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Congress Abstract

Artificial Intelligence in Lung Cancer Screening: A Review of Published Evidence and its Implications for Screening Programmes in Kazakhstan and Central Asia

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Background: Lung cancer leads cancer mortality in Kazakhstan: the International Agency for Research on Cancer estimates 2,798 new cases and 2,617 deaths for 2024. Randomised trials show that low-dose computed tomography screening lowers lung cancer mortality, but population screening brings heavy reading workloads and many false positives. This review examines the published evidence on artificial intelligence in this setting.

Objective: To review published evidence on artificial intelligence in low-dose computed tomography lung cancer screening, with implications for programmes in Kazakhstan and Central Asia.

Materials and Methods: Narrative review of peer-reviewed publications, 2011 to August 2026, in PubMed and publisher databases. Screening trials required a mortality endpoint; artificial intelligence studies required histological outcomes, an expert panel reference standard or randomisation. Included: the National Lung Screening Trial (2011), the Dutch-Belgian screening trial (2020), Sybil (2023), the United Kingdom Lung Cancer Screening trial validation (2025), the 4-IN-THE-LUNG-RUN feasibility study (2025) and a prospective single-centre randomised trial (2026).

Results: The National Lung Screening Trial reduced lung cancer mortality by 20.0 percent (95 percent confidence interval 6.8 to 26.7) versus chest radiography; 96.4 percent of positive screens were false positives. The Dutch-Belgian trial reported a ten-year lung cancer mortality rate ratio of 0.76 (95 percent confidence interval 0.61 to 0.94) among male participants versus no screening. Neither trial used artificial intelligence. Sybil predicted one-year cancer risk from one scan with areas under the receiver operating characteristic curve of 0.92, 0.86 and 0.94 in three retrospective cohorts. In 1,252 United Kingdom baseline scans, an artificial intelligence first reader detected all 31 histologically confirmed cancers, one below its volume threshold (negative predictive value 99.8 percent), with an estimated maximum workload reduction of 79 percent. In 3,678 European baseline scans, artificial intelligence negative misclassifications were 0.8 percent against 11.1 percent for radiologists; its positive misclassifications were 5.7 percent against 0.5 percent for radiologists. In a randomised trial in asymptomatic individuals, artificial intelligence assistance raised detection of Lung Imaging Reporting and Data System positive nodules from 10.3 to 16.9 percent with no significant change in interpretation time.

Conclusions: The mortality benefit belongs to low-dose computed tomography screening itself; no included artificial intelligence study measured mortality. Evidence is strongest for artificial intelligence as a first reader ruling out negative baseline scans while radiologists read the rest; detection assistance raises nodule yield and positive misclassifications; single-scan risk prediction remains retrospective. For Kazakhstan and Central Asia these applications address the reading capacity and false-positive burden that limit programme feasibility, provided tools are validated locally against histological outcomes.

Keywords: Lung Neoplasms; Early Detection of Cancer; Tomography, X-Ray Computed; Artificial Intelligence; Radiographic Image Interpretation, Computer-Assisted; Kazakhstan

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Congress Abstract

Association Between Atmospheric Chromium Concentration and Cancer Incidence in Almaty, Kazakhstan

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Background: The pollution of atmospheric air with heavy metals, including chromium, in major industrial centers has in recent years become one of the significant environmental problems threatening public health. For example, the highest value of the carcinogenic risk (ICR), calculated based on the concentration of chromium in the atmospheric air of Almaty from 2021 to 2025, was 0.044. According to the risk category, this level (10-2) is assessed as "high." Although chromium is recognized as a carcinogen for the human body, there is a lack of local, data-driven studies to assess its specific impact on cancer incidence among the city's residents. Analysis by specific types of cancer is particularly rare.

Objective: To assess the association between the average annual values of the average daily concentration of chromium in the atmospheric air of Almaty city and the incidence of cancer among the city's residents by organ. As well as determining the number of additional cases of disease associated with chromium.

Materials and Methods: The study was conducted as a retrospective analysis of ecological characteristics. Annual average values of the mean daily concentration of chromium in atmospheric air were used as a data source, taken from the informational bulletin of the Almaty City Branch of the "Kazhydromet" RSE. Official statistics on the incidence of malignant neoplasms of seven organ systems (the respiratory system, stomach, colon, rectum, pancreas, liver, and kidneys) for the Republic of Kazakhstan and the city of Almaty (per 100,000), along with the population data of Almaty for the period 2021–2023, were used in the study. To assess regional excess risk, the relative risk was calculated for each organ and each year as the ratio of morbidity in Almaty to the average level across the Republic of Kazakhstan. When the relative risk exceeded 1, the population-attributable fraction, the absolute excess risk, and the resulting annual excess number of cases were determined. The individual carcinogenic risk from inhalation exposure to chromium was calculated using the inhalation slope factor (42 μg/kg/day) recommended by the United States Environmental Protection Agency.

Results: During the three-year monitoring period, the individual carcinogenic risk from chromium in the atmosphere of Almaty was found to remain consistently high. Among the 7 organs, a consistent and clearly elevated relative risk was recorded for only 2 localizations: The relative risk for colorectal cancer ranged from 1.29 to 1.38 over all 3 years, while for kidney cancer it ranged from 1.15 to 1.24. These two localizations accounted for an average of 110 additional cases per year in the city, and approximately 330 additional cases over three years, the majority of which were colorectal cancers (approximately 66 cases per year) and kidney cancer (approximately 29 cases per year). On the contrary, morbidity from the respiratory system (17.1) and the stomach (12.3) was lower than the national average (respectively

20.1; 14.9) lower. The excess risk for the pancreas, rectum, and liver was unstable and modest.

Discussion: The obtained data are also consistent with the results of international studies. However, the identified association is not causal in nature and should be regarded as an ecological-level study. A meta-analysis of previous cohort studies has shown that workers exposed to chromium, especially men, have a significantly higher risk of dying from kidney cancer. And international data on colon cancer are more contradictory. For example, recent systematic reviews have found a weak association between chromium exposure and colon cancer, but an association that cannot be dismissed has been noted, while experimental models have demonstrated that orally ingested hexavalent chromium's oxidized oxygen compounds promote the development of colon cancer through accumulation and changes in the composition of the gut microbiota. These findings suggest that the predominance of colorectal and kidney cancers over respiratory cancers may indicate that chromium exposure occurs primarily through non-inhalation pathways, particularly via ingestion of contaminated drinking water, soil, or food, rather than through inhalation. However, this hypothesis needs to be confirmed with controlled studies that take individual exposure levels into account. Moreover, foreign data indicate that the latent period for the development of respiratory tract tumors exceeds twenty years. This may partly explain why no excess risk for this localization was detected during the three-year follow-up period in our study.

Conclusions: The results obtained, consistent with the study's objective, showed a statistical association between elevated levels of chromium in the atmospheric air and the incidence of certain cancer localizations among the city's residents. Based on these findings, the authors emphasize the need to strengthen the integrated environmental and hygienic monitoring of ambient air, drinking water, and soil in Almaty, in additional to implement screening programs for the early detection of colorectal and kidney cancers among populations residing in highly polluted areas.

Keywords: Chromium; Air Pollution; Neoplasms; Colonic Neoplasms; Kidney Neoplasms; Environmental Exposure

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Congress Abstract

Fetal Magnetic Resonance Imaging in Neuro-Oncology

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Introduction: Fetal brain tumors account for 2% of pediatric tumors and 10% of all congenital tumors. At the same time, prenatal diagnosis of neuro-oncological pathology by ultrasound reaches 68% accuracy, with a relatively high number of false-positive results — about 9.2%. Fetal MRI increases the diagnostic accuracy of fetal tumors to 93%, which makes it possible to timely determine the management strategy regarding pregnancy and early postnatal treatment; to increase the chances of a favorable outcome; and to reduce the rates of intrauterine and early neonatal mortality and childhood disability.

Objective: To consider the current capabilities of fetal MRI in neuro-oncology using a broad spectrum of congenital CNS tumors as an example.

Materials and Methods: The paper presents a systematic review of the capabilities of MRI in the differential diagnosis of the most common malignant and benign brain tumors, as well as tumor-like malformations. The issues of the methodology of fetal brain MRI, specific features of MRI semiotics, localization, morphology, postnatal verification, management strategies, and prognosis for various tumor lesions were considered.

Results: Despite the rare occurrence of fetal tumors, the spectrum of diagnostic features for the differential diagnosis of malignant and benign lesions from brain malformations has been well studied. Unlike pediatric neuro-oncology, congenital tumors have a supratentorial localization in 70% of cases. Among malignant tumors, teratomas, gliomas, and choroid plexus tumors are the most common. Among benign tumors, subependymal giant cell astrocytoma, hamartoma, lipoma, and choroid plexus papilloma are the most common. Vascular malformations and thromboses, hematomas, arachnoid cysts, and cerebral manifestations of tuberous sclerosis should be differentiated from tumor lesions. Compliance with the methodology of performing MRI and the use of modern MRI techniques significantly increase the accuracy of prenatal diagnosis of brain tumors.

Conclusions: Fetal MRI provides the necessary information for the differential diagnosis of a broad spectrum of brain tumors and non-neoplastic changes; allows clarification of the morphology and extent of the lesion, determination of the prognosis, and timely prenatal and early postnatal management.

Keywords: Fetal MRI; Congenital Brain Tumors; Fetal Neuro-Oncology

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Congress Abstract

Computational Signal-Processing Framework for Multichannel Fiber-Optic Biosensor Data Analysis in Cancer Cell Detection

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Introduction: Fiber-optic biosensors generate complex, multichannel interferometric data affected by baseline noise and drift, which must be filtered and converted into standardized performance metrics before they can support cancer cell detection claims. Our group's fiber-optic biosensing programme uses two recognition strategies — a surface plasmon resonance anti-CD44 immunosensor and a PDA-based molecularly imprinted polymer sensor — for TNBC cell lines detection, yet both rely on the same challenge: extracting reliable calibration data from noisy, multi-channel wavelength-shift signals. To address this gap, a computational signal-processing framework was developed and validated that applies baseline correction and noise filtering, automatically identifies high-sensitivity spectral channels, fits calibration curves, and computes limit of detection, coefficient of determination, repeatability, and selectivity, and was applied to quantify and compare the two TNBC biosensor platforms.

Materials and Methods: A computational/analytical approach was applied to previously acquired experimental data. Raw transmission spectra from 8-channel quasi-random extrinsic interferometric fiber-optic sensors were used: (1) the SPR-based anti-CD44 immunosensor exposed to HCC1806 TNBC cells and HEK293 control cells, and (2) the PDA-based MIP sensor exposed to HCC1806 and MDA-MB-231 TNBC cells. Raw spectra were first denoised using a 5th-order Butterworth filter combined with baseline subtraction to correct for high-frequency noise and baseline drift prior to peak identification. For each channel, a custom peak/valley-detection algorithm implemented in MATLAB identified interference fringes and tracked wavelength position across cell concentrations. The sub-range with the steepest slope was selected as the optimal operating range per sensor. Calibration curves were fitted by linear regression, with the coefficient of determination (R^2) as fit quality. Limit of detection (LoD) was calculated as 3σ of the blank response divided by calibration slope. Repeatability was assessed as coefficient of variation across replicates; selectivity by comparing target-cell versus non-target/control responses.

Results and Conclusions: The developed computational framework successfully processed multichannel interferometric data from both the SPR-based immunosensor and the MIP-based biosensor, automatically identifying high-sensitivity spectral channels and extracting calibration-based performance metrics — including limit of

detection, coefficient of determination, repeatability, and selectivity — for each. Filtering with the Butterworth and baseline-subtraction steps improved spectral clarity by suppressing high-frequency noise and drift, yielding calibration curves with higher sensitivity and improved linearity. This provided a consistent, standardized basis for comparing the two recognition strategies and demonstrates the framework's potential as a common analytical backbone for future fiber-optic biosensor platforms in oncology, extendable to currently unanalyzed sensor datasets.

Keywords: Biosensing Techniques; Antibodies; Polymers; Cell Line; Triple Negative Breast Neoplasms

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Congress Abstract

Fiber Optic Biosensors for Triple-Negative Breast Cancer Cells Detection

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Introduction: Triple-negative breast cancer (TNBC) is an aggressive subtype lacking effective targeted therapies, highlighting the need for sensitive and selective cancer cell detection. Optical fiber biosensors offer high sensitivity, compact size, and label-free operation for cancer cell detection. This study developed a quasi-random extrinsic interferometer-based fiber-optic biosensor for label-free TNBC cell detection using two complementary recognition strategies: gold–anti-CD44 antibody functionalization and polydopamine (PDA)-based molecularly imprinted polymer (MIP) recognition. The performance of these functionalized sensors was evaluated for selective recognition of TNBC cells, demonstrating their potential as a sensitive and label-free detection platform.

Materials and Methods: A quasi-random extrinsic interferometer-based fiber-optic sensor was fabricated and coated with polydimethylsiloxane (PDMS), a biocompatible polymer widely used in biomedical applications. For antibody-based recognition, a gold-coated surface was functionalized with anti-CD44 antibodies to target HCC1806 breast cancer cells, with HEK293 cells used as a control. For synthetic recognition, dopamine was polymerized on the sensor surface to form a polydopamine (PDA)-based molecularly imprinted polymer (MIP) designed to recognize HCC1806 and MDA-MB-231 cells. Optical responses at different cell concentrations were recorded using a fiber-optic interrogator, and sensor performance and cell attachment were evaluated by calibration analysis and scanning electron microscopy.

Results and Conclusions: The developed fiber-optic biosensors show potential for integration into liquid biopsy platforms for label-free detection of circulating tumor cells in biological fluids, providing a rapid and minimally invasive approach for cancer detection and monitoring.

