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DIAGNOSTIC CAPABILITIES OF ^{68}GA-FAPI PET/CT IN GASTRIC CANCER

A.A. MELS[1], Z.K. ZHAKENOVA[1], G.M. MUKHIT[1], E.Z. AMANTAYEV[2], Z.M. AMANKULOV[3]

[1]Asfendiyarov Kazakh National Medical University, Almaty, the Republic of Kazakhstan;
[2]City Clinical Hospital No. 8, Almaty, the Republic of Kazakhstan;
[3]Kazakh Institute of Oncology and Radiology, Almaty, the Republic of Kazakhstan

ABSTRACT

Relevance: *Gastric cancer remains a significant medical issue due to its high incidence and mortality rates. Hybrid imaging techniques, including positron emission tomography/computed tomography (PET/CT), play an important role in the diagnosis of malignant tumors, including gastric cancer. The development and clinical evaluation of radiopharmaceuticals used in oncology continues to advance.*

The study aimed to *evaluate the diagnostic capabilities of PET/CT using fibroblast activation protein inhibitor labeled with gallium-68 ([^{68}Ga]FAPI-PET/CT) in gastric cancer.*

Methods: *This review includes data from 8 clinical studies (both prospective and retrospective) comparing the diagnostic performance of [^{68}Ga]FAPI-PET/CT and fluorodeoxyglucose labeled with fluorine-18 ([^{18}F]FDG) in patients with histologically confirmed gastric cancer. The number of patients in the studies ranged from 13 to 112, totaling 379 patients. The parameters analyzed included maximum standardized uptake value (SUVmax), tumor-to-background ratio (TBR), and the sensi-tivity in detecting primary gastric tumors, as well as lymph node and peritoneal metastases.*

Results: *According to multiple clinical studies, [^{68}Ga]FAPI demonstrated higher SUVmax and TBR values compared to [^{18}F]FDG, especially in the visualization of diffuse, mucinous, and signetring cell histological subtypes of gastric cancer. This is associated with strong expression of FAP in the tumor stroma, enabling effective tracer accumulation in affected areas. Furthermore, [^{68}Ga]FAPI-PET/CT showed higher sensitivity in detecting primary gastric lesions (100% vs. 53%), lymph node metastases (79% vs. 54%), and peritoneal metastases (96% vs. 55%) compared to [^{18}F]FDG-PET/CT. In 11-67% of patients, the use of [^{68}Ga]FAPI-PET/CT led to a change in tumor staging and influenced the formulation of an individualized treatment plan.*

Conclusion: *[^{68}Ga]FAPI-PET/CT demonstrated greater diagnostic performance compared to [^{18}F]FDG-PET/CT in staging gastric malignancies, particularly in histological subtypes with low glycolytic activity. The method offers superior sensitivity and visualization of peritoneal, visceral, and lymphatic metastases, playing a crucial role in determining treatment strategies.*

Keywords: *gallium-68 labeled fibroblast activation protein inhibitor ([^{68}Ga]FAPI), gastric cancer (GC), positron emission tomography/computed tomography (PET/CT), cancer staging, fibroblast activation protein (FAP).*

Introduction: According to GLOBOCAN 2022, gastric cancer (GC) remains one of the leading causes of cancer-related mortality worldwide, ranking fifth in terms of the number of new cases and deaths among all malignant neoplasms (MNs). It is estimated that in 2022, 968,784 new cases and 660,175 deaths related to this pathology were recorded, indicating that gastric cancer is one of the most prevalent types of oncological diseases [1]. Gastric MNs have risk factors, most of which are immutable characteristics [2].

The diagnostics of gastrointestinal MNs is conducted using standard imaging methods, such as radiographic examination, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography (PET) [3]. Each method has its advantages and limitations, including in assessing the extent of the malignant process [4].

