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3D TECHNOLOGY IN SURGERY OF LUNG HYDATID CYST

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ИСПОЛЬЗОВАНИЕ 3D-РЕКОНСТРУКЦИИ В ХИРУРГИЧЕСКОМ ЛЕЧЕНИИ ЭХИНОКОККОВОЙ КИСТЫ ЛЕГКОГО

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We present the results of using 3D technology to improve visualization and planning of the lung hydatid cyst (LHC) surgery in a 12-year-old girl. The general physical examination was unremarkable. The 3D reconstruction of the lungs was performed based on CT DICOM files. The most reliable data were obtained with CT with an Air and Fat filter. Based on the performed 3D reconstruction, a multiport thoracoscopic pulmonary echinococectomy was performed. Thoracoscopy revealed an LHC in the left lung's posterior basal segment. Using a linear cutter stapler with two staple leg lengths of 45 mm/60 mm, cyst excision was performed. At the same time, it was possible to reduce the intervention volume and eliminate the bronchial fistula leading to the LHC. Therefore, applying AI technology to the left lung with a parasite cyst allowed for more precise visualization and successful LHC surgery.

Keywords: hydatid cyst, lung, 3D, AI, video-assisted thoracoscopic surgery, echinococcosis, thoracic surgery

Представлены результаты использования 3D-реконструкции для улучшения результатов лечения эхинококковой кисты легкого (ЭКЛ) у девочки 12 лет. 3D-реконструкция легких была выполнена на основе файлов КТ DICOM. Наиболее достоверные данные были получены при КТ с воздушным и жировым фильтром. По результату реконструкции выполнена многопортовая торакоскопическая эхинококкэктомия слева. При торакоскопии выявлена ЭКЛ, расположенная в заднем базальном сегменте левого легкого. С помощью двух кассет линейного степлера (60 мм и 45 мм) выполнена резекция легкого с паразитарной кистой. При этом удалось не только уменьшить объем вмешательства, но и ликвидировать бронхиальный свищ, обнаруженный при 3D-реконструкции. Таким образом, использование технологий искусственного интеллекта позволило улучшить не только визуализацию, но и провести успешную операцию у пациентки с ЭКЛ.

Ключевые слова: эхинококкоз, легкие, 3D, искусственный интеллект, видеоассистированная торакоскопия, торакальная хирургия

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CT – computed tomography
DICOM – digital imaging and communications in medicine

LHC – lung hydatid cyst
MRI – magnetic resonance imaging

The lung hydatid cyst (LHC) is one of the manifestations of echinococcosis, a disease caused by the tape parasite *Echinococcus granulosus*. Surgical treatment remains the primary method of eliminating hydatid cysts. However, the complexity and risks associated with this operation require new approaches to visualization and surgical planning [1–3].

In recent decades, 3D reconstruction has become an indispensable tool in medical practice, allowing surgeons to obtain a more detailed and accurate view of a patient's internal structures. 3D reconstruction is especially relevant when planning complex surgical interventions, including removing hydatid cysts and developing pathological fistulas (bronchial in the lungs and biliary in the liver) [4, 5]. 3D reconstruction involves creating three-dimensional models of organs and internal structures based on medical images (DICOM) obtained from computed tomography (CT) and magnetic resonance imaging (MRI). These 3D models enable surgeons to plan surgeries more accurately, determine the best access to the affected area, and predict potential complications when removing a parasitic cyst [2, 4]. This approach reduces surgery time and risks for the patient and increases the success rate of surgeries.

In this article, we present our experience using 3D reconstruction in planning and performing surgery to remove the LHC in a child.

Case description. An 12-year-old girl, with a primary diagnosis: Echinococcal cyst in the left lung. The patient also had a concurrent diagnosis of a congenital cleft of the upper lip on the left side—a condition after cheiloplasty.

The patient visited the pediatric surgery outpatient department a year ago for a routine evaluation. Laboratory tests and imaging examinations were performed. A cyst in the left lung was detected during fluorography. The general physical examination was unremarkable. Subsequently, the child underwent further examinations and complementary studies on an outpatient basis, which showed no abnormalities. The discovered cyst was initially considered a congenital non-parasitic cyst. However, one month before admission, ultrasound and CT scans indicated a twofold increase in the cyst. The patient was then admitted with a planned surgical treatment. Upon admission, the patient presented no complaints.