Keywords: Biosensing Techniques; Antibodies; Polymers; Cell Line; Triple Negative Breast Neoplasms

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Congress Abstract

Molecularly Imprinted Polymer Biofunctionalized Optical Fiber-Tip Quasi-Random Extrinsic Interferometer for Selective Triple-Negative Breast Cancer Cells Detection

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Introduction: The study of triple-negative breast cancer cells detection is one of the important research fields in modern biomedical engineering, due to its aggressive behavior and limited targeting options. One of the promising methods for cancer cell detection is using Molecularly Imprinted Polymers (MIPs) with polydopamine (PDA) as the primary polymer. The main idea of this combination is based on the properties of dopamine, as it shows good compatibility with cells, biomimicry, and biodegradability. By creating specific cell recognition cavities within this PDA-based MIP layer directly on the fiber surface, the platform shows high selectivity level performance.

Methods and Materials: Using bulk imprinting strategy, dopamine was polymerized under alkaline conditions, where pH was in range of 8.0-9.0. For control group, the non-imprinted polymers (NIPs) were prepared by mixing phosphate buffer solution (PBS) with PDA, while MIPs were functionalized with HCC1806 and MDA-MB231 cancer cell lines. During detection process, the response groups were divided into two categories: target and cross groups. Optical responses of these groups were determined by using fiber-optic interrogator at different cell concentrations and the morphology was evaluated via scanning electron microscopy.

Results and Conclusion: The provided optical fiber technology shows great detection, stability, and biocompatibility levels for novel technology and has a great potential for further development towards the label-free detection platforms' integration.

Keywords: Biosensing Techniques; Polymers; Cell Line; Triple Negative Breast Neoplasms

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Congress Abstract

Diagnostic Algorithm for B-Cell Lymphomas Under Conditions of a Limited Antibody Panel

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Introduction: Under conditions of limited availability of immunohistochemical antibodies, the key challenge is the rational use of a minimal panel that allows confirmation of the lymphoid nature of the tumor, determination of B- or T-cell lineage, and selection of the further direction of investigation.

Objective: To evaluate the feasibility of a stepwise diagnostic algorithm for B-cell lymphomas using a limited antibody panel.

Materials and Methods; A retrospective analysis of 139 cases of lymphoproliferative diseases was conducted. At the first stage, CD45, CD20, CD3, PanCK, and Ki-67 were used. CD45 was used to confirm the lymphoid nature of the process, PanCK to exclude epithelial tumors, CD20 and CD3 to determine B- or T-cell lineage, and Ki-67 to assess proliferative activity. Additional antibodies were ordered based on morphological and immunophenotypic indications, taking into account their actual availability.

Results: A B-cell phenotype was established in 100 of 139 cases (71.9%), Hodgkin lymphoma in 35 (25.2%), and T-cell lymphomas in 4 (2.9%). Among the 100 B-cell lymphomas, in 32 cases (32.0%), the diagnosis was formulated at the level of B-cell lymphoma without precise nosological subclassification. Diffuse large B-cell lymphoma/large B-cell lymphoma was diagnosed in 36 cases (36.0%), follicular lymphoma in 10 (10.0%), small/middle B-cell lymphomas, including SLL/CLL, in 9 (9.0%), marginal zone lymphomas/MALT-type in 7 (7.0%), Burkitt lymphoma/highly aggressive B-cell lymphoma in 4 (4.0%), and mantle cell lymphoma in 2 (2.0%). The high proportion of diagnoses without complete subclassification reflects the limited availability of additional markers, whereas the basic panel allowed lineage determination and identification of the need for a second diagnostic stage.

Conclusion: The CD45/CD20/CD3/PanCK/Ki-67 panel is a practical first step in the diagnosis of lymphoproliferative diseases under resource-constrained conditions. Expansion of the panel should be performed in a targeted manner, based on morphology and the results of the first stage. In the absence of the necessary antibodies, establishing the B- or T-cell phenotype is a justifiable level of diagnostic conclusion and allows avoidance of unjustified nosological verification.

Keywords: B-Cell Lymphomas; Immunohistochemistry; CD20; CD3; CD45; PanCK; Ki-67; Diagnostic Algorithm

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Congress Abstract

An Optical Biosensor for Label-Free Detection of Soluble Biomarker: Toward Minimally Invasive Breast Cancer Monitoring

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ABSTRACT

Tumor cells release biomarkers such as CD44 into the bloodstream, offering opportunities for minimally invasive monitoring of tumor progression. However, conventional analytical methods often suffer from insufficient sensitivity and a limited dynamic range, which hinders reliable detection of such biomarkers in complex biological fluids. Optical fiber biosensors are particularly attractive alternatives, offering high sensitivity, low cost, chemical inertness, and diverse surface functionalization strategies, making them well suited for detecting clinically relevant circulating tumor biomarkers that require sensitive, quantitative analysis. CD44, a cell adhesion glycoprotein whose soluble form (solCD44) is elevated in several cancers including breast cancer (BC), was selected as a model biomarker for this study owing to its well-established diagnostic relevance.

Here, we report the development of a graphene oxide-coated fiber-optic biosensor based on a semi-distributed interferometric sensing platform for the highly sensitive detection of solCD44. A total of 46 sensors were fabricated and characterized for their sensitivity to refractive index changes in the surrounding medium. The sensor surface was subsequently functionalized with anti-CD44 antibodies, and successful biofunctionalization together with antibody specificity was confirmed using several complementary techniques, including atomic force microscopy (AFM) and ELISA.

The optimized biosensor exhibited a wide dynamic detection range, spanning attomolar concentrations up to 100 nM, with a limit of detection (LOD) as low as 175 aM in spiked serum. Specificity was confirmed by comparison with non-functionalized sensors and healthy control samples. To validate its practical clinical applicability, the biosensor was further tested in human serum samples from breast cancer patients, showing significantly higher signal in cancer patients than in healthy controls. Successful detection of solCD44 in urine additionally demonstrated the biosensor's compatibility with multiple biological matrices. Together, these findings establish this fiber-optic biosensor as a promising platform for highly sensitive, label-free, and minimally invasive detection of cancer biomarkers, with strong potential for clinical translation and point-of-care diagnostic systems.

Keywords: Soluble CD44; Breast Cancer; Clinical Samples; Serum; Urine; Optical Fiber Biosensor; Semi-Distributed Interferometry

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Congress Abstract

Colistin in Oncohematological Intensive Care: Clinical Outcomes, Microbiological Profile, and Renal Function Dynamics

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Introduction: Infections caused by multidrug-resistant gram-negative microorganisms are one of the causes of adverse outcomes in critically ill patients with oncohematological diseases. Given the limited availability of modern antibacterial agents, colistin remains a reserve drug; however, its use is associated with concerns regarding nephrotoxicity. Objective: To evaluate clinical outcomes, microbiological profile, and renal function dynamics during colistin therapy in an oncohematological intensive care unit.

Materials and Methods: A single-center retrospective study was conducted on 48 consecutive episodes of colistin therapy in an oncohematological intensive care unit in 2024. Clinical and microbiological data, treatment characteristics, creatinine dynamics, use of renal replacement therapy, and in-hospital outcomes were analyzed. The primary outcome was in-hospital mortality. Comparisons were made using the Mann–Whitney U test and Fisher's exact test; differences were considered statistically significant at $p < 0.05$.

Results: Neutropenia was observed in 36 of 48 episodes (75.0%), and mechanical ventilation and/or vasopressor support prior to therapy initiation was required in 41 episodes (85.4%). Positive cultures were obtained in 30 episodes (62.5%). Klebsiella pneumoniae was isolated in 26 episodes (54.2%); 25 of the 26 isolates exhibited a multidrug-resistant phenotype. Among episodes with positive cultures, 26 of 30 isolates (86.7%) were susceptible to colistin. In-hospital mortality was 60.4% (29 of 48). Compared with survivors, non-survivors more frequently had neutropenia (96.6% vs. 42.1%; $p < 0.001$) and required mechanical ventilation and/or vasopressor support before therapy initiation (100.0% vs. 63.2%; $p < 0.001$). They also had higher median procalcitonin concentrations (17.67 [5.40–34.91] vs. 3.15 [0.87–6.35] ng/mL; $p < 0.001$) and higher median baseline serum creatinine concentrations (108 [96–180] vs. 93 [89.5–102] μmol/L; $p = 0.006$). Colistin susceptibility was not associated with mortality ($p = 0.584$). An increase in creatinine of at least 26.5 μmol/L was observed in 21 episodes (43.8%), and an increase to at least 1.5 times the baseline value was observed in 13 episodes (27.1%). Renal replacement therapy after colistin initiation was required in 7 of 39 episodes without prior renal replacement therapy (17.9%).

Conclusions: Colistin therapy in the oncohematological intensive care unit was predominantly administered to patients with severe infection, neutropenia, and a need for organ support. Adverse outcomes were primarily associated with the baseline severity of the condition, whereas laboratory susceptibility to colistin did not determine prognosis. Worsening renal function during treatment was frequent; however, the retrospective design and concomitant organ dysfunction preclude attributing it exclusively to colistin. These findings underscore the need for early microbiological diagnosis and careful monitoring of renal function.

Keywords: Colistin; Hematologic Neoplasms; Intensive Care Units; Bacterial Drug Resistance; Klebsiella Pneumoniae; Acute Kidney Injury

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Congress Abstract

Risk Factors for Catheter-Associated Thrombosis in Patients After Hematopoietic Stem Cell Transplantation: An Analysis from the Perspective of Virchow's Triad

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Introduction: Catheter-associated thrombosis can lead to dysfunction and unplanned removal of the central venous catheter, as well as to re-catheterization. After hematopoietic stem cell transplantation, its development may be determined by the combined action of the components of Virchow's triad: endothelial injury, venous blood flow disturbance, and hypercoagulability. Objective: To assess the incidence of catheter-associated thrombosis and to interpret the associated clinical factors from the perspective of Virchow's triad in patients after hematopoietic stem cell transplantation.

Materials and Methods: A retrospective single-center study was conducted on 91 episodes of central venous catheter placement in 78 patients at the Department of Bone Transplantation. Risk factors were analyzed in 58 completed primary episodes. Transplant type, conditioning regimen, infectious and mechanical complications, number of puncture attempts, parenteral nutrition, and anticoagulant use were assessed. Fisher's exact test was used; differences were considered statistically significant at $p < 0.05$.

Results: Catheter-associated thrombosis occurred in both episodes with catheter-associated bloodstream infection (2 of 2, 100%), compared with 9 of 56 episodes without such infection (16.1%; $p = 0.033$). Thrombosis occurred in 2 of 5 episodes with early mechanical complications (40.0%) and in 9 of 53 episodes without such complications (17.0%; $p = 0.237$). With prophylactic enoxaparin use, no thrombosis was observed in 12 episodes; without prophylaxis, thrombosis occurred in 11 of 46 episodes (23.9%; $p = 0.097$). In the Virchow's triad model, infection and mechanical complications corresponded to endothelial injury and local inflammation; the presence of the catheter created conditions for blood flow disturbance; differences by transplant type and enoxaparin use may reflect the contribution of hypercoagulability.

Conclusions: Catheter-associated thrombosis after hematopoietic stem cell transplantation can be viewed as a result of the interaction of all components of Virchow's triad. The association with catheter-associated bloodstream infection supports the role of endothelial injury and local inflammation; the central venous catheter creates conditions for blood flow disturbance; the observed differences by transplant type may reflect differing degrees of systemic prothrombotic factors. Virchow's triad unifies the identified factors into a single mechanism of thrombosis; however, the contribution of individual components requires clarification in a larger sample.

Keywords: Hematopoietic Stem Cell Transplantation; Central Venous Catheters; Venous Thrombosis; Catheter-Associated Infections; Risk Factors; Ultrasonography; Interventional

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Congress Abstract

Innovative Approaches to Cervical Cancer Elimination: First Results of the National HPV Vaccination Program in the Republic of Tajikistan

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Introduction: Cervical cancer remains a significant problem in the structure of cancer morbidity and mortality among women in the Republic of Tajikistan. During the period from 2014 to 2025, the average age-standardized incidence rate (ASIR) was 11.68 per 100,000 female population, and the age-standardized mortality rate (ASMR) was 6.80 per 100,000. The highest average age-specific incidence rates were recorded in the 55–64 age group, at 32.16 per 100,000 women. To reduce this burden and in line with the World Health Organization's Global Strategy for the Elimination of Cervical Cancer, the Government of Tajikistan officially launched a mass human papillomavirus (HPV) vaccination campaign in October 2025. Objective: To evaluate the initial results of the implementation, coverage, safety profile, and public perception of the first national HPV immunization campaign targeting adolescent girls aged 10–14 years in the Republic of Tajikistan.

Materials and Methods: Following the vaccination campaign conducted in October 2025, a comprehensive assessment was carried out. The study analyzed official statistical data from the Republican Center for Immunoprophylaxis, covering a target population of 542,268 girls. In December 2025, a formal Post-Introduction Evaluation (PIE) was conducted at 16 immunization centers and 22 medical facilities to assess logistics, cold chain management, and healthcare worker preparedness. In addition, Rapid Convenience Monitoring (RCM) was implemented in 140 schools across 28 districts for operational decision-making, during which 8,834 girls were interviewed using structured teacher-administered questionnaires to identify behavioral and social factors influencing vaccination.

Results: The overall coverage of the national campaign reached 95.5%, with 507,114 girls vaccinated. Specifically, coverage was 91.1% among the cohort of 10-year-old girls (routine vaccination) and 96.7% among the cohort aged 11–14 years (catch-up vaccination). The vaccine safety profile was excellent, with 48 minor adverse events following immunization (AEFI) reported, accounting for 0.009%. The school-based RCM survey confirmed high coverage rates (91.5% in surveyed schools) and demonstrated strong public support, with 81% of parents endorsing the initiative. The main barriers among the unvaccinated minority were parental refusal (17.0%) and absence from school on the day of vaccination (16.3%). PIE results highlighted strong political leadership, a reliable cold chain infrastructure, and effective interaction between parents and educators, although minor local vaccine supply delays were also noted.