Modern approaches to the diagnostics and staging of GC require high sensitivity, specificity, and reproducibility [5]. An important aspect of the diagnostic process remains hybrid imaging methods, particularly positron emission tomography/computed tomography (PET/CT) with the radiopharmaceutical (RPh) 18-fluorodeoxyglucose ([^{18}F]FDG). However, the informativeness of this method is significantly reduced in cases of mucinous, poorly differentiated, and undifferentiated tumors [6]. One of the reasons for this is the low glucose metabolism in some histological subtypes of gastric tumors, which results in insufficient accumulation of [^{18}F]FDG for their detection [7]. Fibroblast activation protein (FAP), expressed in cancer-associated fibroblasts (CAF), plays a key role in remodeling the tumor microenvironment, invasion, and metastasis [8, 9]. FAP belongs to the family of dipeptidyl peptidases and has enzymatic activity involved in the remodeling of the extracellular matrix, contributing to the progression and invasion of epithelial tumors [10]. In 90% of all epithelial-origin tumors, increased FAP expression is observed [11]. Given that the tumor stroma can predominate in the structure of the neoplasm, targeted imaging of its components, such as activated fibroblasts, represents a more sensitive alternative compared to the visualization of tumor cells alone [12]. The RPh fibroblast ac-

tivation protein inhibitor labeled with gallium-68 ([^{68}Ga]FAPI), developed as a high-affinity ligand to FAP, demonstrates a high degree of accumulation in most MNs, including gastric MNs. It has high affinity to FAP, rapid clearance from the blood, and low nonspecific accumulation in normal tissues [13]. [^{68}Ga]FAPI has become widely used in oncological imaging following the demonstration of its high affinity to FAP and its potential for radiolabeling for PET diagnostics [14]. Experience with the use of [^{68}Ga]FAPI in patients with other solid tumors, including thyroid tumors, confirms its universality and high diagnostic effectiveness [15]. Studies have also shown widespread accumulation of FAPI in patients with various solid tumors, including gastrointestinal tumors [16]. [^{68}Ga]FAPI-PET/CT has demonstrated clinical significance in planning radiation therapy and delineating the radiation volume [17]. Aggregated data confirm the high safety of [^{68}Ga]FAPI and its high accuracy in visualizing gastrointestinal tumors [18]. It should also be noted that the accumulation of [^{68}Ga]FAPI is independent of the glycolytic activity of the tumor, making it particularly useful for signet-ring cell tumors of the stomach and other forms with low glucose metabolism [19]. Several studies have shown that [^{68}Ga]FAPI has advantages in detecting peritoneal metastases and metastatic lymph nodes, as well as in identifying early disease recurrence after treatment [20]. Peritoneal metastases are the most common form of spread in GC and are responsible for nearly half of the mortality cases, highlighting the need for accurate methods to detect them at early stages. Additionally, [^{68}Ga]FAPI has proven effective in diagnosing tumors with low glucose metabolism and in cases with negative [^{18}F]FDG-PET/CT results [21]. Thus, [^{68}Ga]FAPI is a versatile tool for imaging the tumor microenvironment and staging the tumor [22].

The study aimed to evaluate the diagnostic capabilities of PET/CT using fibroblast activation protein inhibitor labeled with gallium-68 ([^{68}Ga]FAPI-PET/CT) in gastric cancer.

Materials and Methods: This study includes the results of 8 prospective and retrospective clinical studies published between 2018 and 2024, focusing on the comparison of diagnostic efficacy between [^{68}Ga]FAPI-PET/CT and [^{18}F]FDG-PET/CT in patients with confirmed gastric cancer (GC). The search was conducted in PubMed, Scopus, Web of Science, and Google Scholar databases using the following keywords: "68Ga-FAPI", "PET/CT", "gastric cancer", "fibroblast activation protein". Inclusion criteria for the publications were: histological confirmation of the diagnosis, performance of both [^{68}Ga]FAPI-PET/CT and [^{18}F]FDG-PET/CT, reporting of maximum standardized uptake value (SUVmax) and tumor-to-background ratio (TBR), indication of TNM stage, and data on the impact of the method on treatment strategies.

