THE ANALYSIS OF POSTOPERATIVE COMPLICATIONS AFTER THROMBECTOMY FROM INFERIOR VENA CAVA IN RENAL CELL CARCINOMA

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The aim of the investigation is to analyze the results of thrombectomy from inferior vena cava in renal cell carcinoma to reveal the main prognostic factors of postoperative complications.

Materials and Methods. Nephrectomy with thrombectomy from inferior vena cava was performed in 34 patients. Thrombus level T_{3b} was revealed in 27 patients (79.4%) (thrombus length — 5.10±1.75 cm), T_{3c} — in 7 patients (20.6%) (thrombus length — 14.80±0.98 см). Postoperative complications were analyzed according to Clavien–Dindo classification of surgical complications.

Results. Blood loss volume in operation was on average 866 ml (250–4000 ml). 18 patients (52.9%) had no complications. Two patients (5.9%) had I degree complication (anemia). The II degree of complication was revealed in 11 patients (32.3%), after the operation they underwent blood transfusion. One patients (2.9%) had IIIb degree of complications (after the operation he required pleural punctures and pericardium drainage under local anesthesia), and one patients had IIIb degree of complications (descending colon perforation) — he underwent relaparotomy and colostomy. There were no IV degree complications. One patient (2.9%) died (V degree) from pulmonary embolism. Correlation analysis determined high (r=0.7) complications dependence of thrombus size and blood loss volume (r=0.6) and low dependence — of tumour size (r=0.44). There were revealed no complication dependence of patients age (r=0.1), status on Karnofsky scale (r=0.0). All 33 patients discharged from hospital had lived over 6 months after the operation.

Conclusion. After nephrectomy with thrombectomy from inferior vena cava there is high risk of postoperative complications, the frequency and type of which to a greater degree depend on thrombus size and blood loss volume.

Key words: renal cell carcinoma, tumour thrombus, inferior vena cava, operative therapy, complications.

The characteristic of renal cell carcinoma (RCC) in 4–10% of patients is the formation of tumour venous thrombi, and their extending along the renal vein and inferior vena cava (IVC) up to the right atrium [1–4].

Surgical removal of tumour thrombus from IVC runs the risk of postoperative complications. According to different authors, surgical mortality varies from 1.4 to 13%, and total postoperative complication rate is 30-60% [2–8]. The main causes of intraoperative lethality are thrombus fragmentation with pulmonary embolism by tumour masses, massive hemorrhage, and congestive heart failure. Among the causes of postoperative mortality there are sepsis, cardiac failure, multiple organ failure, as well as stroke, acute gastrointestinal bleeding, and renal failure [2, 6, 8].

The aim of the investigation is to analyze the results of thrombectomy from inferior vena cava in renal cell carcinoma to reveal the main prognostic factors of postoperative complications.

Materials and Methods. Since 2005 till present time, in Privolzhsky District Medical Centre of Federal Medico-Biologic Agency of Russia (Nizhny Novgorod) 34 patients have undergone nephrectomy with thrombectomy from IVC. In the study there were included only patients with extended, over 3–4 cm (II–IV level [7]) thrombi — T_{3b} and T_{3c} according to revised version of TNM classification, 2009 [9]. There were 21 males (61.8%), and 13 females (38.2%). The patients' age was 35–76 years (58.7±10.1 yrs).

According to Karnofsky scale, the status >90% was determined in 26 patients (76.5%), 80% — in 7 patients (20.6%), 70% — in 1 patient (2.9%).

In 25 cases the thrombus originates from right renal tumour, in 9 cases — from left renal tumour. T_{3b} stage was diagnosed in 27 patients (79.4%): average thrombus length was 5.10±1.75 cm. T_{3c} diagnosis was made in 7 patients (20.6%): average thrombus length was 14.80±0.98 cm (Fig. 1).

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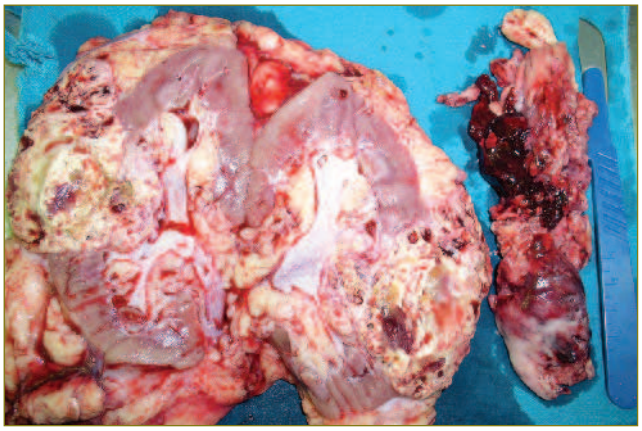

Fig. 1. Right renal carcinoma with inferior vena cava tumour thrombus, the thrombus apex localizing in the right atrium

Clear cell carcinoma was found in 31 patients (91.2%), papillary carcinoma — in one patients, and mixed — in two patients. In 10 cases (29.4%) tumours had moderate (G_2) degree of differentiation, and 24 (70.6%) patients had low-differentiated carcinomas (G_3).

