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КЛИНИЧЕСКАЯ МЕДИЦИНА

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ULTRASOUND-GUIDED RADIOFREQUENCY ABLATION OF LIVER TUMORS — ANALYSIS OF IMMEDIATE OUTCOMES AT GOMEL REGIONAL CLINICAL ONCOLOGY CENTER

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Objective: to systematize the existing techniques of ultrasound-guided percutaneous radiofrequency ablation.

Materials. The research subjects were 34 patients with focal liver malignancies who had undergone radiofrequency ablation at Gomel Regional Clinical Oncology Center from 2014 to 2019.

Results. The data about the existing techniques of ultrasound-guided percutaneous radiofrequency ablation have been systematized. The possibilities to increase the ablation efficiency of the liver tumor foci have been determined. The main components of the treatment algorithm that allow to achieve the best ablation results have been identified.

Conclusion. Strict adherence to the described techniques of radiofrequency ablation which takes into account tumor vascularisation makes it possible to achieve complete necrosis of the foci with no complications in 82.4 % of the patients, and minor complications that do not require therapy in 17.7 % of the patients [9].

Key words: focal liver tumors, local exposure, ultrasound, roentgen, interventional radiology.

Цель: систематизировать существующие методики проведения чрескожной радиочастотной абляции под сонографическим контролем.

Материалы. Объектом исследования являются 34 пациента с очаговыми злокачественными изменениями печени, которые подверглись радиочастотной абляции в Гомельском областном клиническом онкологическом диспансере с 2014 по 2019 гг. включительно.

Результаты. Систематизированы данные существующих методик проведения чрескожной радиочастотной абляции под сонографическим контролем. Определены возможности повышения эффективности проведения абляции очагов печени. Сформированы основные положения алгоритма, позволяющие добиться наилучших результатов абляции.

Заключение. Строгое соблюдение описанных методик радиочастотной абляции с учетом васкуляризации опухоли позволяет добиться полного некроза очага при отсутствии каких-либо осложнений у 82,3 ± 7,1 % пациентов, незначительных осложнений, не требующих терапии — у 17,6 ± 7,1%.

Ключевые слова: очаговые образования печени, локальное воздействие, ультразвук, рентген, интервенционная радиология.

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Ultrasound-Guided Radiofrequency Ablation of Liver Tumors — Analysis of Immediate Outcomes at Gomel Regional Clinical Oncology Center

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Introduction

Primary malignant tumors of the liver and metastatic liver disease have extremely unfavourable prognosis. After radical surgery for colorectal cancer, approximately 55 % of patients subsequently experience liver metastases [1, 2]. Without treatment, the life expectancy of patients with colorectal cancer is 2–6 months [2].

Metastatic liver disease in colorectal cancer occurs 20 times more often than primary liver tumors. Among patients with primary colorectal cancer, 20 % already have metastases (synchronous form), and 50 % develop them later (metachronous form) [3]. Cross-sectional data, more than 50 % of patients died from liver metastases from cancer of various localization. [4].

The concept that considers isolated liver metastases as a separate independent disease is gaining more and more popularity. This has led to an increase in the surgical treatment of liver tumors. It is important to determine which group of patients should undergo extensive operations for liver metastases, and who should use minimally invasive methods that achieve the best results without exposing patients to extensive interventions.

The main invasive treatment for this pathology is surgery (liver resection). However, a low resectability rate (15–20 %), coupled with a high percentage of recurrence (60 % or more) require search for new, more effective and less traumatic therapeutic solutions in the treatment strategy for metastatic liver disease [5].