Standardized PET/CT protocols were used in all included studies: intravenous injection of RPh, a field of view from the head to the upper third of the thighs, and hybrid PET/CT imaging.

Effectiveness of imaging was assessed by comparing SUVmax and TBR between [^{68}Ga]FAPI and [^{18}F]FDG in primary lesions, lymph nodes, and metastatic sites.

Results: An analysis of the results from 8 prospective and retrospective clinical studies allowed for a comprehensive overview of the existing evidence. Table 1 presents the clinical and methodological parameters of studies on the use of [^{68}Ga]FAPI-PET/CT in gastric cancer.

Study Design. 5/8 sources included in the review describe prospective studies, which enhances the evidence strength of the presented results. 3/8 studies followed a retrospective design, which potentially increases the risk of systematic errors and biases related to data selection and the lack of control over variables. Sample size varied from 13 patients [19] to 112 patients [3].

Indications for [^{68}Ga]FAPI. The indications to perform [^{68}Ga]FAPI-PET/CT were staging, restaging, diagnostics of [^{18}F]FDG-PET/CT negative cases, visualization of specific histological subtypes, and peritoneal metastatic lesions. These indications highlight the expanding clinical use of [^{68}Ga]FAPI beyond standard diagnostics.

Patients (n). A total of 8 clinical studies with 379 patients were included. Larger samples (e.g., S. Zhang [3], Y. Sun [7]) allow for statistically significant conclusions, while smaller series focus on more specialized subtypes.

Activity. The RPh activity used in the studies ranged from 1.11 to 2.96 MBq/kg. In 2 out of 8 studies, the activity was between 1.11-1.85 MBq/kg, in 2 studies it was 1.85 MBq/kg, in 2 studies it ranged from 1.8 to 2.2 MBq/kg, and one study used [^{68}Ga]FAPI activity in the range of 2.0-2.5 MBq/kg and 1.85-2.96 MBq/kg. The standard activity dosage range is 1.8-3.7 MBq/kg.

Interval. This parameter indicates the period from the intravenous injection of the RPh to the PET/CT scan. In 7 out of 8 studies, this interval was 60 minutes, and in 1 out of 8 studies, the PET/CT scan was performed between 60 and 90 minutes after the RPh injection.

Stage Correction. The highest frequency of stage modification was noted in the study by A. Selçuk [18], 2025, which was 67%, potentially related to the selection of patients with [^{18}F]FDG-negative tumors. Similarly, a high percentage of stage progression was observed in the studies by J. Kuten [19], 2022 (38.5%), and Z. Shumao [20], 2022 (27.9%). The lowest frequency of stage correction, 5.8%, was observed in the study by Y. Sun [7], 2024, which can be attributed to the prevalence of signet-ring cell and mucinous subtypes of gastric MNs with high FAPI accumulation, but without significant revision of the TNM stage.

Treatment Adjustment. The performance of [^{68}Ga]FAPI-PET/CT also impacted treatment strategies. In 4 out of 8 studies where this parameter was specifically tracked, changes in therapy ranged from 12.9% [4] to 67% [18]. In the study by S. Zhang, the proportion of therapy adjust-

ments was 17.9%, confirmed by the decision of a multidisciplinary team [3].

Table 2 presents a comparative analysis of [^{68}Ga]FAPI and [^{18}F]FDG in the visualization of gastric cancer (GC) based on the data from 8 studies.

Table 2 provides a comparative analysis of the diagnostic characteristics of [^{68}Ga]FAPI and [^{18}F]FDG based on data from 8 clinical studies. All studies included patients with confirmed GC, including difficult-to-visualize histological types such as signet-ring cell carcinoma (SRCC), mucinous carcinoma (MAC), and diffuse adenocarcinoma types. In some studies, the TBR value was not provided. In such cases, the contrast between the tumor and background tissues was calculated using the formula

$$\mathrm{TBR} = \frac{\mathrm{SUVmax\ \ опухоли.}}{\mathrm{SUVmean\ \ фона}} \quad (1)$$

The average SUVmean value of the ascending aorta (SUVmean≈2.5) was used as the standard for background accumulation in evaluating the effectiveness of [^{68}Ga]FAPI-PET/CT. Given the repeatability of these values in several publications (e.g., [4, 6, 7]), the adopted value can be considered a reasonably acceptable benchmark for comparative analysis.