Only 5 patients (14.7%) had no metastases in lymph nodes and distant metastases. Metastases in regional lymph nodes were revealed in 16 patients (47%). Distant metastases (in one or several organs) were diagnosed in 24 patients (70.6%): in the lungs — in 17 patients (56.3%), in bones — in 5 (15.6%), in the liver — in 5 (15.6%), in the adrenal gland – in 2 (6.3%), and in brain — in 1 (3.1%).

Localization diagnosis of the thrombus localization and length is of prime importance when planning the course and volume of the operation, and the choice of adequate surgical approach. Magnetic resonance tomography (MRT) (Fig. 2), ultrasound with colour Doppler mapping (Fig. 3) and multispiral computed tomography enable to determine to high precision the thrombus presence in IVC, its length, size, the blood flow condition in IVC and collaterals [10–12].

In all the cases nephrectomy with thrombectomy were performed from laparoscopic approaches: “mercedes” and “chevron” types of approaches. These approaches enable to perform successfully thrombectomy from IVC in thrombi originating from both the right and the left kidney. In supradiaphragmatic thrombi, diaphragmotomy and pericardectomy were performed according to M.I. Davydov [2] (Fig. 4). Regardless the damage side, the operation was always started with Kocher duodenum mobilization, and the release of IVC and renal veins (Fig. 5). In case

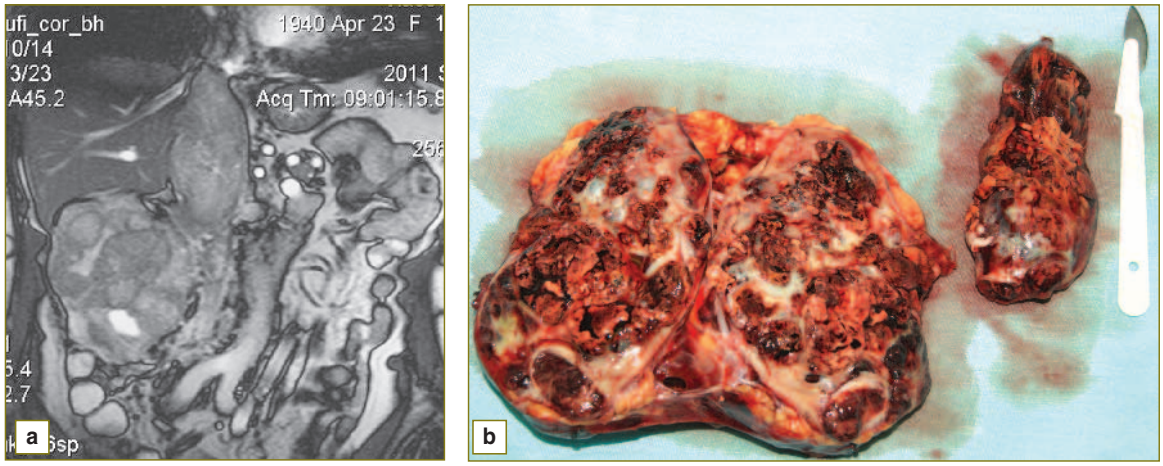

Fig. 2. Right renal tumour with a large supradiaphragmatic inferior vena cava thrombus: *a* — magnetic resonance image; *b* — Macroslide of removed kidney and thrombus, complete MR-image compliance

