for a complete resection section of the surface of the kidney with a tumor (Fig.3). In addition to saving time and effort, this approach is considered from the point of view of nephroprotection, as the most benign method of kidney resection. The absence of the need to isolate the entire surface of the kidney undoubtedly has a positive effect on the functional state of the organ as a whole.

Kidney resection is performed with cold scissors, within the limits of healthy tissue, 3-5 mm from the tumor, which ensures minimal damage to the intact parenchyma (Fig. 4). The absence of arterial bleeding ensures complete control over the dissection plane, which allows you to precisely control the volume of the excised tissue, localize the tumor mass and ensure maximum abdominal resection. Minor venous bleeding is effectively aspirated by a suction pump, which also acts as a retractor for the tissue to be removed. The removed preparation is immediately placed in the endoscap for complete ablasticity of the operation. The wound of the kidney parenchyma is sutured with standard Z-and P-sutures, imposed with the capture of the fibrous capsule. To save time, fixing biodegradable clips can be used at the ends of the ligature, providing, in addition to the effect of fixation, an additional compression moment on the edges of the kidney parenchyma to achieve reliable final hemostasis. When opening the collector system of the kidneys, which occurs with a deep intraparenchymal arrangement of the absence of active bleeding and, consequently, the blood supply to the renal cup-pelvis system, does not create conditions for tamponade of the renal pelvis and violation of urodynamics, thus there is no need for ureteral stenting. The blood flow to the ischemic segment is performed immediately after suturing the kidney parenchyma under endovideo control by bleeding a balloon inflated in the artery (Fig. 5). In the presence of hemorrhage, the surgeon has the opportunity to impose additional hemostatic sutures on the kidney wound and thereby achieve a reliable final hemostasis.

The only, in our opinion, disadvantage of this method lies in the technological separation of 2 stages: X-ray embolization is performed under conditions of X-ray surgery, and laparoscopic resection is performed in the operating room. This

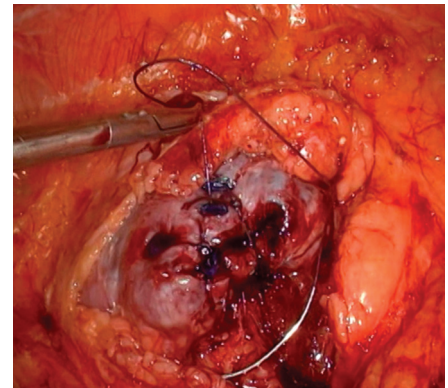


Fig. 5. Starting blood flow. Uniform staining of the parenchyma, the restoration of turgor and the absence of bleeding.

leads to an unjustified lengthening of the thermal ischemia time of the parenchyma area that underwent embolization. This disadvantage can be eliminated by combining both stages in the same room - using a hybrid operating room, equipped with an X-ray surgery unit and a standard endovideo-surgical complex.

Conclusion. The proposed method of superselective balloon embolization of the renal artery intraorganic branches has its peculiarities which makes it possible to perform a complete intraoperative hemostasis of the renal parenchyma segment in which the tumor-like formation is located. At the same time, the functional state of the rest of the kidney does not decrease, transluminal temporary embolization of the segmental or lobar artery of the kidney reliably blocks the blood flow, preventing massive uncontrolled bleeding. Maintaining blood flow to the intact parenchyma is an important factor in preventing acute kidney damage during organ-sparing operations. No need for skeletonization of the kidney arteries for their temporary clipping allows laparoscopic resection of the kidney to mid-level urological endosurgeon physicians without the help of highly skilled experts, which implies massive use of this technique in multidisciplinary clinics.

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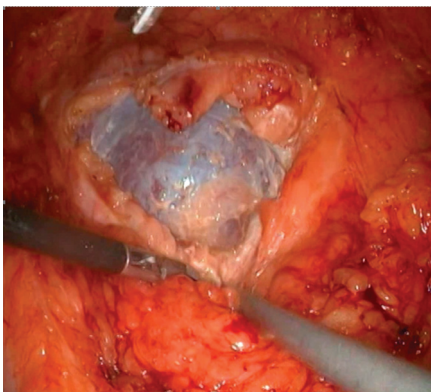


Fig. 3. The lower segment of the kidney with a tumor. Parenchyma is ischemic.

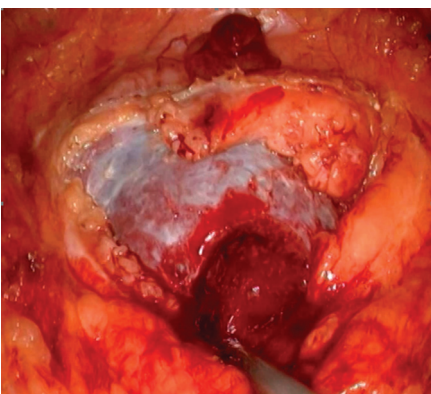


Fig. 4. The tumor is resected. Minimal venous bleeding.

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