The comparative analysis of the studies presented in the table confirms a consistent advantage of [^{68}Ga]FAPI-PET/CT over [^{18}F]FDG in terms of SUVmax and TBR in patients with GC, including aggressive histological subtypes and cases with low glucose metabolism.

J. Kuten et al. demonstrated that the SUVmax for [^{68}Ga]FAPI was 16.6, while for [^{18}F]FDG it was 11.6. The median TBR value for [^{68}Ga]FAPI was 11.9, compared to 3.2 for [^{18}F]FDG. These data were accompanied by 100% detection of primary tumors using [^{68}Ga]FAPI, while [^{18}F]FDG showed only 50% sensitivity [17].

In the study by Y. Pang et al., the SUVmax for [^{68}Ga]FAPI was 12.7, while for [^{18}F]FDG it was 3.7. The TBR was also significantly higher for [^{68}Ga]FAPI, with [^{18}F]FDG showing values of 7.6 versus 2.2. All tumors (n=20) were visualized with [^{68}Ga]FAPI, while [^{18}F]FDG detected only 53%, emphasizing the limitations of [^{18}F]FDG in non-intestinal tumor types [8].

A. Selçuk et al. reported a primary tumor SUVmax of 14.8 for [^{68}Ga]FAPI and 6.8 for [^{18}F]FDG. For peritoneal metastases, the values were 6.9 and 3.3, respectively. The calculated TBR for [^{68}Ga]FAPI was 5.92, while for [^{18}F]FDG it was 2.72. [^{68}Ga]FAPI enabled stage modification in 30% of patients [18].

In the study by S. Zhang et al., the average SUVmax for primary tumors with [^{68}Ga]FAPI was 10.28 versus 3.20 for [^{18}F]FDG. For metastatic lesions, the values were also higher for [^{68}Ga]FAPI: in lymph nodes, 9.20 versus 3.15, and in distant metastases, 8.00 versus 4.20, respectively. Based on our calculations, the TBR for [^{68}Ga]FAPI was 4.11, while for [^{18}F]FDG it was 1.28. This allowed for stage modification in 7 out of 25 patients [20].

D. Jiang et al. presented the most detailed comparison of SUVmax based on tumor size and T-stage: Overall SUVmax: 7.4 ([^{68}Ga]FAPI) vs. 6.5 ([^{18}F]FDG); Tumors >4 cm: 11.0±4.5 ([^{68}Ga]FAPI) vs. 6.3±1.8 ([^{18}F]FDG); T2–T4: 9.7±4.4 ([^{68}Ga]FAPI) vs. 5.6±1.9 ([^{18}F]FDG); T1: 3.1±1.5 ([^{68}Ga]FAPI) vs. 2.7±0.9 ([^{18}F]FDG); TBR: 9.2±5.9 ([^{68}Ga]FAPI) vs. 5.9±4.2 ([^{18}F]FDG) [6].

Y. Miao et al. demonstrated the highest absolute SUVmax among all studies: 18.81 for [^{68}Ga]FAPI compared to 10.44 for [^{18}F]FDG, also confirming the superiority of [^{68}Ga]FAPI across all stages and histological subtypes. The TBR for [^{68}Ga]FAPI was 12.9 and 4.5 for [^{18}F]FDG, respectively [4]