Conclusion: The rapid integration and exceptionally high vaccination coverage against HPV mark a critical public health achievement for Tajikistan. The first national campaign has successfully laid the foundation for achieving international cervical cancer elimination targets. To sustain the results achieved, future efforts should focus on local microplanning, continued community awareness initiatives to address vaccine hesitancy, and ensuring reliable supply chains for routine immunization.

Keywords: Cervical Cancer Elimination; HPV Vaccination; Immunization Campaign; Target Population Coverage

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Congress Abstract

Comprehensive Diagnosis of Cervical Intraepithelial Neoplasia Based on a Digital Module

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Objective: To evaluate the medical-organizational and clinical effectiveness of optimizing comprehensive diagnostics and follow-up care for patients with cervical intraepithelial neoplasia (CIN) through the introduction of a specialized digital module into the national Health Management Information System (HMIS/DHIS2) of the Republic of Tajikistan.

Materials and Methods: An analysis was conducted on the results of diagnosis, treatment, and dynamic follow-up of 542 patients with morphologically verified CIN1–3/Tis, aged 20 to 65 years, examined during 2023–2026. The main group using the digital system (n=82) was compared with a control group managed through paper-based documentation (n=460). The developed Digital Module for Early Diagnosis (DMED) of cervical cancer enabled the integration of 51 specialized cervical pathology units at district and city health centers, HPV diagnostics laboratories, cytology laboratories, and the State Institution "Republican Oncological Scientific Center" (ROSC). Time intervals for completing stages of medical care and the proportion of patients under follow-up care were assessed.

Results: The use of automatic tracking algorithms through the DMED for cervical cancer reduced the total diagnostic and treatment time interval (from abnormal visual screening through extended diagnostics to organ-preserving treatment with LEEP/cone biopsy) from 68.4 ± 5.2 to 21.2 ± 2.4 days ($p < 0.001$). The proportion of women lost to follow-up decreased from 34.2% to 6.1%. All 5 cases of invasive cervical cancer detected using the DMED were diagnosed at stage I of the disease.

Conclusion: The implementation of the DMED for cervical cancer optimizes the organization of gynecologic oncology care, eliminates lost links in patient referral pathways, and ensures a high level of monitoring of the health status of patients with precancerous pathology of the cervix.

Keywords: Cervical Intraepithelial Neoplasia; CIN; Cervical Cancer; Diagnostic Optimization; Digital Module; HMIS; DHIS2; Patient Referral Pathways; Follow-Up Monitoring; Tajikistan

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Congress Abstract

Spectrum of Germline Mutations in BRCA1 and BRCA2 Genes in Patients with Breast Cancer and Women with a Family History in the Kazakh Population

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Introduction: Germline mutations in the BRCA1 and BRCA2 genes are an important hereditary risk factor for the development of breast cancer. The spectrum of pathogenic variants of these genes is characterized by pronounced ethnic and population specificity, including the presence of founder mutations. Data on the spectrum of germline BRCA1/BRCA2 variants in the Kazakh population remain limited, which hinders their application in clinical practice and genetic counseling.

Objective: To study the spectrum of germline mutations in the BRCA1 and BRCA2 genes in patients with breast cancer and women with a family history in the Kazakh population and to identify the founder mutation.

Materials and Methods: The study included 544 women of Kazakh ethnicity with breast cancer or a family history of cancer. DNA was isolated from peripheral blood lymphocytes according to the manufacturer's protocol. Exons and adjacent intronic regions of the BRCA1 and BRCA2 genes were sequenced by NGS. Variants were classified by clinical significance, and their spectrum and distribution by gene, type, and localization were analyzed.

Results: Of the 544 examined patients, 178 (32.7%) were found to have mutations in the BRCA genes. Mutations in the BRCA1 gene were detected in 35 patients (19.7%), in the BRCA2 gene — in 119 patients (66.8%), and mutations in both genes — in 24 patients (13.5%).

The study identified a total of 125 BRCA gene variants. Sequence analysis revealed 37 pathogenic variants in 81 patients, 83 likely pathogenic variants in 104 patients, 1 likely benign variant in 6 patients, 2 benign variants in 6 patients, and 2 variants of uncertain clinical significance in 2 patients.

Among BRCA1 gene variants, the most common was a deletion of exon 6, detected in 11 patients (6.1%). Deletions of exons 2, 13, and 20 were found in 7 patients each (3.9%), while deletions of exons 8 and 23, as well as variants BRCA1 c.3214delC and BRCA1 c.1044_1045insC, were found in 3 patients each (1.7%).

Among the identified BRCA2 gene variants, the most common was a deletion of exon 16, detected in 37 patients. The variant c.24_27delGCCAinsCG was identified in 15 patients, c.2600_2601insA in 12 patients, and c.9241_9242insA in 11 patients.

Conclusions: The spectrum of germline BRCA1/BRCA2 mutations in the Kazakh population is characterized by a predominance of BRCA2 gene variants. Deletion of exon 16 of the BRCA2 gene was identified as a founder mutation.

Keywords: BRCA1, BRCA2, Breast Cancer, Sequencing, Germline Mutation

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Congress Abstract

Comparison of the Sensitivity of CT-Arteriohepaticography and Intravenous Contrast-Enhanced CT in Colorectal Cancer Liver Metastases After Neoadjuvant Chemotherapy

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Introduction: The main method for preoperative assessment of colorectal cancer (CRC) liver metastases remains intravenous contrast-enhanced computed tomography (CT); however, its sensitivity is limited, especially for lesions smaller than 10 mm, and neoadjuvant chemotherapy further reduces it. The characteristic CT appearance of a metastasis is hypodensity in the portal phase and a rim of enhancement at the lesion edge, which can be enhanced by injecting contrast material directly into the hepatic arteries. CT-arteriohepaticography (CT-AHG) is potentially more effective, including during drug treatment, but data on its sensitivity after chemotherapy are virtually absent.

Objective: To compare the diagnostic efficacy of CT-AHG and intravenous contrast-enhanced CT in the detection and characterization of CRC liver metastases in patients after neoadjuvant chemotherapy.

Materials and Methods: This single-center prospective study included 22 patients with CRC and liver metastases who underwent both imaging methods prior to liver resection at the N.N. Petrov National Medical Research Center of Oncology. The unit of analysis was the lesion. The reference standard was targeted histological examination of each resected lesion. CT and CT-AHG were evaluated independently, using animated images, by radiologists with more than 5 years of experience, one for each "patient–method" pair. For each method, sensitivity, specificity, and predictive values with 95% Clopper–Pearson confidence intervals (CIs) were calculated for 129 included lesions. The difference in sensitivities was reported with 95% CI (patient-level bootstrap) and tested using McNemar's exact test.

Results: With combined use of CT and CT-AHG (a lesion was considered positive if detected by at least one method), sensitivity was 80.8% [72.6–87.4], which was 10.0 percentage points (95% CI: +2.4 to +17.9) higher than the sensitivity of CT alone. Individually, sensitivity was 70.8% [61.8–78.8] for CT and 73.3% [64.5–81.0] for CT-AHG. The difference between them was −2.5 percentage points (95% CI: −9.5 to +6.8) and was not statistically significant (p = 0.66). For lesions smaller than 10 mm, sensitivity was 35.3% for CT versus 50.0% for CT-AHG; for lesions 10 mm or larger, sensitivity was 84.9% and 82.6%, respectively.

Conclusion: The sensitivity of CT-AHG does not differ significantly from that of intravenous contrast-enhanced CT; however, the combination of methods improves sensitivity by 10.0 percentage points. Therefore, CT-AHG should be considered as a complement to CT, rather than a replacement for it.

Keywords: Colorectal Cancer; Liver Metastases; CT-Arteriohepaticography; Intravenous Contrast-Enhanced CT

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Congress Abstract

Three-Dimensional Liver Master Model as a Tool for Lesion-By-Lesion Correlation of Radiological Data, Intraoperative Findings, and Histological Examination in Colorectal Cancer Metastases

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Introduction: The extent of surgery for colorectal cancer (CRC) liver metastases is currently planned on a lesion-by-lesion basis, making lesion-by-lesion assessment of the diagnostic efficacy of radiological methods important. Such studies are few in number: they are labor-intensive, and lesions detected by different methods are difficult to correlate with each other. Typically, the correspondence between radiological findings and histological conclusions is established by liver segment or anatomical landmarks, which is unreliable in cases of multiple lesions.

Objective: To develop a methodology for lesion-by-lesion correlation of radiological data, intraoperative findings, and histological examination based on a three-dimensional liver master model.

Materials and Methods: A single-center study at the N.N. Petrov National Medical Research Center of Oncology included 18 patients with CRC liver metastases who underwent intravenous contrast-enhanced CT, CT-arteriohepaticography (CT-AHG), MRI with hepatobiliary contrast agent, and MR-arteriohepaticography (MR-AHG) 1–7 days prior to liver resection. Using 3D Slicer software, a master model—a three-dimensional reconstruction of the liver with numbered lesions—was constructed from CT data. Lesions detected by at least one imaging method, including those only visible prior to chemotherapy, were mapped onto the model. The lesion number linked the label on images, the surgeon's finding on intraoperative ultrasound (IOUS), and the gross specimen. Correspondence between model lesions and the gross specimen was established by a consensus of the radiologist, surgeon, and pathologist based on location relative to the capsule, resection margin, and vessels.

Results: In 18 patients, 147 lesions were mapped on the master models: median 5.5 per patient (range 1–27). Sixteen patients had more than one lesion. A total of 111 lesions were histologically verified (median 3.5 per patient), of which 103 were metastases; 36 non-resected lesions were excluded from accuracy calculations. The model enabled independent correlation of the four imaging methods: sensitivity was 77.7% for CT, 69.9% for CT-AHG, 56.3% for MRI, and 50.5% for MR-AHG; with combined assessment (at least one method), sensitivity was 90.3%: 93 of 103

metastases were detected, while 10 were missed by all methods. No additional lesions were identified on the gross specimen outside the master model.

Conclusion: When performing liver resection for CRC metastases, the master model provides a unified coordinate system from preoperative images to the gross specimen and continuous lesion numbering. This enables rigorous lesion-by-lesion verification in cases of multiple lesions, where segmental correspondence alone is insufficient.

Keywords: Colorectal Cancer; Liver Metastases; Three-Dimensional Modeling; Master Model; Preoperative Planning

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Congress Abstract

Molecular Profile of Extracranial Solid Tumors in Children: Diagnostic and Therapeutic Opportunities

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Introduction: Despite the relatively low mutational burden of most pediatric tumors, molecular genetic studies are increasingly being used in pediatric oncology. They enable confirmation of diagnosis, assessment of prognosis, and identification of potential targets for molecularly targeted therapy. Analysis of molecular diagnostic results in real-world clinical practice allows us to assess the capabilities and limitations of molecular diagnostics across different pediatric tumors.

Materials and Methods: Targeted sequencing of tumor DNA using a customized QIAseq panel (Qiagen, Germany) was performed in 334 patients with extracranial solid tumors treated at the Dmitry Rogachev National Medical Research Center of Pediatric Hematology, Oncology and Immunology between 2018 and 2023.

Results: The highest diagnostic yield was observed in malignant rhabdoid tumors (n=23): diagnostically significant alterations were identified in 91.3% of patients.

In most cases, these alterations were highly specific to this tumor type and could be used to confirm the diagnosis alongside morphological and immunohistochemical data.

Prognostically significant molecular alterations were most frequently detected in neuroblastoma – in 66.7% of patients (112/168). The majority of these consisted of mutations in genes of the RAS/p53 signaling pathways, allowing further characterization of tumor biology and identification of patients with molecular features potentially associated with disease course and response to therapy.

Potentially therapeutically significant alterations were identified in 36% of patients (120/334). However, the presence of a molecular target did not always lead to the administration of the corresponding drug, as evidence for the efficacy of targeted therapy in children remains limited for a significant proportion of these alterations.

Targeted therapy based on molecular genetic testing results was administered in 6.3% of cases (21/334), predominantly in neuroblastoma (n=13).

It was used in the first-line setting or at first relapse in 66.7% of cases (14/21). In 61.9% (13/21) of patients, targeted agents were used in combination with standard antitumor therapy.

An objective response or disease stabilization lasting more than 6 months was observed in 66.7% (14/21) of patients. The median time to best response or stabilization was 6 months (range 0.8–12.3). The median duration of targeted therapy as monotherapy was 10.9 months (range 0.8–43.5), and in combination with chemotherapy – 12.3 months (range 0.3–61.5). In 42.8% (9/21) of patients, the response was maintained at the time of last follow-up.

Conclusion: Thus, molecular genetic plays an important role in improving the diagnosis and treatment of pediatric tumors. Futher accumulation of clinical and

molecular data will provide a deeper understanding of tumor biology and expand opportunities of personalized treatment.

Keywords: Personalized Medicine; Targeted Therapy; NGS; Pediatric Tumors; Neuroblastoma

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Congress Abstract

Targeted Delivery of the CDC42 Inhibitor Casin to Colorectal Cancer Cells Using PLGA-PEG Nanoparticles Functionalized with Nucleolin-Binding Aptamers

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Introduction: Cdc42 is a small Rho GTPase that regulates various cellular functions controlling cell motility, shape, and growth through actin cytoskeleton dynamics. This protein is also known to be overexpressed in various diseases, particularly in cancer. Colorectal cancer is a common malignancy with a high mortality rate. Elevated Cdc42 expression is observed in colorectal cancer. Inhibition of Cdc42 can significantly slow the growth and metastasis of colorectal cancer but often causes severe side effects. To address this issue, PLGA-PEG nanoparticles functionalized with DNA aptamers were developed to selectively deliver the Cdc42 inhibitor CASIN to tumor cells by targeting nucleolin—a protein that is overexpressed in colorectal cancer.