The introduction of minimally invasive technologies, which were initially used exclusively for the purpose of tumor debulking in inoperable patients has been going on since 1991 [6]. Gradually, based on the accumulated practical data, there appeared more basis for the use of minimally invasive methods as an alternative to surgical treatment in operable patients with a high degree of operational risk. At present, there is no unified position regarding the indications and contraindications for minimally invasive interventions in cancer patients, there are no reliable objective criteria for assessing the completeness of destruction of nodular formations. From an anesthetic standpoint, the clinician's goal, as always, must be to alleviate or moderate procedural discomfort while also facilitating the performance of the procedure. In general, the two primary stimuli are the initial skin puncture as well as the deeper pain associated with thermal tissue necrosis. In some cases, especially with lesions of the liver and lung, patient cooperation may actually help facilitate accurate lesion and needle localization making monitored anesthesia care (MAC) by itself or in combination with regional anesthesia the technique of choice [17]. According to several authors, the three-year relapse-free survival of patients with colorectal cancer metastases is from 20 to 34 % [19, 20].

It is worth noting such an important fact that morphological changes in tissues after minimally invasive interventions, their semiotics during instrumental examination remain poorly understood.

Radiofrequency ablation in Gomel Regional Clinical Oncology Center is used since 2014. The experience gained allows us to study the immediate results of the antitumor effect and postoperative complications.

Purpose

To analyze immediate outcomes of ultrasound-guided radiofrequency ablation (RFA) of liver tumors in the Gomel Regional Clinical Oncology Center.

Material and methods

The study subjects were 34 patients with focal malignant changes in the liver who have underwent radiofrequency ablation in the Gomel Regional Clinical Oncology Center since 2014. Patient pool: 3 patients with hepatocellular liver cancer, 24 with metastasis of colorectal cancer, 3 with metastasis of renal cell cancer, 2 with metastasis of lung cancer, 2 with metastasis of breast cancer, who were examined and underwent ultrasound-guided RFA in the Gomel Regional Clinical Oncology Center from 2014 to 2019.

Numerical data are presented as median and standard deviations ($M \pm SD$).

RFA of liver tumors was performed in 34 patients, including 19 (55.8%) men and 15 (44.1%) women. The age of the patients ranged from 42 to 83 years (62.5 years). 24 (70.5 %) patients had a solitary metastatic lesion, 8 patients (23.5 %) — 2 lesions, 2 (5.9 %) — 3 lesions, a total of 46 lesions were exposed. Sizes of knots are from 6 to 52 mm ($Me = 29 \pm 23$ mm).

Study Results and Discussion

Pre-ablative stage. The indications for ablation were as follows [7–8]: previous radical surgical treatment of the primary tumor; the absence of extrahepatic manifestations of the disease; no more than 5 tumor nodes; the diameter of the nodes should be not more than 5 cm each; residual tumor after a previous RFA or other treatment; local recurrence after former RFA; metachronous metastases after previous RFA for liver resection or another treatment method; the possibility of safe access to the tumor (the location of the nodes is not closer than 1 cm from the portal or hepatic veins for lobar bile ducts); patient consent for treatment, tumors visualized by ultrasound, CT, MRI scan [18].

Contraindications

We consider the following contraindications the patient has an artificial cardiac pacemaker; class C liver cirrhosis according to Child-Pugh; uncorrectable coagulopathy for platelet count less than 50,000 / ml, prothrombin time coefficient less than 50 %; subcapsularly located tumors ad-

adjacent to the gallbladder, loop of the intestine, or the stomach wall [9].

The minimal sufficient set of medicines, dressings and tools used during the manipulations consisted of: an antiseptic solution, sterile gloves and medical napkins, a sterile dressing, a scalpel, an ultrasound machine Aloka Prosound Alpha 6, a puncture adapter and a 15–25 cm long disposable Cool-tip™ RF Ablation discharge electrode (Covidien) with a 2.0–3.0 cm active tip and a generator. Patients were treated under general anaesthesia in all cases [10, 11].

Technique to perform the manipulations. At this stage, a standardized sequence of actions was followed. The most used position of the patient was lying on his back or on his left side. Self-adhesive discharge electrodes were placed on the anterolateral thigh. The skin on the thigh was previously shaved and skin oil was removed to provide a better contact. The criteria for access adequacy were the detection of the safest anatomical pathway for the electrode and the best visualization of the object of the ablation.