Y. Sun et al. studied [^{68}Ga]FAPI in patients with mucinous and signet-ring cell carcinoma (MAC/SRCC), showing a primary tumor SUVmax of 9.3 for [^{68}Ga]FAPI compared to 3.1 for [^{18}F]FDG. For peritoneal metastases, the values were 6.9 and 3.3, respectively. The TBR calculation indicated that [^{68}Ga]FAPI (3.7) outperformed [^{18}F]FDG (1.2). In the study by Y. Sun et al., FAPI outperformed [^{18}F]FDG in sensitivity for peritoneal and intestinal metastases. For peritoneal metastases, SUVmax was: 5.66±1.97 for [^{68}Ga]FAPI versus 4.28±2.70 for [^{18}F]FDG, and TBR was: 4.22±1.47 for [^{68}Ga]FAPI versus 1.41±0.89 for [^{18}F]FDG. For tumor implantation into the intestinal wall, SUVmax for FAPI was 6.70±0.25, and for [^{18}F]FDG it was 7.58±1.66, but the TBR was still higher for [^{68}Ga]FAPI (5.63 vs. 2.20) [7].

S. Zhang et al. provided the following values for [^{68}Ga]FAPI: SUVmax=13.6, TBR=5.44. For [^{18}F]FDG in this study, SUVmax and TBR values were not provided [3].

Advantages. Table 2 reflects the qualitative parameters highlighted by the authors of the original studies, and the comparative analysis of these allows the assessment not only of numerical parameters such as SUVmax and TBR but also the practical significance of each method. In 5 out of 8 of the analyzed sources, a clear advantage of detecting metastatic lesions was identified. The remaining studies emphasize that [^{68}Ga]FAPI-PET/CT provides a clear visualization of primary gastric MNs, histological subtypes like MAC and SRCC, and lymph nodes.

Discussion: FAP is expressed in the tumor microenvironment, particularly in activated fibroblasts, making it a valuable target for stromal imaging [22, 23]. FAP expression in the microenvironment of gastrointestinal tumors opens new opportunities for targeted visualization of stromal components, particularly in clinical scenarios where the effectiveness of conventional imaging modalities, such as CT, MRI, and [^{18}F]FDG PET/CT, is limited due to cirrhotic changes or high background activity in normal tissues [24]. Despite its high specificity, it is known that FAPI can accumulate in areas of inflammation, trauma, and IgG4-related diseases, which must be taken into account when interpreting imaging results [25]. [^{68}Ga]FAPI PET/CT demonstrates superior contrast and faster clearance kinetics, making it more suitable for use in frail patients [26]. The

increased sensitivity of [^{68}Ga]FAPI in detecting peritoneal metastatic lesions is a critically important factor in surgical decision-making, particularly concerning the need for laparoscopy and the extent of surgical intervention [27]. FAP, expressed by activated fibroblasts in the tumor microenvironment, has been identified as a key factor in tumor progression and has emerged as a promising target for the development of next-generation RPhs [28].

In contrast to [^{18}F]FDG, which reflects glucose metabolism, [^{68}Ga]FAPI accumulates more uniformly within the tumor background and is effective in tumors with low glycolytic activity, such as mucinous adenocarcinoma and signet ring cell carcinoma. Consequently, it can detect lesions that are poorly visualized by [^{18}F]FDG PET/CT [29]. Due to the low metabolic activity of [^{18}F]FDG and potential physiological confounders, the method has certain limitations in imaging specific subtypes of gastrointestinal tumors, including MAC and SRCC [30].

In recent years, [^{68}Ga]FAPI PET/CT has demonstrated expanding clinical utility in the diagnosis and staging of GC [31]. Several studies emphasize its superiority over traditional imaging methods, including [^{18}F]FDG PET/CT and CT, particularly in identifying peritoneal metastases, regional lymphatic spread, and tumors with low glucose metabolism [32, 33]. The high reproducibility across different histological tumor types, consistent uptake parameters, and high selectivity of [^{68}Ga]FAPI for tumor stroma underscore its diagnostic value [34]. Systematic reviews and meta-analyses confirm the superiority of [^{68}Ga]FAPI not only in terms of imaging performance but also in clinical relevance, from more accurate staging to direct influence on treatment strategies [35]. Furthermore, the use of [^{68}Ga]FAPI is actively discussed in contemporary clinical guidelines, including national protocols in China, where it is considered a potential alternative to [^{18}F]FDG PET/CT [36]. Its integration into preoperative diagnostics remains a promising direction, including the detection of [^{18}F]FDG-negative metastatic lesions, helping to avoid unnecessary surgical procedures and improve therapy personalization. The two tables presented in this study summarize both methodological and clinical parameters as well as the comparative diagnostic advantages of [^{68}Ga]FAPI relative to conventional [^{18}F]FDG.