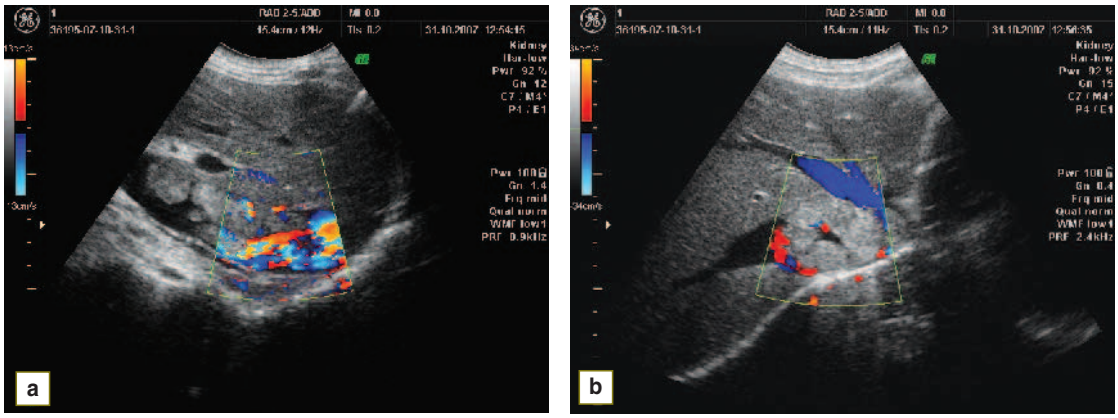

Fig. 3. Inferior vena cava sonography in longitudinal section: *a* — a large thrombus with partial blood flow in vein; *b* — a thrombus partially blocks hepatic veins

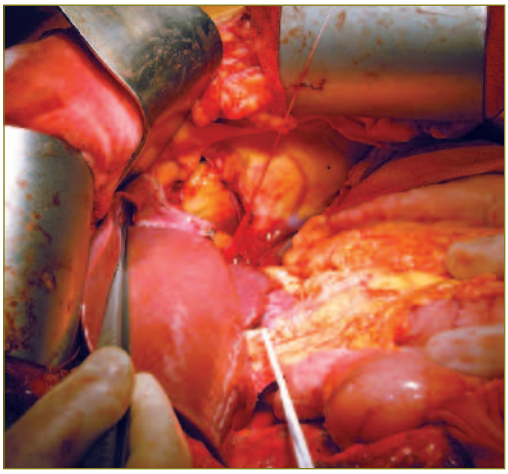

Fig. 4. The liver is mobilized, tourniquet is applied on hepatoduodenal ligament, sagittal diaphragmo-pericardectomy is performed

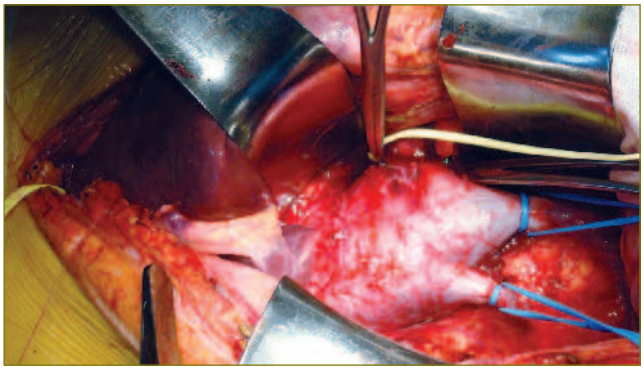

Fig. 5. Inferior vena cava, right and left renal veins are released

there were two enlarged lymph nodes, preliminary regional lymphadenectomy was made to improve the procedures on great vessels and for early renal vein secure. After nephrectomy, there was performed extended lymphadenectomy. In three cases nephrectomy with thrombectomy was combined with atypical hepatectomy. For refusion of blood there was used Cell-Saver device (Haeheonetics, Switzerland).

Postoperative complications were divided into groups according to the classification of surgical complications according to Clavien–Dindo [13] (See Table).

Statistic analysis was performed using license program package for STADIA 4.5 and Statistica/W. The results were processed by analysis of variance using Student criterion, as well as software support StatEx-2004.2 and electronic worksheets Excel.

Results. Punctual and delicate performance of all the stages enabled to avoid intraoperative complications and uncontrolled bleedings. Intraoperative blood loss was on average 866 ml (minimal — 250 ml, maximal — 4000 ml). Correlation analysis determined low blood loss coefficient (r=0.3) of IVC thrombus length. The main blood loss volume was at the stage of tumourous kidney removal from highly dilated collateral vein of retroperitoneal space.

18 patients (52.9%) had no complications. Two patients (5.9%) had I degree complication (anemia corrected by iron preparations), 11 patients (32.3%) — II degree (they underwent hemotransfusion after the operation). One patient aged 35 years (2.9%) had IIIa degree complications, and he was performed nephrectomy with thrombectomy and hepatectomy (tumour — over 10 cm, thrombus length — 15 cm, and the thrombus apex localizing in the right atrium — Fig. 6). Before the operation the patient had had ascites and hydrothorax, after the operation there were required pleural punctures and pericardium drainage because of hemopericardium under local anesthesia. IIIb degree complications (ischemic necrosis and descending colon perforation) were found in one patient after left nephrectomy with mesocolon resection and supradiaphragmatic inferior vena cava thrombus resection (Fig. 7). This patient underwent relaparotomy and colostomy. Later on colostoma was closed, and the patient has lived 3.5 years after the operation.