Personal medical history: Tuberculosis, sexually transmitted diseases, HIV infection, hepatitis, injuries, or blood transfusions were denied. There was no allergic history.

Clinical examination: The patient was in good general condition with no current symptoms or recent pathologies. Height – 151 cm, weight – 52 kg. BMI – 22.81. The skin showed no abnormalities. Peripheral lymph nodes were not enlarged. Pulse 82 per minute. Heart sounds were sonorous and rhythmic. There was no pulse deficit. Percussion of the heart borders was typical. Blood pressure 120/75 mm Hg. In the lungs, breathing was carried

out in all parts, vesicular; there were no wheezes. Percussion – dullness and tympanitis over the lungs were not detected. The respiratory rate is 16 per minute. The tongue was wet and clean. The abdomen was not swollen, participated in breathing, and was painless on palpation. The gallbladder was not palpable. The liver was at the edge of the costal arch; by palpation, its surface was smooth. There were no peritoneal symptoms. The intestinal peristaltic was active. The spleen and kidneys were not palpable. Pasternatsky's symptom was negative on both sides. The stool was regular, well-formed, and without any pathological impurities. Diuresis 4–5 times a day, no symptoms of dysuria.

Laboratory and instrumental studies: General blood test: WBC – $8.76 \times 10^9/l$; RBC – $5.1 \times 10^{12}/l$; HGB – 127 g/l; HCT – 38.4 %; MCV – 75.4 fL; MCH – 24.9 pg; MCHC – 330 g/l; PLT – $201 \times 10^9/l$; RDW-SD – 40.8 fL; RDW-CV – 16.5 %; PDW – 10.4 fL; MPV – 9.0 fL; P-LCR – 23.6 %; PCT – 0.18 %; NEUT – $4.357 \times 10^9/l$; LYMPH – $3.714 \times 10^9/l$; MONO – $0.634 \times 10^9/l$; EO – $0.054 \times 10^9/l$; BASO – $0.001 \times 10^9/l$; ESR – 5 mm/hour.

Biochemical blood test: urea – 3.5 $\mu\text{mol/l}$; creatinine – 49 $\mu\text{mol/l}$; bound bilirubin – 3 $\mu\text{mol/l}$; AST – 19.7 u/l; ALT – 11.2 u/l; total protein – 67 g/l; albumin – 43.2 g/l; total amylase – 57 u/l; pancreatic amylase – 14.6 u/l; cholesterol – 3.54 mmol/l; serum iron – 16.02 $\mu\text{mol/l}$; blood serum glucose – 4.23 mmol/l; LDH – 292 u/l; SRP – 3.14 mg/l.

The enzyme immunoassay, which determined IgG antibodies to Echinococcus in the blood serum, was negative. The AFP, NSE, and CA were negative.

General urine analysis – without pathology.

A preoperative CT scan of the chest with intravenous bolus contrast was performed. The study was conducted in high-resolution mode with a slice thickness of 64x0.5 mm, analysis with the construction of MIP, MPR reconstructions in conditions of dynamic blur – without breath holding. A series of computed tomograms subpleural in S8 of the left lung revealed an oval-shaped cystic formation of a homogeneous structure measuring 41x30 mm with a visualized connective tissue capsule, slight compression of the adjacent pulmonary parenchyma, and no accumulation of contrast agent. In S6 of the left lung, a single calcification with a diameter of up to 2 mm was detected. In other sections, no focal or infiltrative changes were detected in the lungs. The patency of the 1st–4th order bronchi was not changed. CT signs of enlarged intrathoracic and axillary lymph nodes are not detected. The mediastinum was not displaced; its structures were well differentiated. The heart was usually located; the cavities were not expanded. The aorta and large vessels were unchanged. No fluid in the pericardial cavity was detected. No effusion was detected in the pleural cavities. In the bone window mode, no destructive changes were detected. IV contrast did not reveal any areas of pathological accumulation of contrast agents. CT scan conclusion: The cystic forma-

tion in the lower lobe of the left lung is likely of parasitic origin. A single calcification was observed in S6 on the left.