Aggregated data from eight studies demonstrated that [^{68}Ga]FAPI PET/CT was used for initial staging and evaluation of disease extent, including signet ring cell carcinoma, mucinous adenocarcinoma, and other diffuse forms of GC. These histological tumor types are traditionally characterized by low glucose metabolism, limiting the sensitivity of [^{18}F]FDG PET/CT. In this context, FAPI shows an advantage by accumulating in the tumor stroma regardless of the glycolytic activity of tumor cells. Notably, all studies employed standardized protocols (60-minute interval post-injection, scan coverage from head to upper/mid-thigh, PET/CT acquisition), ensuring data comparability. Particular attention is given to "Treatment Correction." In 7 out of 8 studies, the impact was quantified numerically (ranging from 12.9% to 67.0%), where FAPI PET/CT findings led to changes in treatment strategy, including the choice between surgical and pharmacological approaches. In the remaining cases, the impact was reflected in improved staging, detection of peritoneal metastases, or clarification of tumor resectability. These data indicate that [^{68}Ga]FAPI PET/CT functions not only as a diagnostic tool but also as a patient management aid.

The second analytical section focuses on the comparison between [^{68}Ga]FAPI and [^{18}F]FDG. In all included studies, [^{68}Ga]FAPI outperformed [^{18}F]FDG in terms of SUVmax and tumor-to-background ratio (TBR), primarily due to lower physiological background in abdominal organs when using [^{68}Ga]FAPI. This is especially significant for visualizing: SRCC and MAC, which often yield false-negative results on [^{18}F]FDG PET/CT; Peritoneal metastases, where FAPI imaging enabled detection of lesions not visible with conventional PET or CT; Metastatic and small-volume lesions, including lymph nodes and subserosal spread. To date, [^{18}F]FDG PET/CT remains the imaging standard in oncology. However, in GC – particularly undifferentiated and mucinous forms – its effectiveness is limited. In the review by X. Liu et al., [^{68}Ga]FAPI PET/CT demonstrated 100% sensitivity in detecting primary gastric tumors and 96% sensitivity for peritoneal metastases, significantly surpassing [^{18}F]FDG, which showed 53% and 55%, respectively [37].

[^{68}Ga]FAPI also outperformed [^{18}F]FDG in detecting lymphatic metastases, with sensitivities of 79% and 54%, respectively [6, 38, 39]. [^{68}Ga]FAPI exhibited rapid and selective accumulation in the tumor microenvironment with minimal background uptake, enabling high-contrast visualization of peritoneal metastatic lesions [40]. These findings underscore the advantages of FAPI for imaging tumors with low glucose metabolism, particularly metastatic lesions. Several studies consistently confirm that [^{68}Ga]FAPI PET/CT improves the detection of malignant peritoneal involvement, which is often difficult to diagnose using conventional imaging methods [41, 42]. Additionally, the low background activity associated with [^{68}Ga]FAPI-04 provides a clearer contrast between tumor and surrounding tissues compared to [^{18}F]FDG, enhancing lesion visualization [43].

In all studies, [^{68}Ga]FAPI demonstrated superiority in SUVmax and TBR compared to [^{18}F]FDG. This was especially evident in difficult-to-visualize forms of gastric MNs and in cases where [^{18}F]FDG yielded negative results [44].