Electrode lengths were placed perpendicular to the axis of the femur [12]. Next, the location and depth of the liver tumor were determined. Using Doppler methods, the vascular pattern in the zone of interest was evaluated. After treatment area with an antiseptic, the ablation site was outlined by a sterile surgical drape and medical napkins. Then the puncture adapter was fixed and the optimal place for the skin incision was determined, taking into account the expected direction of the electrode movement.

An incision up to 4 mm long was made with a scalpel in the pathway outlined for the electrode passage. Then the tissue at the site of the skin incision was infiltrated up to the liver capsule with a local anaesthetic lidocaine 2 % for better visualization of the distal end of the electrode and lower tissue resistance in the electrode pathway.

Through this incision, an electrode was introduced in the direction of the object of the procedure [12]. The mechanical ventilation is turned off to prevent respiratory movements of the patient during this manipulation. In case there are problems with the visualization of the electrode, for example, when the front segment of the distal end of the electrode leaves the scanning plane, measures were taken to improve the visualization of the latter: rotation of the electrode (for example bevel angle up); determination of tissue mobility by Doppler imaging.

The electrode is inserted so that it reaches the opposite site of the tumor. It should be remembered that the destruction zone should cover, in addition to the tumor itself, 10 mm of tissue adjacent to the tumor. This approach allows one to obtain the most radical destruction of tumor cells [13].

To increase the likelihood of complete tumor necrosis, we propose a method for preliminary co-

agulation of vessels that supply the tumor and exceed 3 mm [14]. In some cases, a malignant tumor of the liver has a fairly pronounced vascularization when the diameter of the blood vessels is more than 3 mm. This is a relative contraindication to RFA due to the increased risk of the residual component of the tumor. This can be explained by the fact to powerful blood flow in the large blood vessels adjacent to the tumor, there can be heat removal effect from the ablation site, which reduces the effectiveness of the treatment [15].

The essence of the method: before radiofrequency ablation, tumors with 3–5 mm diameter supply blood vessels were pre-sealed with a Cool-Tip (Covidien) electrode in coagulation mode until the blood flow was stopped in the colour Doppler imaging mode to prevent the heat removal effect. Subsequently, “standard” tumor ablation was performed. After selecting the desired position of the electrode, the countdown timer was activated and the supply of the radio frequency energy by the RFA.

The exposure time per tumor was from 12 to 15 minutes ($Me = 13.5 \pm 1.5$ min.). After the set time elapsed, the electrode was removed in the mode of coagulation of the puncture channel. In the case when the zone of the planned necrosis after a single exposure did not cover the entire tumor plus 10 mm of adjacent tissue, additional application was immediately performed in accordance with the procedure described above. Complications were assessed by sonography directly during the manipulation, when the patient was under general anesthesia in the operating room, and then in the morning after surgery.

The follow-up history of patients underwent ablation of the liver tumor was observed for a period of 3 months. Complications of interventions when following the described approaches were distributed as follows: no complications — 27 (79.4 %); minor complications that do not require therapy — 7 (20.6 %). General complications were observed [16].

The detected adverse reactions manifested early (within 24 hours after the manipulation). Minor complications were mainly of a combined nature, among which vagal reactions and pain symptoms lasting up to six hours prevailed. Not a case of infection of the electrode pathways was noted. There have been no cases of prolonged bleeding in the abdominal cavity.

In the study group, compulsory CT monitoring was performed on the third month of discharge from the hospital and every subsequent 6 months in the absence of progress. According to the results of the CT scan complete destruction of the tumor was observed in 28 patients (82.4 %); residual tumor in 5 patients (14.7 %); in one case, due to the large size of the tumor (8.4 cm), ablation was performed to reduce the tumor damage to the liver, with a predicted residual component (2.9 %).

Conclusion

Thus, strict adherence to the technique of radiofrequency ablation that takes into account vascularization of the tumor allowed for its complete necrosis in the absence of any complications in 82.4 % of the patients, minor complications that did not require therapy were observed in 17.7 % of the patients.

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