Materials and Methods: The nucleolin-targeting aptamer AS1411 (5'-FAM–GGT GGT GGT GGT TGT GGT GGT GGT GG–3'-NH2) was synthesized as a 28-base single-stranded DNA oligonucleotide modified with a fluorescein label at the 5' end and an amine group at the 3' end. PLGA-PEG-NHS nanoparticles conjugated with the AS1411 aptamer were prepared using the nanoprecipitation method. Conjugation efficiency was assessed by DNA quantification, as well as by fluorescence microscopy and Raman spectroscopy. Binding affinity and specificity of aptamer-functionalized nanoparticles to nucleolin-positive cancer cells were confirmed by flow cytometry.

Results: AS1411-functionalized PLGA-PEG-NHS nanoparticles loaded with CASIN had an average size of approximately 129 nm (polydispersity index 0.259) and a zeta potential of –52.3 mV. Encapsulation efficiency was 38.1%, and drug loading content was 7.35%. CASIN release occurred in two phases: an initial burst release followed by a gradual release over 48 hours. In vitro, these nanoparticles significantly suppressed the growth of colorectal cancer cells (HT29, SW620, HCT116) and substantially reduced HT29 cell migration, while AS1411-modified nanoparticles without CASIN had minimal effects. Furthermore, the nanoparticles significantly reduced the migratory and invasive capacity of colorectal cancer cells.

Conclusion: Overall, this targeted nanoparticle system represents a promising strategy for improving the precision and efficacy of colorectal cancer treatment. This research was funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP26100973) and Nazarbayev University under Collaborative Research Project (CRP) No. 211123CRP1611.

Keywords: Colorectal Neoplasms; Molecular Targeted Therapy; Cdc42 GTP-Binding Protein; Nanoparticles; Polylactic-Co-Glycolic Acid (Copolymer); Nucleotide Aptamers

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Congress Abstract

Optimization of Positron Emission Tomography Computed Tomography Using 68Ga-FAPI in the Diagnosis of Colorectal Cancer Metastases and Monitoring of Antitumor Treatment Efficacy

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Introduction: Colorectal cancer remains one of the leading causes of cancer morbidity and mortality. Timely detection of metastases and assessment of treatment efficacy are important tasks in modern oncology. PET/CT with 18F-FDG has limitations related to physiological uptake of the radiopharmaceutical in the intestine and variable sensitivity across different histological tumor types. The use of 68Ga-FAPI, which has high affinity for tumor stroma and low background uptake, is a promising alternative.

Objective: To evaluate the diagnostic value of PET/CT with 68Ga-FAPI in detecting colorectal cancer metastases and monitoring treatment efficacy.

Materials and Methods: The study included 311 patients with histologically verified colorectal cancer examined between January 2024 and January 2026. The study had a retrospective-prospective design. All patients underwent PET/CT using 68Ga-FAPI. Radiopharmaceutical distribution, the presence of metastatic and additional suspicious lesions, as well as dynamic changes during treatment were assessed. Statistical analysis was performed in Microsoft Excel, calculating mean, median, and SUVmax range. The study was approved by the Local Bioethics Committee of the "Astana Medical University" NJSC (Decision No. 11 dated 27.02.2026).

Results: The mean age of patients was 58.5 years (range 17–87 years); 171 (55.0%) were women and 140 (45.0%) were men. Adenocarcinoma predominated (87%), predominantly G2; the majority of patients had stage II–III disease. Metastases were detected in 31.2% of patients, most frequently in the liver and lymph nodes; recurrence was observed in 13.0%. Additional suspicious lesions requiring verification were identified in 40% of patients. The mean SUVmax of metastatic lesions was 6.46 (range 1.1–13.8), for recurrence – 5.78 (range 2.6–9.5), and for suspicious lesions – 4.02.

Conclusions: PET/CT using 68Ga-FAPI is a promising imaging modality for colorectal cancer, allowing detection of metastatic and additional suspicious lesions and assessment of dynamic changes during antitumor treatment.

Keywords: Colorectal Neoplasms; Neoplasm Metastasis; Positron-Emission Tomography; Fibroblast Activation Protein Alpha; Treatment Outcome; Neoplasm Recurrence; Local

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Congress Abstract

CT-Based Assessment of Sarcopenia Using an Artificial Intelligence Program for Predicting Postoperative Complications in Patients with Gastric and Pancreatic Tumors

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Introduction: Sarcopenia is associated with an unfavorable prognosis in cancer patients, especially in the presence of concurrent nutritional deficiency risk. CT-based sarcopenia assessment remains the gold standard for non-invasive evaluation of muscle mass; however, its routine use is limited by the high labor intensity of manual muscle segmentation on CT images.

Objective: To determine the prognostic value of preoperative CT-based sarcopenia assessment, performed using a developed software assistant, as a predictor of postoperative complications in patients with gastric and pancreatic tumors.

Materials and Methods: The study was conducted in two stages. At the first stage, a muscle tissue segmentation model was trained on 610 CT images (Dice coefficient on the training set — 0.95). A program was developed as an integrated information system incorporating computer vision algorithms, which identifies a single axial slice at the L3 level and performs subsequent semantic segmentation using convolutional neural networks. Thus, the muscle tissue area at the L3 vertebral level was automatically calculated with adjustment for the square of the patient's height, and the skeletal muscle index (SMI) was computed.

At the second stage, using this software module, sarcopenia was assessed preoperatively in 65 patients with gastric cancer and 55 patients with pancreatic cancer who subsequently underwent gastrectomy and pancreaticoduodenal resection, respectively. Sarcopenia was defined as SMI values of < 52.4 cm^2/m^2 for men and < 38.5 cm^2/m^2 for women. The severity of postoperative complications was assessed according to the Clavien–Dindo classification. Differences were considered statistically significant at $p < 0.05$.

Results: The prevalence of sarcopenia was evaluated in both groups: in patients with gastric cancer it was 77% (50 out of 65 patients), and in patients with pancreatic cancer – 73% (40 out of 55), indicating a considerable prevalence of this condition in this patient population.

The crude relative risk of overall postoperative complications (RR = 0.94; 95% CI 0.60–1.47; $p > 0.05$) and pancreatic fistulas in particular (RR = 0.64; 95% CI 0.33–1.26; $p > 0.05$) in pancreatic cancer patients with sarcopenia did not differ from that in patients without sarcopenia, indicating comparable complication rates in both groups.

In gastric cancer patients, the overall rate of postoperative complications also did not correlate with the presence of sarcopenia ($p = 0.392$); however, severe complications (≥ IIIb by Clavien–Dindo) were observed only in patients with sarcopenia ($p < 0.001$).

Conclusions: Thus, the inclusion of automated CT-based sarcopenia assessment in preoperative workup may help identify a high-risk group of cancer patients for severe postoperative complications, enabling optimization of personalized management strategies. However, multivariate analysis accounting for other clinical factors is required; further studies with validation on larger cohorts are necessary to justify the implementation of this method into clinical practice.

Keywords: Sarcopenia; Gastric Cancer; Pancreatic Cancer; Postoperative Complications; Computer Vision

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Congress Abstract

CT Perfusion as a Biomarker of the Efficacy of Preoperative Treatment for Gastric Cancer

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Introduction: Given the difficulties in assessing response of the primary tumor and metastatic lesions in gastric cancer patients using standard RECIST 1.1 criteria, there is a need to search for new biomarkers to evaluate treatment efficacy, especially at early stages after therapy initiation. Perfusion computed tomography is a functional imaging technique that provides qualitative and quantitative information about tumor microcirculation and can serve as a tool for predicting or assessing treatment response, helping to optimize and individualize subsequent patient management.

Objective: To evaluate the role of perfusion CT (PCT) in monitoring response to neoadjuvant chemotherapy in patients with locally advanced gastric cancer.

Materials and Methods: The results of PCT in 28 patients aged 36 to 76 years with histologically confirmed gastric cancer who received combined treatment at the A.F. Tsyb Medical Radiological Research Center between June 2023 and June 2026 were analyzed. Baseline CT, supplemented by perfusion imaging, was performed before treatment initiation to assess tumor extent and obtain baseline perfusion parameters. Follow-up PCT was performed before surgery to evaluate treatment efficacy and changes in perfusion parameters.

Patients were divided into 2 groups: 12 of 28 patients with regression grade 1a/b according to the scale established by K. Becker (2003) were considered "responders" to neoadjuvant chemotherapy, and 16 of 28 patients with regression grade 2/3 were considered "non-responders." Quantitative PCT analysis was based on interpretation of perfusion parameter values automatically calculated from the region of interest (ROI) placed within the tumor. The following PCT parameters were analyzed: blood flow (BF), blood volume (BV), mean transit time (MTT), and permeability surface area (PS).

Results: The obtained perfusion data were subjected to both qualitative and quantitative analysis. Qualitative analysis included interpretation of parametric perfusion maps automatically generated by the software for each perfusion parameter. For each group, the significance of changes in each parameter was assessed using the paired Wilcoxon test. In patients who responded to treatment, a statistically significant decrease in BF, BV, and PS perfusion parameters was observed ($p < 0.05$). In patients who did not respond to treatment, none of the parameters changed significantly ($p > 0.1$ for all). Differences in BF and BV dynamics between groups were highly significant ($p < 0.01$), with significantly greater changes in responders. For PS, the difference was also significant ($p = 0.04$), although less pronounced. When

assessing the prognostic value of baseline PCT parameters, none of the parameters reached statistical significance ($p > 0.05$); only PS showed a weak trend toward lower values in the responder group.

Conclusion: CT perfusion parameters reflect tissue vascularization and can serve as objective quantitative biomarkers of tumor response to neoadjuvant treatment. Baseline low PS values are associated with a likelihood of clinical response to preoperative chemotherapy in gastric cancer. Further studies with larger sample sizes are needed to clarify the prognostic role of PCT.

Keywords: Gastric Cancer; Perfusion CT; Tumor Response Prediction; Neoadjuvant Chemotherapy

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Congress Abstract

Application of Erector Spinae Plane Interfascial Block as a Component of the ERAS Protocol in Surgical Treatment of Breast Cancer

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Introduction: The implementation of Enhanced Recovery After Surgery (ERAS) protocols in breast oncology surgery requires optimization of perioperative analgesic management to minimize systemic opioid exposure and enable early mobilization.

Objective: To evaluate the clinical efficacy of the erector spinae plane (ESP) block as a core component of a multimodal ERAS protocol in patients undergoing surgical treatment for breast cancer.

Materials and Methods: This prospective study included 240 patients who underwent breast surgery. Patients were divided into two groups of 120 each:

Main group (n=120): Postoperative analgesia within the ERAS protocol incorporating ultrasound-guided ESP block.

Control group (n=120): Standard systemic postoperative analgesia.

The ESP block was performed under ultrasound guidance at the Th5–Th6 level. A mixture of 15 mL of 0.75% ropivacaine and 15 mL of 0.9% sodium chloride solution was administered (total volume – 30 mL, final ropivacaine concentration – 0.375%, total dose – 112.5 mg).

Pain intensity was assessed using the Visual Analogue Scale (VAS) at 3, 6, 12, and 24 hours. To determine the integrated pain burden, the area under the curve (AUC-VAS) was calculated. Early rehabilitation dynamics and functional activity (deep breathing activation, ability to sit up independently, and upper limb excursion) were assessed at 12 and 24 hours using a 3-point scale (0 – no limitations, 1 – moderate limitations due to discomfort, 2 – severe limitations/inability to perform).

Statistical analysis: Normality of distribution was tested using the Shapiro–Wilk test. VAS dynamics within groups were analyzed using the Friedman test, and intergroup differences using the Mann–Whitney U test. Data are presented as M±SD. Differences were considered statistically significant at $p < 0.05$.

Results: Incorporation of the ESP block into the ERAS protocol provided stable and pronounced pain control during the first 24 hours. Mean VAS scores in the main group at 3, 6, 12, and 24 hours were 3.96±0.44; 1.87±0.56; 1.15±0.44; and 0.71±0.47, respectively. In the control group, scores were 7.65±0.80; 5.80±1.21; 4.70±1.46; and 3.45±1.36, respectively ($p < 0.001$ for all time points).

At 3 hours postoperatively, severe pain (VAS ≥ 7) was observed in 95% of patients in the control group, while no such cases were recorded in the ESP block group. At 24 hours, all patients in the main group had pain levels not exceeding 2 on the VAS, whereas in the control group, 65% of patients still had clinically significant pain (VAS ≥ 4).

The total pain burden (AUC-VAS) over the 3–24 hour interval in the main group was 28.94±6.37 score·hours versus 100.58±21.47 score·hours in the control group, corresponding to a 71% reduction in integrated pain burden ($p < 0.001$).

Effective analgesia contributed to accelerated achievement of ERAS target parameters for early mobilization. At 12 hours, the mean limitation score for attempting to sit up in bed was 0.93 in the main group versus 1.65 in the control; for deep breathing – 0.14 versus 0.95; and for upper limb movement – 0.98 versus 1.75 ($p < 0.001$). By 24 hours, patients in the ESP block group had virtually no functional limitations.

Conclusions: The erector spinae plane interfascial block (Th5–Th6, 30 mL of 0.375% ropivacaine) provides highly effective pathogenetic protection against acute postoperative pain, reducing the total pain burden by 71% during the first 24 hours after surgical treatment for breast cancer.

Incorporation of the ESP block as a multimodal component of the ERAS protocol significantly accelerates the postoperative rehabilitation process, restoring full respiratory excursion and shoulder girdle mobility by the end of the first postoperative day, supporting the recommendation of this technique for widespread use in breast oncology surgery.

Funding: This research was funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan under Grant No. BR24992950 ("Creation and implementation of innovative methods for the treatment of oncological diseases").