Thus, [^{68}Ga]FAPI is a more sensitive imaging tool for diffuse, mucinous, and metastatic disease forms. [^{68}Ga]FAPI PET/CT for GC staging demonstrates high effectiveness in detecting peritoneal metastases and histologically challenging tumor types [45, 46]. [^{68}Ga]FAPI has proven to be an effective component of a comprehensive therapeutic approach, facilitating optimized preoperative planning and objective assessment of tumor resectability [47, 48].

Table 1 – Clinical and methodological parameters of studies on the use of [^{68}Ga]FAPI-PET/CT in gastric cancer patients

Study	Year	Study Design	Indications	Patients (n)	Potency (MBq/kg)	Interval (min.)	Staging Correction (%)	Treatment Correction (%)
Kuten J. [19]	2022	P	Staging/restaging	13	1.8-2.2	60	38.5	30.8
Pang Y. [8]	2021	R	Staging	20	1.8-2.2	60	21.0	21.0
Selcuk A. [18]	2025	P	[^{18}F]FDG-negative/ peritoneal metastases	23	2.0-2.5	60	67	67
Shumao Z. [20]	2022	R	Staging/restaging	25	1.85	60	27.9	27.9
Jiang D. [6]	2021	P	Staging/peritoneal metastases	38	1,11-1.85	60	10.5	n/a
Miao Y. [4]	2023	P	Staging	62	1.85-2.96	60-90	12.9	12.9
Sun Y. [7]	2024	P	Histological subtype	86	1.85	60	5.8	30.0
Shunyu Z. [3]	2025	R	Restaging	112	1.11-1.85	60	18.8	17.9

Table 2 – Comparative analysis of the effectiveness of [^{68}Ga]FAPI and [^{18}F]FDG in gastric cancer imaging

Study	Radiopharmaceutical	SUVmax ([^{68}Ga]FAPI/ [^{18}F]FDG)	TBR ([^{68}Ga]FAPI/ [^{18}F]FDG)	Advantages [^{68}Ga]FAPI
Kuten J. [19]	[^{68}Ga]FAPI [^{18}F]FDG	16,6 / 11,6	11.9 / 3.2	Detection of peritoneal metastatic foci, [^{18}F]FDG-negative cases
Pang Y. [8]	[^{68}Ga]FAPI [^{18}F]FDG	12,7 / 3,7	7,6 / 2.2	Better visualization of tumors and lymph nodes in [^{18}F]FDG-negative cases
Selcuk A. [18]	[^{68}Ga]FAPI [^{18}F]FDG	14,8 / 6,8	5.92 / 2.72	Detection of peritoneal metastases in [^{18}F]FDG-negative cases
ShumaoZ. [20]	[^{68}Ga]FAPI [^{18}F]FDG	10,28 / 3,20	4.11 / 1.28	Effective in [^{18}F]FDG-negative cases, early detection of peritoneal metastatic foci
Jiang D. [6]	[^{68}Ga]FAPI [^{18}F]FDG	7,4 / 6,5	9.2 / 5.9	Clear visualization of primary tumors, early detection of metastases
Miao Y. [4]	[^{68}Ga]FAPI [^{18}F]FDG	18,81 / 10,44	12.9 / 4.5	High contrast of lymph nodes, submucosal lesions
Sun Y. [7]	[^{68}Ga]FAPI [^{18}F]FDG	9,3 / 3,1	3.7 / 1.2	Clear visualization of SRCC and MAC histological sub-types
Shunyu Z. [3]	[^{68}Ga]FAPI [^{18}F]FDG	13,60 / н. д.	5.44 / n/a	Early detection of peritoneal metastatic foci

Note: MAC – Mucinous adenocarcinoma, SRCC – Signet ring cell carcinoma, SUVmax – Maximum standardized uptake value, TBR – Tumor-to-background ratio

Its inclusion in clinical guidelines and research protocols confirms its practical value and clinical promise [49, 50]. Further research should aim to explore the prognostic significance of FAPI, its role in therapy monitoring, and the potential therapeutic use of FAPI-based RPhs.