Subsequent *3D reconstruction of the lungs to detect the parasitic cyst* using the HoloDoctor AR. VR software package (Stavropol, Russian Federation), design for image processing in DICOM format with CT images as the data source. The performed 3D modeling of the elements of the root of the left lung did not reveal vascular anomalies of the venous and arterial beds (Fig. 1). No additional arteries approaching the cyst and compressed by it were identified. Using the 3D/4D viewing functionality in multiplanar reconstruction

mode (volume rendering), the subsegmental bronchus S8 was found adjacent to the parasitic cyst (Fig. 2). Considering its intimate connection with the hydatid cyst and its relatively large diameter, there was a high risk of developing a bronchopulmonary fistula. Based on these findings, it was decided to perform an «ideal» echinococectomy with resection of the basal segments of the left lung, which simultaneously ensures the elimination of the pathological fistula. Considering the 3D reconstruction of the lungs with a parasitic cyst, the most appropriate trocar insertion points for surgery in this case were determined.

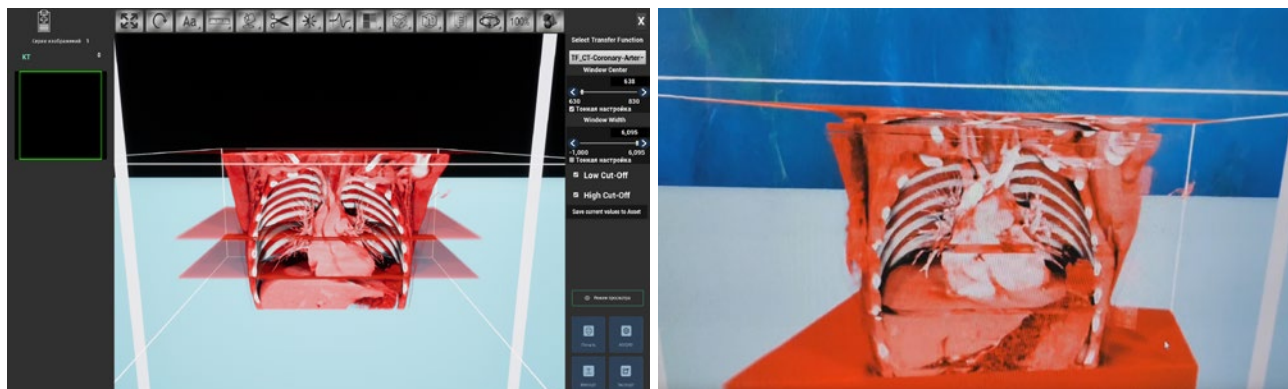


Fig. 1. Mode of multiplanar reconstruction of 3D/4D segmental anatomy of the right and left lung vessels in a patient

Based on these diagnostic findings, the patient underwent a multiport thoracoscopic pulmonary echinococectomy with resection of the posterior basal segments of the left lung.

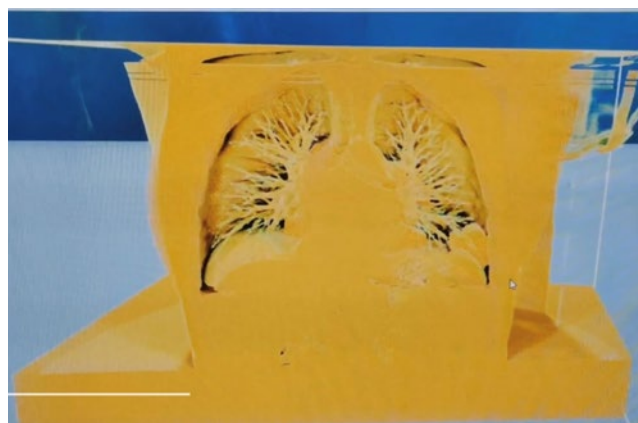


Fig. 2. 3D reconstruction of the bronchial tree of the lungs with a parasitic cyst in the left lung in multiplanar reconstruction mode (Lung filter)

The girl was placed on the operating table on her right side with a tilt of 20–30 degrees to the side of her abdomen with her left arm extended anteriorly, under endotracheal anesthesia with single-pulmonary intubation. Then, a thoracic puncture was performed on the left at the level of the angle of the scapula along the posterior axillary line. CO₂ insufflation was performed in the left hemithorax with a pressure of 2 mm Hg. Considering single-pulmonary intubation, this pressure was enough, and the left lung collapsed.