Keywords: Regional Anesthesia; Mastectomy; Pain Management

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Congress Abstract

Anesthetic Management for Cytoreductive Thoracic Surgeries with Hyperthermic Intrapleural Chemotherapy: Experience of the National Research Oncology Center

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Introduction: Hyperthermic intrapleural chemotherapy combined with cytoreductive surgery is used for malignant pleural neoplasms and tumors with pleural dissemination. Anesthetic management is complicated by prolonged one-lung ventilation, surgical trauma, blood loss, fluid loading, hyperthermia, and the potential nephrotoxicity of cisplatin.

Objective: To evaluate the characteristics of anesthetic management and major perioperative complications associated with cytoreductive thoracic surgeries with hyperthermic intrapleural chemotherapy.

Materials and Methods: A retrospective analysis was conducted on 15 patients who underwent the aforementioned procedures between 2024 and 2025. General anesthesia included intubation with a double-lumen endobronchial tube and one-lung ventilation with a tidal volume of 4–6 mL/kg of ideal body weight and positive end-expiratory pressure of 5–8 cm H_2O. Non-invasive blood pressure, temperature, urine output, acid-base status, and venous blood lactate were monitored; central venous access was used. Perfusion was performed in a closed circuit at 42 °C for up to 60 minutes with cisplatin at 125 mg/m². Descriptive statistics were used.

Results: Patient age ranged from 35 to 68 years, with a mean age of 56.6 years. The median duration of anesthesia was 8 hours and 13 minutes, blood loss – 500 mL, fluid therapy – 5500 mL, and urine output – 900 mL. Respiratory and pleural complications were recorded in 9 (60.0%) patients, acute kidney injury – in 2 (13.3%); one patient required 10 sessions of hemodialysis. One case each (6.7%) of thrombotic complications and atrial fibrillation was observed. The median length of stay in the intensive care unit was 2 days. All patients were discharged from the hospital; two late deaths were recorded during follow-up.

Conclusions: Cytoreductive thoracic surgeries with hyperthermic intrapleural chemotherapy are associated with significant perioperative burden and a risk of respiratory, pleural, and renal complications. Our experience highlights the need for protective one-lung ventilation, adequate fluid and hemodynamic support, monitoring of acid-base status, temperature, and urine output, as well as early detection of renal dysfunction.

Funding: This study was financially supported by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, Grant No. BR24992950 "Creation and implementation of innovative methods for the treatment of oncological diseases."

Keywords: Hyperthermic Intrapleural Chemotherapy; Anesthesia; One-Lung Ventilation; Cisplatin; Thoracic Surgery; Perioperative Management

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Congress Abstract

Epidemiology of Viral Infections and Characteristics of Epstein–Barr Virus DNA Detection After Allogeneic Hematopoietic Stem Cell Transplantation

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Introduction: Viral reactivations frequently complicate the post-transplant period; however, unified viral load thresholds and criteria for preemptive therapy of Epstein–Barr virus infection are lacking. Objective: To evaluate the frequency of reactivations and the characteristics of Epstein–Barr virus DNA detection in various biological materials in adults after first allogeneic hematopoietic stem cell transplantation.

Materials and Methods: This single-center retrospective cohort study of anonymized data included 120 patients over 18 years of age after first allogeneic hematopoietic stem cell transplantation in 2023. Six patients with viral events preceding transplantation were excluded; 114 patients were analyzed. Viral DNA was detected by polymerase chain reaction. Reactivation was recorded when more than 500 copies of viral DNA were detected. Quantitative data are presented as median and range, categorical data as number of observations and proportions.

Results: Viral reactivations were recorded in 75 patients (65.8%), with two or more viruses in 33 patients (28.9%). Cytomegalovirus was detected in 41 patients, human herpesvirus type 6 in 30, parvovirus B19 in 27, and Epstein–Barr virus in ten (8.8%). After transplantation, Epstein–Barr virus DNA was detected in blood or bone marrow in ten patients, in gastrointestinal mucosal biopsy specimens in seven, and in bronchoalveolar lavage fluid in ten. When considering all materials, the virus was detected in 23 patients (20.2%); in 13 patients, it was detected only in biopsy specimens or bronchoalveolar lavage fluid. Post-transplant lymphoproliferative disease was not recorded.

Conclusions: Viral reactivations were detected in two-thirds of patients, with multiple viruses in nearly one-third. The detection rate of Epstein–Barr virus DNA depended on the material tested: 8.8% in blood or bone marrow and 20.2% when considering all samples. Local positive results require clinical interpretation. Post-transplant lymphoproliferative disease was not recorded.

Keywords: Hematopoietic Stem Cell Transplantation; Epstein–Barr Virus Infections; Viral Diseases; Viral Load; Polymerase Chain Reaction

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Congress Abstract

Supplemental Screening for Women with Dense Breast Tissue: A Review of Published Evidence from the Dense, Braid, Praim and Assure Studies

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Background: Dense breast tissue reduces mammographic sensitivity and raises breast cancer risk. Supplemental imaging and artificial intelligence supported mammography reading have been tested prospectively. The European Society of Breast Imaging recommends supplemental magnetic resonance imaging for extremely dense breasts, whereas the American College of Physicians in 2026 advised against it for average risk women with dense breasts. This review summarises what the principal studies measured and found.

Objective: To review the published evidence on both strategies in dense breasts, reporting each study's endpoints and results.

Materials and Methods: Narrative review of primary publications, published online 2019 to 2025, quoted verbatim. Four large prospective multicentre studies reporting on dense breasts were selected, two per strategy: the randomised trials DENSE (Netherlands, magnetic resonance imaging) and BRAID (United Kingdom, abbreviated magnetic resonance imaging, automated ultrasound and contrast-enhanced mammography), and the observational studies PRAIM (Germany, artificial intelligence supported double reading) and ASSURE (United States, artificial intelligence supported single reading with safeguard review).

Results: DENSE randomised 40,373 women with extremely dense breasts and normal mammography to invitation for supplemental magnetic resonance imaging or to mammography alone: interval cancers 2.5 versus 5.0 per 1000; among the 59% accepting, detection was 16.5 and false positives 79.8 per 1000. BRAID randomised 9361 women with dense breasts and a negative mammogram: detection was 17.4 per 1000 examinations with abbreviated magnetic resonance imaging, 19.2 with contrast-enhanced mammography and 4.2 with automated ultrasound, the contrast-based modalities not differing significantly; recall 9.7%, 9.7% and 4.0%, median invasive size 10, 11 and 22 millimetres. In PRAIM (463,094 women), artificial intelligence supported double reading was associated with detection of 6.7 versus 5.7 per 1000 (17.6% higher) and non-inferior recall; in dense breasts the 18.7% increase was not statistically significant. In ASSURE (579,583 tomosynthesis examinations, single reading), detection with the artificial intelligence workflow was 5.6 versus 4.6 per 1000 (21.6% higher), recall 11.1% versus 10.6%, and detection in dense breasts 22.7% higher.

Conclusions: In BRAID, abbreviated magnetic resonance imaging and contrast-enhanced mammography detected three times as many invasive cancers as automated ultrasound, at half the size with more than twice the recall, and did not differ significantly from each other. In DENSE, invitation to supplemental magnetic resonance imaging halved the interval cancer rate. Artificial intelligence support was associated with higher detection in PRAIM without higher recall and in ASSURE with slightly higher recall; neither was randomised. No included study measured breast cancer mortality; survival benefit remains undemonstrated and overdiagnosis unquantified.

Keywords: Breast Neoplasms; Breast Density; Mammography; Magnetic Resonance Imaging; Ultrasonography; Mammary; Radiographic Image Interpretation; Computer-Assisted

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Congress Abstract

Minimally Invasive Technology in The Treatment of Bladder Tumors Complicated by Bleeding

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Background: Tumor-related bleeding in bladder cancer is a serious complication that may limit the feasibility of standard surgical treatment, particularly in patients with comorbidities. Chemoembolization of the inferior vesical arteries is a minimally invasive technique combining local administration of an antineoplastic agent with embolization of the vessels supplying the tumor.

Objective: To evaluate the outcomes of chemoembolization of the inferior vesical arteries in patients with bladder cancer complicated by bleeding.

Materials and Methods: From 2020 to November 2024, chemoembolization of the inferior vesical arteries was performed in 12 patients with bladder cancer at the State Enterprise on the Right of Economic Management "Multidisciplinary Medical Center" of the Akimat of Astana. The procedure was performed using doxorubicin (Adriamycin) at a dose of 50 mg or cisplatin at a dose of 50 mg. Treatment efficacy was assessed based on the patients' general condition, presence of gross hematuria, changes in laboratory blood parameters, and tumor size evaluated by computed tomography, ultrasonography, and cystoscopy.

Results: At two months after chemoembolization, no episodes of gross hematuria were observed, and laboratory blood parameters showed improvement. After two chemoembolization sessions, tumor size decreased by more than 25% on average, as assessed by computed tomography, ultrasonography, and cystoscopy. Six patients underwent surgical treatment three months after the first chemoembolization procedure: transurethral resection in four patients, open bladder resection in one, and cystectomy in one. Histopathological examination of the resected tumor tissue demonstrated treatment-induced tumor necrosis. Three patients with advanced disease were referred for further chemoradiotherapy. Three patients with early-stage disease remained under surveillance with a recommendation for intravesical chemotherapy.

Conclusions: Chemoembolization of the inferior vesical arteries may be considered a minimally invasive method for controlling tumor-related bleeding in patients with bladder cancer, particularly when major surgical intervention is limited by comorbidities. The findings suggest that this approach may be promising; however, the small sample size and limited follow-up period warrant further investigation to determine the optimal number of treatment sessions and assess long-term efficacy.

Keywords: Bladder Cancer; Hematuria; Chemoembolization; Embolization; Cisplatin; Transurethral Resection

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Congress Abstract

The Role of Fine-Needle Aspiration Biopsy and Sonographic Stratification in Surgical Decision-Making for Pediatric Thyroid Nodules: Experience from an Ambulatory Surgery Center

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Introduction: Pediatric nodular thyroid disease is associated with an elevated probability of malignant transformation (20% to 26%), necessitating precise preoperative diagnostic triage (1). International consensus guidelines establish ultrasound-based risk stratification using the Thyroid Imaging Reporting and Data System (TI-RADS) alongside fine-needle aspiration biopsy (FNAB) with cytopathological evaluation under the Bethesda System as pivotal clinical instruments guiding the choice between observation and surgical intervention (1,2). This study aimed to evaluate the impact of TI-RADS and cytopathological classification on the selection of surgical versus observational management strategies in pediatric patients with thyroid nodules.

Materials and Methods: A consecutive retrospective analysis was conducted on 15 patients aged 10 to 17 years with thyroid nodules evaluated between October 2024 and July 2026 at an ambulatory surgical center. Inclusion criteria encompassed age under 18 years, ultrasonographic confirmation of a nodular lesion, and completion of fine-needle aspiration biopsy. No exclusion criteria were applied. The diagnostic workup incorporated sonography with TI-RADS categorization, ultrasound-guided biopsy with cytopathological reporting according to the Bethesda System (2,3), and serological assessment of thyroid-stimulating hormone (TSH), free thyroxine, antithyroid antibodies, and calcitonin. Data analysis relied on the calculation of relative frequencies and proportions. The study was conducted in accordance with the principles of the Helsinki Declaration; retrospective analysis of anonymized data did not require informed consent.

Results: Female adolescents constituted the majority of the cohort (86.7%; 13/15), with an overall mean age of 14.8 ± 2.3 years, consistent with the age distribution of thyroid pathology in adolescents (1). Ultrasound stratification revealed TI-RADS 2–3 in 73.3% (11/15) and TI-RADS 4 in 26.7% (4/15). Initial cytopathological classification yielded category I in 40.0% (6/15), category III in 26.7% (4/15), category IV in 26.7% (4/15), and category V in 6.7% (1/15). The proportion of non-diagnostic aspirates was related to the presence of cystic elements within this cohort (4). Hormonal profiling demonstrated euthyroidism in all evaluated cases with a median thyroid-stimulating hormone concentration of 2.1 mIU/L. Conservative dynamic surveillance at three- to six-month intervals was chosen for 93.3% of children (14/15). In one adolescent (6.7%; 1/15) presenting concordant TI-RADS 4 and category IV cytology, total thyroidectomy with regional lymph node clearance was performed; postoperative histopathology confirmed metastatic papillary thyroid carcinoma (1,5). The overall confirmed malignancy rate was 6.7%, which aligns with literature data for pediatric populations (5% to 26%) (1,5).

Conclusions: Combined application of TI-RADS sonographic stratification and Bethesda-based biopsy enables reliable triage of pediatric patients. The substantial proportion of category I aspirates (40.0%) mandates repeat aspiration for cystic lesions, whereas concordance between TI-RADS 4 sonographic criteria and neoplastic cytology constitutes a direct indication for surgical intervention.

Keywords: Thyroid Nodule; Biopsy, Fine-Needle; Thyroid Neoplasms; Child; Ultrasonography; Cytopathology

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Congress Abstract

15-Year Development of the Oncology Service in Astana

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Background: The rapid population growth of Astana has been accompanied by an increasing demand for specialized cancer care. Cancer prevention, early diagnosis, improvement of treatment strategies, and enhancement of patients' quality of life and survival remain key priorities of the oncology service.

Objective: To assess major changes in the organization, capacity, and technological development of the oncology service in Astana over a 15-year period.

Materials and Methods: A retrospective analysis of the main organizational indicators of the State Enterprise on the Right of Economic Management "Multidisciplinary Medical Center" of the Akimat of Astana over a 15-year period was performed. Changes in patient volume, staffing, implementation of modern diagnostic and treatment technologies, screening, and cancer prevention activities were evaluated.