There were no IV degree complications. In early postoperative period one patient (2.9%) died (V degree), the cause of death was pulmonary embolism.

Correlation analysis stated high (r=0.7) dependence of postoperative complications on thrombus size and blood loss volume (r=0.6), and low dependence – on tumour size (r=0.44). At the same time there was revealed no

Classification of surgical complications according to Clavien–Dindo

Complication degree	Characteristics
I	Any anomalies in postoperative course that do not require medical or surgical treatment, endoscopic, or radiological intervention. Therapeutic treatment is indicated: antipyretics, pain relievers, diuretics, electrolytes, physiotherapy. Treatment of wound infection
II	Hemotransfusion, enteral or parenteral feeding is required
III IIIa IIIb	Surgical, endoscopic or radiological intervention Surgery without general anesthesia Syrgery under general anesthesia
IV IVa IVb	Life threatening complications (including CNS complications)* requiring intensive therapy, supervision of a patient in ICU, organ resection One organ failure Multiple organ failure
V	Patient's death

*Apoplectic shock, stroke, subarachnoid bleeding, except for transient ischemic attack.

Fig. 6. Macroslide of removed kidney with a large supradiaphragmatic IVC thrombus and the renal part with tumour

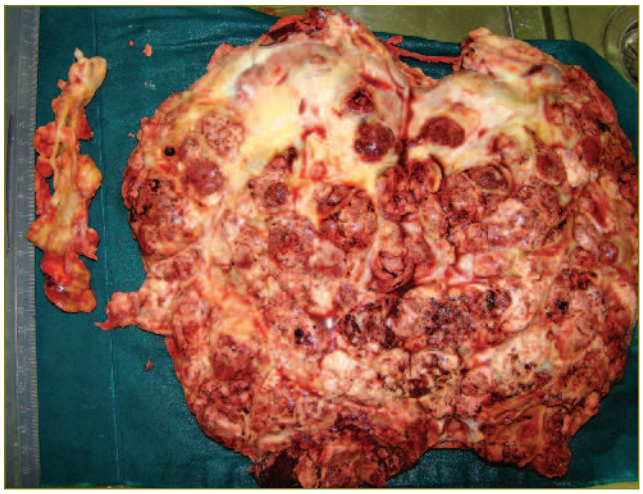

Fig. 7. Macroslide. Left renal carcinoma with IVC tumour thrombus, the thrombus apex localizing in the right atrium

dependence of complications development on patients age (r=0.1), and on status according to Karnofsky scale (r=0.0).

All 33 patients discharged from hospital had lived over 6 months after the operation. Median overall survival was 22.1±2.8 months (median — 17 months). Probability of 5-year survival according to Kaplan-Meyer was 36%, three-years' survival — 38%.

Discussion. Management of patients with RCC complicated by IVC thrombosis still remains the challenge. The introduction of new noninvasive topical diagnosis techniques of tumour thrombus [10-12], the improvement of surgical and anesthetic equipment have increased the treatment possibilities of patients with tumour thrombus of various length brining good short-term results of surgical management [6, 14, 15], postoperative lethality being 0–13%, complication rate — 6,7-60% [3–8, 15–17]. According to our data, lethality is 2.9%, III–IV degree complications according to Clavien — 5.8%.

The Mayo clinic experience with surgical management of IVC tumour thrombi [5] showed the dependence of the number of postoperative complications on thrombus length in IVC: in 0 level thrombus (renal vein), complications occur in 8.6% of cases, in I level (the opening of renal vein) — in 15.2%, in II level (subhepatic part of IVC) — in 14.1%, in III level (retrohepatic part of IVC) — in 17.9%, in IV level (intra-atrial) — in 30.0% of cases, $p < 0.001$). Moreover, high correlation dependence of complication rate on thrombus size was revealed.

A considerable number of RCC patients with IVC tumour thrombus has metastases in regional lymph nodes — 26% and distant metastases — 54% [18–21], in our situation: 47% (regional lymph nodes) and 70.6% (distant metastases), and low 5-year survival index — 36%. Our data confirmed the presence and level of metastases to have a negative effect on long-term results of nephrectomy with thrombectomy from IVC.

Conclusion. After nephrectomy with thrombectomy from IVC there is high risk of perioperative complications, their type and rate depending in a greater degree on the thrombus size and blood loss volume.

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