Under video control, working trocars were placed: the anterior axillary line of the 8th intercostal space – 12 mm and the posterior axillary line of the 5th intercostal space – 5 mm. The left lung and pleural cavity were examined. An LHC located in the posterior basal segment was discovered. Using a linear cutter stapler with two staple leg lengths – 45 mm and 60 mm. An atypical resection of a section of lung tissue with a hydatid cyst was performed. Using an endoscopic bag, the parasitic cyst with resected lung tissue was removed through an extended incision at the site of the 12 mm port (8th intercostal space). Under video control, a drainage was placed in the pleural cavity and connected to a passive aspiration system. It was confirmed that there was no bleeding or air leakage. Gas was deinsufflated. The wounds were sutured with aseptic dressings applied.

In the postoperative period, the drainage was removed on the 2nd postoperative day. The child was discharged on the 5th day to continue recovery under outpatient supervision by the pediatrician and pediatric surgeon at the local place of residence.

A histological examination confirmed the presence of living *Echinococcus granulosus*. During a follow-up examination six months after surgery, the patient had no complaints, and a CT scan of the lungs showed no pathology.

Conclusion. The use of 3D reconstruction in planning and performing surgical treatment of LHC significantly improves the accuracy of the operation and reduces the risk for the patient. 3D technologies in the preoperative period in pediatric thoracic surgery enhance the visualization of the parasitic cyst with adjacent bronchial structures, increasing the safety of video-assisted thoracoscopic echinococectomy.

Disclosures: The authors declare no conflict of interest.

References

1. He T., Sun X., Zhang Z., Xu B., Liu W. Cystotomy with non-capitonnage in treating children with pulmonary hydatid disease. *Ann. Thorac. Cardiovasc. Surg.* 2022;28(1):41-47. <https://doi.org/10.5761/atcs.0a.20-00390>
2. Minaev S. V., Gerasimenko I. N., Kirgizov I. V., Sham-siev A. M., Bykov N. I. [et al.] Laparoscopic treatment in children with hydatid cyst of the liver. *World J. Surg.* 2017;41(12):3218-3223. <https://doi.org/10.1007/s00268-017-4129-x>
3. Aidemirov A. N., Minaev S. V., Rubanova M. F., Grigoro-va A. N., Gerasimenko I. N. [et al.] The treatment of the pulmonary hydatid cyst in the Stavropol Region. *Medical News of North Caucasus.* 2023;18(2):152-155. <https://doi.org/10.14300/mnnc.2023.18033>
4. Minaev S. V., Gerasimenko I. N., Shchetin E. V., Scheti-nin V., Mishvelov A. E. [et al.] 3D reconstruction in surgery of hydatid cyst of the liver. *Medical News of North Cauca-sus.* 2019;14(1.2):220-223. <https://doi.org/10.14300/mnnc.2019.14019>
5. Negi T., Nagano H., Tochii D., Tochii S., Suda T. Uni-portal video-assisted thoracoscopic surgery for pediatric cases. *Gen. Thorac. Cardiovasc. Surg.* 2024;72(2):144-147. <https://doi.org/10.1007/s11748-023-01965-0>

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CLINICAL CASE OF PRIMARY MULTIPLE METACHRONOUS BRCA-ASSOCIATED CANCER

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КЛИНИЧЕСКИЙ СЛУЧАЙ ПЕРВИЧНО-МНОЖЕСТВЕННОГО МЕТАХРОННОГО BRCA-АССОЦИИРОВАННОГО РАКА

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The article offers a clinical case presentation involving the treatment of a patient featuring symptoms of primary multiple metachronous cancer affecting the patient's breast, and ovaries, associated with the BRCA1c5382insC mutation. From 2007 to 2023, the patient underwent comprehensive treatment, which included surgical, antitumor, and radiotherapy of various modes and targeted therapy with PARP inhibitors. The obtained data reveal the importance of identifying the genetic reason behind tumor growth when dealing with oncological cases.

Keywords: primary multiple cancer, breast cancer, ovarian cancer, BRCA1, molecular genetic tests, PARP-inhibitors