Results: Over 15 years, the nearly threefold increase in the population of Astana was accompanied by a substantial rise in the workload of the oncology service. Despite a planned outpatient capacity of 380 visits per day, the actual number reached up to 1,300 patients daily. The total number of employees increased from 250 to 864, including 177 physicians and 318 nursing professionals. Modern laboratory and radiation diagnostic methods, immunohistochemical and cytochemical testing, targeted therapy, and immunotherapy were introduced into clinical practice. Linear accelerators, angiographic systems, and video endoscopic equipment expanded the capabilities of radiation therapy, diagnostic procedures, and minimally invasive treatment. Cancer screening, follow-up programs, and public cancer awareness initiatives were further developed to support early detection of malignancies.

Conclusions: Over the 15-year period, the oncology service in Astana substantially expanded its workforce and technological capacity while responding to rapid population growth and increasing demand for cancer care. The implementation of modern diagnostic and treatment technologies, development of screening programs, and strengthening of human resources provide a foundation for further improvements in the accessibility and quality of oncology care.

Keywords: Oncology Service; Cancer Care; Screening; Early Diagnosis; Medical Technology; Healthcare Management

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Congress Abstract

Multidisciplinary Approach to The Organization of Cancer Care

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Background: A multidisciplinary approach is an important component of high-quality cancer care, enabling collaborative decision-making on diagnostic and treatment strategies in accordance with clinical protocols and recommendations of international oncology societies. In accordance with the national Standard for the Organization of Cancer Care in the Republic of Kazakhstan, multidisciplinary teams (MDTs) covering the main areas of oncology have been established at the State Enterprise on the Right of Economic Management "Multidisciplinary Medical Center" of the Akimat of Astana.

Objective: To evaluate the organization of multidisciplinary team activities and their role in collaborative clinical decision-making in cancer care.

Materials and Methods: Six specialized MDTs were established: thoracic surgery, abdominal surgery, head and neck oncology, gynecologic oncology, urologic oncology, and medical oncology, along with a chemotherapy council. MDT meetings review newly diagnosed patients with histologically verified malignancies, patients with diagnostic challenges, recurrent or progressive disease, treatment-related complications or contraindications, and cases requiring modification of the treatment strategy. Decisions are made collaboratively based on medical records, diagnostic findings, clinical protocols, and recommendations of the European Society for Medical Oncology (ESMO), American Society of Clinical Oncology (ASCO), and National Comprehensive Cancer Network (NCCN). MDT protocols are continuously monitored for compliance with established requirements.

Results: In 2025, a total of 4,142 patient cases were reviewed at MDT meetings. The MDT process included collaborative selection of diagnostic and treatment strategies, determination of further patient management, assessment of the need to modify previously prescribed treatment, referral for specialized and highly specialized medical care, and evaluation of indications for targeted therapy. MDT decisions were documented in meeting protocols and incorporated into patients' medical records. The established MDT process ensured systematic multidisciplinary review of clinical cases and continuous monitoring of clinical decisions.

Conclusions: The implementation of specialized multidisciplinary teams provides a structured framework for collaborative decision-making in cancer care and promotes a consistent approach to diagnostic and treatment strategies. Regular monitoring of MDT protocols supports compliance with established requirements. Further assessment using quantitative indicators of adherence to MDT recommendations, treatment modifications, and patient outcomes is warranted to objectively evaluate the impact of MDTs on the quality and outcomes of cancer care.

Keywords: Multidisciplinary Team; Oncology; Clinical Decision-Making; Healthcare Management; Quality of Care; Monitoring

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Congress Abstract

Nutritional Disorders, Mucositis, and Sepsis after Autologous and Allogeneic Hematopoietic Stem Cell Transplantation

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Introduction: Nutritional deficiency is a significant clinical problem in patients who have undergone hematopoietic stem cell transplantation (HSCT). The development of mucositis, systemic inflammatory response, and infectious complications is accompanied by reduced oral intake, increased catabolic processes, and body weight loss. At the same time, specialized nutritional support in real-world clinical practice is often initiated only after severe complications have already developed, which determines the need to shift from a reactive to an early differentiated strategy of nutritional support.

Objective: To compare nutritional status and clinical complications after autologous and allogeneic HSCT, to assess the associations of severe mucositis, sepsis, and specialized nutritional support with laboratory parameters and length of hospitalization, and to substantiate the need for an algorithm of early differentiated nutritional support.

Materials and Methods: A single-center retrospective study was conducted on 70 patients who underwent HSCT: 35 after autologous and 35 after allogeneic transplantation. Body weight dynamics, total protein and albumin levels, maximum C-reactive protein levels, presence and grade of mucositis, frequency of sepsis and thromboses, microbiological profile of infectious complications, use of specialized nutritional support, and length of hospitalization were analyzed. Comparative analysis was performed taking into account the type of HSCT, presence of severe mucositis, sepsis, and use of nutritional support. Fisher's exact test was used for comparison of categorical variables. Differences were considered statistically significant at $p < 0.05$.

Results: A body weight loss of more than 5% was statistically significantly more frequent after allogeneic HSCT compared to autologous: 100% vs. 77.1%, respectively ($p = 0.005$). Sepsis was recorded in 62.9% of patients after allogeneic and 45.7% after autologous HSCT; the difference did not reach statistical significance ($p = 0.229$). Among cases with identified pathogens, gram-positive microorganisms accounted for 51.4% ($n = 19$) and gram-negative for 48.6% ($n = 18$). Resistant or clinically problematic microorganisms were identified in 22 cases of sepsis (57.9%); Klebsiella pneumoniaeand Escherichia coli predominated among the pathogens.

In patients with sepsis, minimum albumin values were lower compared to patients without sepsis: 30.1 vs. 32.5 g/L ($p = 0.001$), as were minimum total protein values: 50.9 vs. 54.1 g/L ($p = 0.033$). Maximum C-reactive protein levels were substantially higher:

163.5 vs. 78.0 mg/L ($p < 0.001$). Sepsis was also associated with a longer length of hospitalization: 36.9 vs. 34.5 days ($p = 0.010$).

Thrombotic complications were more frequently recorded after allogeneic HSCT: 34.3% vs. 11.4% after autologous HSCT ($p = 0.044$). With grade III–IV mucositis, specialized nutritional support was received by 39 of 41 patients (95.1%), whereas among patients without severe mucositis – 4 of 29 (13.8%; $p < 0.001$). Initiation of specialized nutritional support within the first 48 hours was noted in only 4 of 70 patients (5.7%).

After autologous HSCT, the length of hospitalization in patients receiving specialized nutritional support was 36.0 ± 5.7 days vs. 32.2 ± 2.9 days in patients without it ($p = 0.03$). After allogeneic HSCT, the corresponding values were 37.8 ± 3.2 and 36.3 ± 2.7 days ($p > 0.05$).

Conclusions: Nutritional disorders are a frequent complication of both autologous and allogeneic HSCT; however, the most pronounced body weight loss is observed after allogeneic transplantation. Sepsis is associated with a more pronounced decrease in albumin and total protein levels, an increase in C-reactive protein, and a longer length of hospitalization. Specialized nutritional support was prescribed predominantly to patients with already developed severe mucositis, whereas its early initiation within the first 48 hours was used only in isolated cases. The obtained data indicate the predominantly reactive nature of the existing nutritional support strategy and substantiate the need for its earlier individualization.

Based on the study results, an algorithm of early differentiated nutritional support for patients after HSCT was developed. Currently, a prospective phase of the study is being conducted with daily monitoring of actual energy and protein intake, volume of nutritional support, and clinical and laboratory dynamics in patients after allogeneic HSCT. The prospective observation is aimed at evaluating the applicability of the developed approach and its subsequent association with nutritional and clinical outcomes.

Keywords: Hematopoietic Stem Cell Transplantation; Nutritional Status; Nutritional Support; Mucositis; Sepsis

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Congress Abstract

Immunotherapy and Targeted Therapy for Metastatic Renal Cell Carcinoma

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Background: The introduction of targeted therapy and immune checkpoint inhibitors has significantly improved treatment outcomes in patients with locally advanced and metastatic renal cell carcinoma (mRCC). However, tumor heterogeneity and the development of alternative signaling pathways may contribute to treatment resistance, emphasizing the need for effective combination strategies.

Objective: To evaluate the efficacy of contemporary immunotherapy-based combinations in the first-line treatment of metastatic renal cell carcinoma and identify clinical factors relevant to treatment selection.

Materials and Methods: Published data from randomized phase III studies of first-line systemic therapy for advanced and metastatic renal cell carcinoma were analyzed. Particular attention was given to nivolumab plus ipilimumab and lenvatinib plus pembrolizumab compared with sunitinib. Treatment efficacy was assessed using progression-free survival (PFS), overall survival (OS), objective response rate (ORR), and outcomes according to International Metastatic Renal Cell Carcinoma Database Consortium (IMDC) risk groups.

Results: In the CLEAR trial, lenvatinib plus pembrolizumab significantly prolonged median PFS compared with sunitinib (23.9 vs 9.2 months) and improved overall survival. In patients with intermediate/poor IMDC risk, median PFS was 22.1 months with lenvatinib plus pembrolizumab versus 5.9 months with sunitinib, while ORR was 72.4% versus 28.8%, respectively. Long-term results of the CheckMate 214 trial demonstrated a sustained survival benefit with nivolumab plus ipilimumab compared with sunitinib. The final analysis after a median follow-up of 9.3 years showed an OS hazard ratio of 0.71 in the intention-to-treat population and 0.69 in patients with intermediate/poor IMDC risk. Durable responses were maintained across long-term follow-up.

Conclusions: Immunotherapy-based combinations have substantially improved the treatment of metastatic renal cell carcinoma. Lenvatinib plus pembrolizumab provides significant improvements in PFS and objective response compared with sunitinib, while nivolumab plus ipilimumab demonstrates durable long-term survival benefits. Selection of first-line therapy should consider IMDC risk group, tumor burden, metastatic sites, clinical condition, histological characteristics, and individual patient factors.

Keywords: Renal Cell Carcinoma; Immunotherapy; Targeted Therapy; Lenvatinib; Pembrolizumab; Nivolumab

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Congress Abstract

Development of a Pharmacological Agent for the Prevention of Complications of Radiotherapy for Solid Tumors: Results of Preclinical Studies

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Introduction: The problem of developing effective and safe pharmacological agents for the prevention and treatment of acute and late complications of radiation therapy for malignant neoplasms is highly relevant for the entire global community. Currently, various modalities of radiation therapy are used in the treatment of 50–70% of patients with oncological diseases. At the same time, despite continuous improvement of medical radiological devices and methods of planning radiation exposure, a significant proportion of patients (from 10–20% to 40–60%, depending on localization) receiving radiotherapy develop acute or late complications caused by radiation-induced damage to normal, non-malignant tissues.

At the A.F. Tsyb Medical Radiological Research Center, an innovative agent for the prevention of radiotherapy complications has been developed – a unique radioprotector T1082, capable of selectively protecting healthy tissues without reducing the efficacy of radiation therapy for solid tumors. Its high efficacy has been demonstrated with both parenteral and oral administration in small and large laboratory animals using models of acute and late radiation injuries and in experimental radiation therapy of tumors.

It has been shown that T1082, when administered as a single oral dose at safe doses of 180–220 mg/kg (constituting 1/13–1/10 of LD10), provides pronounced (DRF – 1.6–1.9) prevention of bone marrow and intestinal acute radiation sickness in mice and rats under total-body gamma irradiation, without being inferior in efficacy to the best known radioprotectors. Moreover, the radioprotective effect of T1082 is systemic in nature, which allows it to also effectively (DRF – 1.4–1.7) counteract the development of and mitigate the course of acute and late local radiation injuries to normal somatic tissues, as demonstrated in models of radiation skin burn, radiation mucositis, and radiation pneumofibrosis.

At the same time, in malignant tissues of solid neoplasms, the radioprotective effect of T1082 is practically not realized: in models of radiotherapy of transplantable solid tumors of animals of various histogenesis and organ specificity, T1082, when administered as a single oral dose at 1/13–1/10 of LD10, reliably protected irradiated normal tissues but did not attenuate the antitumor effects of gamma and β radiation against experimental solid neoplasms.

Thus, the results of preclinical studies demonstrate the efficacy and safety of the developed agent and create the conditions for the development and introduction into clinical practice of an innovative domestic medicinal product capable of qualitatively limiting the toxicity of existing methods of radiation therapy for solid tumors and, overall, improving the efficacy and quality of treatment of oncological diseases.

Keywords: 1-Isobutanoyl-2-Isopropylisothiourea Phosphate; NOS Inhibitor; Hypoxic Radioprotector; Safety; Radiotherapy Complications; Selective Protection of Healthy Tissues

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Congress Abstract

Association Between the Cervicovaginal Microbiota and Tumor Characteristics in Cervical Cancer

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Introduction: Persistent infection with high-risk human papillomavirus is a necessary step in cervical carcinogenesis; however, the development of neoplasia is also determined by the state of the local microbial and immune microenvironment. Lactobacillus deficiency, anaerobic dysbiosis, and inter-kingdom biofilms can sustain inflammation, damage to the epithelial barrier, and persistence of viral infection.

Objective: To study the cervicovaginal microbiota in cervical cancer and to determine its association with histological type and characteristics of the tumor process.

Materials and Methods: The study had an analytical case-control design with cross-sectional and prospective-analytical components and included two research arms of 100 women each: a clinical screening cohort without verified invasive cervical cancer and a cohort of patients with morphologically confirmed invasive cancer. Cervicovaginal biocenosis was investigated by quantitative real-time polymerase chain reaction using the "Femoflor-16" panel. Genotyping of 14 types of high-risk human papillomavirus, cytological assessment, and histological verification were performed. Statistical analysis included the Mann–Whitney U test, chi-square or Fisher's exact test, univariate and multivariate logistic regression, interaction analysis, and clustering of microbiome profiles.

Results: In the clinical screening cohort, high-risk human papillomavirus was detected in 72% of women, microbial community type IV in 20%, cervical intraepithelial neoplasia grade 2 or higher in 27%, Candida fungi in 56%, Gardnerella vaginalis in 59%, and their co-colonization in 30%. The combined detection of Candida fungi and Gardnerella vaginalis had the most pronounced association with cervical intraepithelial neoplasia grade 2 or higher: odds ratio 4.84; 95% confidence interval 2.41–9.70; $p < 0.001$. In invasive cancer, microbial community type IV was detected in 86% of patients. Squamous cell carcinoma predominantly corresponded to a profile dominated by bacteria of the genera Fusobacterium and Sneathia, while the glandular phenotype corresponded to a cluster dominated by bacteria of the genera Prevotella and Gardnerella. Belonging to the latter cluster retained an independent association with adenocarcinoma and adenosquamous carcinoma after accounting for human papillomavirus genotype 18 and tumor stage: adjusted odds ratio 8.76; 95% confidence interval 2.72–28.20; $p < 0.001$.

Conclusions: The cervicovaginal microbiota represents an additional biological level of human papillomavirus-associated carcinogenesis. Co-colonization with Candida fungi and Gardnerella vaginalis is most pronouncedly associated with cervical intraepithelial neoplasia grade 2 or higher, while microbial community type IV predominates in invasive cancer. Histotype-specific profiles justify further development and external validation of a microbiome-viral risk stratification model.

Keywords: Cervical Neoplasms; Papillomavirus Infections; Vaginal Microbiome; Microbiota; Candida; Gardnerella Vaginalis

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Congress Abstract

HER2-Ultralow in Invasive Breast Cancer: Frequency, Reclassification and Concordance of HER2 Status Assessment

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Introduction: The expansion of indications for trastuzumab deruxtecan following the DESTINY-Breast06 trial has increased the clinical relevance of minimal HER2 membrane staining that was previously included within the HER2 0 category. In the current CAP protocol, HER2 0 is further subdivided into 0 with no membrane staining and 0+ with membrane staining, corresponding to the HER2-ultralow phenotype. Conventional HER2 immunohistochemistry (IHC) has historically been focused on identifying HER2 overexpression, whereas assessment of very low levels of HER2 staining is less reproducible. This places greater emphasis on the distinction between HER2 0 with no detectable expression (HER2-null), HER2-ultralow, and HER2 IHC 1+.

Objective: To determine the frequency of HER2-ultralow expression among invasive breast carcinomas initially classified as HER2 0, to assess patterns of reclassification on repeat review, and to evaluate concordance between the initial and repeat standard HER2 status.

Materials and Methods: A retrospective single-center study included 241 cases of invasive breast carcinoma without prior neoadjuvant therapy diagnosed between January and July 2026. Initial HER2 status was assessed by IHC in routine clinical practice according to the 2023 ASCO/CAP recommendations, and all slides were subsequently reviewed by a second pathologist. IHC was performed using the HER2 antibody clone 4B5 (Ventana). During repeat assessment, HER2 0 cases were further subclassified as HER2-null or HER2-ultralow. For concordance analysis, both subcategories were combined within the conventional HER2 0 category. Overall percent agreement and Cohen's κ coefficient were calculated. Clinicopathological associations were evaluated in an exploratory analysis.

Results: The initial HER2 distribution was as follows: 0 in 112/241 cases (46.5%), 1+ in 66 (27.4%), 2+ in 24 (10.0%), and 3+ in 39 (16.2%). Following repeat review, HER2-ultralow expression was identified in 55/241 cases (22.8%). Among the 112 tumors initially classified as HER2 0, 61 (54.5%) were categorized as HER2-null, 44 (39.3%; 95% CI, 30.7–48.5%) as HER2-ultralow, and 7 (6.2%) were reclassified as HER2 1+. Standard HER2 status changed in 22/241 cases (9.1%), with 20/22 discrepancies (90.9%) occurring at the HER2 0↔1+ boundary. Overall agreement was 90.9%, with a Cohen's κ of 0.864. Among tumors initially classified as HER2 0 with known hormone receptor (HR) status, HER2-ultralow expression was identified in 35/80 (43.8%) HR-positive tumors and 2/16 (12.5%) HR-negative tumors (OR, 5.44; 95% CI, 1.16–25.55; p=0.024). No statistically significant differences were observed according to histologic grade or Ki-67 proliferation index.

Discussion and Conclusions. HER2-ultralow expression was identified in 39.3% of tumors initially classified as HER2 0, a proportion comparable with that reported in recent retrospective studies. Changes in HER2 classification occurred predominantly at the HER2 0↔1+ boundary, highlighting the diagnostic vulnerability of the lower

range of HER2 expression. Although concordance for conventional HER2 categories was high (κ=0.864), this analysis does not assess the reproducibility of distinguishing HER2-null from HER2-ultralow because interobserver agreement specifically at this boundary was not evaluated. These findings emphasize the heterogeneity of the HER2 0 category and support the importance of standardized assessment and explicit reporting of minimal HER2 membrane staining in routine pathologic practice.

Keywords: Breast Cancer; HER2-Ultralow; Immunohistochemistry

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Congress Abstract

Activities of the Medical Quality Control Service

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Background: Internal quality control is an essential component of healthcare management aimed at ensuring compliance with established standards, identifying and eliminating deficiencies, improving clinical processes, and enhancing patient safety.

Objective: To evaluate the main activities and outcomes of the Medical Quality Control Service at the State Enterprise on the Right of Economic Management "Multidisciplinary Medical Center" of the Akimat of Astana.

Materials and Methods: The activities of the Quality Control Service in 2024–2025 were analyzed. Key areas included preparation for national accreditation, updating standard operating procedures, internal audits of medical records and clinical processes, identification of deficiencies, and analysis of complications and mortality.

Results: In 2024–2025, the Center successfully completed national accreditation. In 2025, more than 3,000 inpatient medical records and 1,500 day-care records were audited. Clinical processes in surgical and chemotherapy departments were regularly monitored. More than 40 mortality case reviews and 14 meetings of the Medical Quality Control Committee were conducted. Identified deficiencies were analyzed, followed by the development of corrective measures.

Conclusions: Systematic internal audits, process standardization, and analysis of healthcare deficiencies are important tools for quality assurance. The Quality Control Service contributes to identifying areas for improvement, implementing corrective measures, and maintaining compliance with established healthcare quality standards.

Keywords: Quality of Care; Internal Audit; Accreditation; Patient Safety; Quality Management; Medical Records

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Congress Abstract

Assessment of Process Quality Indicators for Adjuvant Chemotherapy in Stage III Colon Cancer

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Background: Adjuvant chemotherapy is the standard of care after radical resection of stage III colon cancer. Key process quality indicators include the use of standard regimens, timely treatment initiation, treatment completion, and documentation of reasons for deviations. In Kazakhstan, data on these indicators and regional patient pathways remain limited.

Objective: To assess process quality indicators of adjuvant chemotherapy after radical surgery, taking into account subsequent treatment provided at the patients' place of residence.

Materials and Methods: This single-center retrospective cohort study included 45 patients aged ≥18 years with morphologically confirmed stage III colon cancer who underwent radical resection at the National Scientific Oncology Center between January 9, 2021, and December 5, 2023. Patients with distant metastases at surgery, prior neoadjuvant chemotherapy, or rectal cancer were excluded. Subsequent treatment was mainly provided at the patients' place of residence, and data were retrieved from medical records. We assessed treatment administration, reasons for non-initiation, use of standard regimens, time to treatment initiation, proportion of planned cycles completed, and reasons for non-completion. Descriptive statistics were performed using IBM SPSS Statistics. Interregional comparisons were not performed due to small and uneven subgroup sizes.

Results: Adjuvant chemotherapy was administered to 36/45 patients (80.0%). Among nine untreated patients, one had medical contraindications, one refused treatment, and the reason was undocumented in seven. Standard regimens were used in 34/36 patients (94.4%). Among 34 patients with available timing data, median time to treatment initiation was 5.4 weeks (range, 1.0–11.7), and 31 (91.2%) started within 8 weeks. Among 34 patients with data on planned cycles, the median proportion of completed cycles was 70.8% (range, 25.0–100.0%); 15 (44.1%) completed the full course and 17 (50.0%) received ≥75% of planned cycles. Among 19 patients who did not complete treatment, reasons included progression in seven, toxicity in three, and coronavirus infection, drug unavailability, and death due to stroke in one case each; the reason was undocumented in six. Patients represented 12 regions, with subgroup sizes of 1–18 patients.

Conclusions: Most patients received standard adjuvant chemotherapy and initiated treatment within the recommended timeframe; however, fewer than half completed the full planned course. Reasons for non-completion were heterogeneous and should not be interpreted as a single marker of inadequate quality of care. Incomplete documentation and interregional patient pathways limited the assessment. Expansion of the registry and standardized data exchange are required for further analysis.

Keywords: Colonic Neoplasms; Chemotherapy, Adjuvant; Quality Indicators, Health Care; Treatment Outcome; Retrospective Studies

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Congress Abstract

Light as Treatment, Support as a Resource: The Role of Psycho-Oncology in Supporting Patients Undergoing Photodynamic Therapy

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Introduction: The growing cancer burden in Kazakhstan necessitates improvement not only in antitumor treatment but also in comprehensive patient-centered support. According to the analyzed statistical data, the number of patients under follow-up observation increased from 190,159 in 2020 to 246,205 in 2025, corresponding to a 29.5% increase. During this period, the number of registered breast cancer cases increased by 31.8%, and lung cancer by 64.9%. Cancer and its treatment can be accompanied by anxiety, emotional distress, and reduced quality of life. Photodynamic therapy (PDT) is a modern minimally invasive treatment for a range of oncological diseases; however, the psychological characteristics of patients undergoing this method and the effectiveness of specialized support remain insufficiently studied.

Objective: To analyze the dynamics of the cancer burden in Kazakhstan for 2020–2025 and to summarize data on the role of psycho-oncological support for patients undergoing PDT, while identifying prospects for further study in this area.

Materials and Methods: An analytical analysis of secondary data was conducted in two stages. At the first stage, a retrospective analysis of cancer incidence indicators in Kazakhstan for 2020–2025 was performed, calculating the absolute and relative change in the number of patients under follow-up observation, as well as indicators for breast cancer and lung cancer. At the second stage, a qualitative analysis of published scientific data on psycho-oncology, psychological distress, anxiety, quality of life, and psychological support for cancer patients, including materials on PDT, was conducted. Primary collection of clinical and psychometric data was not performed.

Results: During the study period, the number of patients under follow-up observation increased by 56,046 individuals (29.5%)—from 190,159 to 246,205. The number of breast cancer cases increased from 4,290 to 5,652 (31.8%), and lung cancer from 2,324 to 3,833 (64.9%). A literature analysis showed that cancer and antitumor treatment can be accompanied by emotional distress, anxiety, and reduced quality of life. Psycho-oncological interventions generally demonstrate a positive impact on the psychological state and quality of life of patients. In PDT, psychological tension may be related to the diagnosis, anticipation of the procedure, and treatment characteristics; however, the specific effectiveness of psychological support in this method remains insufficiently studied.

Conclusions: The growing cancer burden in Kazakhstan confirms the need to develop a comprehensive patient support system. Psycho-oncological support is regarded as a promising component of care in PDT; however, prospective clinical studies using validated psychometric instruments to assess anxiety, depressive symptoms, psychological distress, and quality of life before and after treatment are needed to confirm its effectiveness.

Keywords: Psycho-Oncology; Photodynamic Therapy; Oncological Diseases; Psychological Distress; Anxiety; Quality of Life

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Congress Abstract

Clinical-Pathological and Molecular Predictors of Recurrence in Papillary Thyroid Cancer in Adolescent and Young Adult Patients in the Republic of Kazakhstan

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Introduction: Papillary thyroid cancer (PTC) is characterized by a favorable prognosis; however, disease recurrence remains a clinically significant problem among adolescent and young adult (AYA) patients. The prognostic role of molecular alterations in this age group remains insufficiently studied, especially in Central Asian populations.

Objective: To evaluate clinical-pathological and molecular factors associated with PTC recurrence in young adult patients from Kazakhstan.

Materials and Methods: This retrospective multicenter study included 246 patients with histologically confirmed PTC. Tumor tissue samples obtained between 2016 and 2020 were collected at three specialized oncology centers in Kazakhstan: the Kazakh Institute of Oncology and Radiology (Almaty), the Center for Nuclear Medicine and Oncology (Semey), and the Multidisciplinary Center of Oncology and Surgery (Ust-Kamenogorsk). Clinical-pathological characteristics and molecular genetic alterations were analyzed in relation to recurrence risk and survival outcomes. Multivariate regression analysis and time-to-event methods were used to identify factors associated with recurrence, progression-free survival (PFS), and overall survival (OS).

Results: In the AYA subgroup, none of the evaluated clinical-pathological or molecular factors retained a statistically significant association with recurrence after multivariate adjustment. TERT promoter alterations demonstrated the largest estimated association with recurrence (odds ratio [OR] 9.05; 95% confidence interval [CI] 1.00–59.86; p = 0.333); however, statistical significance was not reached. In the overall cohort, the presence of lymph node metastases demonstrated the most pronounced trend toward worse PFS (hazard ratio [HR] 9.61; 95% CI 0.92–100.49; p = 0.059). No statistically significant clinical-pathological or molecular predictors of overall survival were identified.

Conclusions: The risk of PTC recurrence in young adult patients is characterized by heterogeneity and cannot be fully assessed based on clinical-pathological factors alone. TERT promoter alterations may have potential prognostic significance. Larger prospective studies in the Central Asian population are needed to clarify the role of molecular markers and improve individual risk stratification.

Keywords: Papillary Thyroid Cancer; Adolescents and Young Adults; Recurrence; Risk Stratification; TERTp

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Congress Abstract

Results of Stereotactic Radiosurgery for Renal Cell Carcinoma Brain Metastases: A Retrospective Single-Center Study

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Introduction: Renal cell carcinoma brain metastases are a complication of oncological disease and are associated with an unfavorable prognosis. Stereotactic radiosurgery is one of the main methods of local treatment for intracranial metastases. Data on its outcomes in renal cell carcinoma brain metastases in Kazakhstan are limited.

Objective: To evaluate overall survival, intracranial progression-free survival, and local control after stereotactic radiosurgery.

Materials and Methods: A retrospective cohort study was conducted on patients with renal cell carcinoma brain metastases who underwent stereotactic radiosurgery using the Gamma Knife at the National Center for Neurosurgery between 05.10.2021 and 18.03.2026. The median age was 60 years (44–75), the median Karnofsky Performance Status score was 75 (50–90), and the median prognostic score was 1.5 (0–3.5). Extracranial metastases were present in 25 patients (78.1%), and 21 patients (65.6%) received systemic therapy prior to radiosurgery. Overall survival was assessed in 32 patients; intracranial progression-free survival and local control were assessed in 28 patients with available follow-up magnetic resonance imaging (MRI) studies. For local control assessment, 89 treated lesions were analyzed. Survival rates were calculated using the Kaplan–Meier method. The study was approved by the Bioethics Commission No. 1 of the "National Center for Neurosurgery" JSC (protocol extract No. 7 dated April 13, 2026) and conducted in accordance with the ethical principles of the Declaration of Helsinki.

Results: The median overall survival was 22.1 months. Overall survival rates at 6, 12, and 24 months were 71.4%, 60.8%, and 47.9%, respectively. Among the 28 patients with follow-up MRI studies, the median follow-up period was 4.5 months (1.23–36.13), and the median intracranial progression-free survival was 12.7 months. Intracranial progression was recorded in 11 patients: 9 developed new brain metastases, and 2 had leptomeningeal dissemination. Local control was analyzed in 89 treated metastatic lesions in 28 patients. One case of local progression of a treated lesion was recorded by MRI, detected 9.57 months after treatment. Local control at 6 and 12 months was 100% and 96.8%, respectively.

Conclusions: Stereotactic radiosurgery using the Gamma Knife provides high local control of renal cell carcinoma brain metastases. Intracranial progression was predominantly due to the appearance of new metastatic lesions and leptomeningeal dissemination, rather than progression of previously treated lesions. The obtained results demonstrate the high efficacy of the Gamma Knife in achieving local control in patients with renal cell carcinoma brain metastases.

Keywords: Carcinoma, Renal Cell; Brain Neoplasms; Radiosurgery; Progression-Free Survival; Survival Rate; Magnetic Resonance Imaging.

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Congress Abstract

Apheresis-Based Leukapheresis as a Key Step in CAR-T Cell Manufacturing: First Experience in Kazakhstan

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Introduction: CAR-T cell therapy is the newest and most effective treatment method for resistant forms of B-cell hematological malignancies; however, it has until now remained unavailable in Kazakhstan. The first and critically important step in the manufacturing of CAR-T products is apheresis-based leukapheresis — a procedure that determines the quality of the starting cellular material for genetic modification of T lymphocytes. In the Republic of Kazakhstan, this procedure was performed within the framework of a national scientific and technical program for the implementation of CAR-T therapy.

Objective: To study the parameters of apheresis-based leukapheresis and to characterize the cellular composition of the obtained mononuclear cell concentrate in order to assess its suitability as starting material for the manufacturing of CAR-T products.

Materials and Methods: At the Department of Cell Technologies of the Scientific and Production Center of Transfusiology (Astana), 12 leukapheresis procedures were performed in 7 healthy donors and 5 patients with oncohematological diseases. An automated separator Spectra Optia (Terumo BCT, USA) was used with the Mononuclear Cell Collection program. The volume of processed blood, procedure duration, product cellularity, $CD3^+$ T-cell content, and sterility were assessed.

Results: All 12 procedures were completed without complications. The mean volume of processed blood was 9549.5 mL (1.0–2.6 blood volumes), and the mean duration was 230.8 min. Cell yield varied: total leukocyte count ranged from 6.5×10^9 to 32.1×10^9 (mean $14.4\pm8.0\times10^9$), and $CD3^+$ T-lymphocyte content ranged from 129.1×10^7 to 1629.7×10^7 cells per dose. Products from all participants were sterile and deemed suitable for CAR-T cell manufacturing. Differences were noted between the donor and patient groups; however, due to the small sample size, statistical analysis was not performed.

Conclusions: Apheresis-based leukapheresis yields a cellular concentrate that fully meets the requirements for initiating the manufacturing of CAR-T products. This work represents the first standardized protocol in Kazakhstan for obtaining clinically significant cellular material for CAR-T cell manufacturing and lays the foundation for the development of national quality criteria.

Funding: Program-Targeted Funding of the Ministry of Health of the Republic of Kazakhstan BR25293293 "Implementation of chimeric antigen receptor (CAR)-T cell therapy technology for hematological tumors into practical healthcare."

Keywords: CAR-T Cell Therapy; Apheresis-Based Leukapheresis; Mononuclear Cells; $CD3^+$ Lymphocytes; Onomatology

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Congress Abstract

Immunophenotypic Signature of Immature Granulocytes as a Key Predictor of Genetically Confirmed Acute Promyelocytic Leukemia

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Introduction: Acute promyelocytic leukemia is a specific and hematologically emergent subtype of acute myeloid leukemia that requires the fastest possible verification due to the high risk of developing severe coagulopathy. Multicolor flow cytometry enables rapid verification of atypical promyelocytes and the establishment of their immunophenotypic signature even before molecular genetic study results are obtained.

Objective: To study the specific immunophenotypic profile of "immature granulocyte" populations and to evaluate its predictive value in verifying genetically confirmed acute promyelocytic leukemia in comparison with a blast phenotype group.

Materials and Methods: The results of examination of 54 patients with a primary diagnosis of acute leukemia (37 women, 17 men; mean age — 43.7±12.3 years) were analyzed. Based on flow cytometry data, two groups were formed: 1. Main group (n=45): patients with an immature granulocyte phenotype (29 women, 16 men; mean age — 41.8 years). 2. Additional group (n=9): patients with a defined blast phenotype (CD34+/-, HLA-DR-, with expression of myeloid markers). Immunophenotyping was performed by multicolor flow cytometry using a panel of monoclonal antibodies (CD34, CD117, HLA-DR, CD64, CD33, CD13, CD15, CD16, CD11b, CD11c, MPO, CD4). Genetic status verification was performed by FISH (t(15;17)) and polymerase chain reaction (PML-RARα).

Results: Signature profile of the "immature granulocytes" group (n=45): A) Absolute expression of the pan-myeloid marker CD33 (100%, 45/45); B) High frequency of expression of CD13 (93.3%, 42/45), CD117 (91.1%, 41/45), CD64 (91.1%, 41/45), and cytoplasmic MPO (91.1%, 41/45); C) Virtually complete absence of HLA-DR expression (negative in 95.6% of patients); D) Moderate expression of the stem cell marker CD34 (40.0%, 18/45) and CD4 (44.4%, 20/45); E) Complete absence of mature granulocyte markers (CD15, CD16, CD11b, CD11c — 0%). Predictive value: Of 41 examined patients in the main group, the presence of t(15;17) translocation / PML-RARα chimeric gene was confirmed in 97.6% (40/41); only 1 patient (2.4%) tested negative. In 4 patients, testing was not performed. Comparison group ("blasts," n=9): in this group, expression of the stem cell marker CD34 was significantly more frequently recorded (66.7%); CD33 expression was 100%, CD117 — 88.9%, CD13 — 88.9%, MPO — 77.8%, CD64 — 66.7%; HLA-DR was negative in 88.8% of cases. Genetic confirmation (PML-RARα) was obtained in 55.6% of patients; in 44.5% the result was negative, indicating other variants of acute myeloid leukemia.

Conclusions: Detection of the cytometric signature "immature granulocytes" with the specific profile $CD33^+$ $CD117^+$ MPO^+ $CD64^+$ $HLA\text{-}DR^-$ is a highly accurate predictor of acute promyelocytic leukemia, with confirmation of molecular genetic status (PML-RARα) in 97.6% of cases. The blast phenotype is associated with a higher proportion

of PML-RARα-negative variants, which requires differential diagnosis with other subtypes of myeloid leukemias.

Keywords: Acute Promyelocytic Leukemia; Flow Cytometry; Immunophenotyping

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Congress Abstract

BRAF and TERTp Co-Mutations in Radioiodine-Refractory Differentiated Thyroid Cancer: Association with Aggressive Clinical-Pathological Characteristics

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Introduction: Differentiated thyroid cancer (DTC) is characterized by a favorable prognosis in most cases. However, the development of radioiodine refractoriness significantly worsens the disease course, limits the effectiveness of standard therapy, and is associated with an increased risk of progression. In this regard, the search for molecular genetic markers that allow early identification of patients at high risk of developing an aggressive radioiodine-refractory phenotype is a relevant area of research. Integration of molecular and clinical-pathological characteristics of the tumor may improve the accuracy of risk stratification and contribute to personalization of treatment strategy.

Objective: To evaluate the relationship between molecular genetic alterations, including BRAF and TERT promoter mutations, and clinical-pathological characteristics of radioiodine-refractory differentiated thyroid cancer.

Materials and Methods: A retrospective single-center study was conducted, including 167 patients with DTC treated between 2021 and 2023. The study was performed in the Republic of Kazakhstan among patients treated at the Radionuclide Therapy Department of the Center for Nuclear Medicine and Oncology, Health Department of the Abai Region. Depending on the response to radioiodine therapy, patients were divided into two groups: radioiodine-sensitive DTC (n = 130) and radioiodine-refractory DTC (n = 37). Multivariate analysis was performed to identify independent predictors of radioiodine refractoriness. The discriminatory ability of the prognostic model was assessed using ROC analysis.

Results: The development of radioiodine refractoriness was associated with clinical-pathological signs of aggressive disease course, including elevated levels of thyroglobulin and/or antibodies to thyroglobulin, the presence of lymphogenous metastasis, and the need for more extensive surgical intervention. Individual BRAF and TERTp mutations did not demonstrate independent statistically significant prognostic value. At the same time, the simultaneous presence of BRAF and TERTp mutations was significantly associated with the development of radioiodine refractoriness. The integrated clinical-molecular model demonstrated good discriminatory ability (AUC = 0.796) and outperformed the model based solely on clinical-pathological characteristics, indicating the additional prognostic value of molecular profiling.

Conclusions: The inclusion of molecular genetic profiling in comprehensive clinical-pathological assessment may improve the accuracy of risk stratification, contribute to early identification of patients with potentially aggressive disease course, and serve as a basis for personalization of treatment strategy.

Keywords: Differentiated Thyroid Cancer; Radioiodine Resistance; BRAF; TERTp; Co-Mutation

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Congress Abstract

Neutrophil Extracellular Traps as a Potential Marker of Neoadjuvant Endocrine Therapy Efficacy in Breast Cancer

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Introduction: Neutrophil extracellular traps (NETs) are web-like structures composed of decondensed chromatin and neutrophil granule proteins. Accumulating evidence suggests that NETs are involved in tumor progression, invasion, and metastasis in breast cancer. Therefore, investigating changes in NET formation during anticancer therapy and their potential use as a marker of treatment efficacy is of particular interest.

Objective: To evaluate the dynamics of induced NET formation during neoadjuvant endocrine therapy (NET) in patients with hormone receptor (HR)-positive breast cancer and to determine its association with changes in primary tumor size.

Materials and Methods: The study included 50 patients with stage II–III HR-positive breast cancer who received neoadjuvant endocrine therapy for 3–6 months. Endocrine therapy included letrozole and toremifene (Fareston); in a subset of patients, toremifene was combined with ovarian suppression using triptorelin (Diphereline). Induced NET formation in peripheral blood was assessed using the method developed by I.I. Dolgushin with pyrogenal stimulation, followed by May–Grünwald azure-eosin staining and microscopy. NET-forming neutrophils were counted per 100 neutrophils. Primary tumor size was assessed by ultrasonography (US) and mammography (MMG). Statistical analysis included the Wilcoxon signed-rank test, Friedman test, and Spearman's rank correlation.

Results: In the three-time-point analysis of patients with serial measurements (n=32), the median number of induced NETs was 2 [0; 15] at baseline, 0 [0; 1.5] after 3 months, and 2 [0; 6] after 6 months of neoadjuvant endocrine therapy; the overall change did not reach statistical significance ($p=0.051$). After 3 months of treatment, a reduction in primary tumor size was observed. On US, the median tumor size decreased from 25.0 [22.0; 36.25] to 21.0 [18.0; 27.25] mm ($p<0.001$), while on MMG it decreased from 29.0 [21.5; 36.5] to 24.0 [18.0; 30.5] mm ($p=0.049$). The median relative reduction was 16.0% and 11.8%, respectively. No statistically significant correlation was found between changes in NET formation and the percentage change in tumor size after 3 months: US, $r_s=0.139$, $p=0.351$; MMG, $r_s=0.015$, $p=0.918$.

Conclusion: Changes in induced NET formation were observed during neoadjuvant endocrine therapy, with the lowest values recorded after 3 months of treatment. However, no association was established between changes in NET formation and the degree of primary tumor size reduction. These interim findings do not support the use of induced NET dynamics as a standalone marker of radiological response to neoadjuvant endocrine therapy and warrant further evaluation in a larger cohort.

Keywords: Breast Cancer; Neutrophil Extracellular Traps; NETs; Neoadjuvant Endocrine Therapy; Biomarker; Treatment Response