Conclusion: [^{68}Ga]FAPI-PET/CT is a promising imaging method for GC staging, demonstrating high accuracy in detecting peritoneal metastases and difficult-to-diagnose tumor forms. This makes [^{68}Ga]FAPI a valuable tool in a multimodal approach to treatment. The potential of this method is confirmed by its integration into clinical guidelines and research protocols.

References:

1. Bray F., Laversanne M., Sung H., Ferlay J., Siegel R.L., Soerjomataram I., Jemal A. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries // Cancer J. Clin. – 2024. – Vol. 74 (3). – P. 229–263. https://doi.org/10.3322/caac.21834

2. Joshi S.S., Badgwell B.D. Current treatment and recent progress in gastric cancer // Cancer J. Clin. – 2021. – Vol. 71 (3). – P. 264–279. https://doi.org/10.3322/caac.21657

3. Zhang S., Hu Q., Chen X., Zhou N., Huang Q., Tan S., Su M., Gou H. Ga-FAPI-04 positron emission tomography/CT and laparoscopy for the diagnosis of occult peritoneal metastasis in newly diagnosed locally advanced gastric cancer: study protocol of a single-centre prospective cohort study // BMJ Open. – 2024. – Vol. 14 (4). – Art. no. e075680. https://doi.org/10.1136/bmjopen-2023-075680

4. Miao Y., Feng R., Guo R., Huang X., Hai W., Li J., Yu T., Qu Q., Zhang M., Shangguan C., Mi J., Zhu Z., Li B. Utility of [68Ga]FAPI-04 and [18F]FDG dual-tracer PET/CT in the initial evaluation of gastric cancer // Eur. Radiol. – 2023. – Vol. 33 (6). – P. 4355–4366. https://doi.org/10.1007/s00330-022-09321-1

5. Yang T., Ma L., Hou H., Gao F., Tao W. FAPI PET/CT in the Diagnosis of Abdominal and Pelvic Tumors // Front. Oncol. – 2022. – Vol. 11. – Art. no. 797960. https://doi.org/10.3389/fonc.2021.797960

6. Jiang D., Chen X., You Z., Wang H., Zhang X., Li X., Ren S., Huang Q., Hua F., Guan Y., Zhao J., Xie F. Comparison of [68 Ga]Ga-FAPI-04 and [18F]-FDG for the detection of primary and metastatic lesions in patients with gastric cancer: a bicentric retrospective study // Eur. J. Nucl. Med. Mol. Imaging. – 2022. – Vol. 49 (2). – P. 732-742. https://doi.org/10.1007/s00259-021-05441-w

7. Sun Y., Xu J., Qiao Y., Zhang J., Pan H., Xu X., Song S. Assessing the value of 68Ga-FAPI PET/CT in gastric mucinous adenocarcinoma or signet ring cell carcinoma // Radiology: Imaging Cancer. — 2024. — Vol. 6 (6). — P. e230195. https://doi.org/10.1148/rycan.230195

8. Pang Y., Zhao L., Luo Z., Hao B., Wu H., Lin Q., Sun L., Chen H. Comparison of 68Ga-FAPI and 18F-FDG Uptake in Gastric, Duodenal, and Colorectal Cancers // Radiology. – 2021. – Vol. 298 (2). – P. 393–402. https://doi.org/10.1148/radiol.2020203275

9. Rezaei S., Gharapapagh E., Dabiri Sh., Heidari P., Aghanejad A. Theranostics in targeting fibroblast activation protein bearing cells: progress and challenges // Life Sci. – 2023. – Vol. 329. – Art. no. 121970. https://doi.org/10.1016/j.lfs.2023.121970

10. Sidrak M.M.A., De Feo M.S., Corica F., Gorica J., Conte M., Filippi L., Schillaci O., De Vincentis G., Frantellizzi V. Fibroblast Activation Protein Inhibitor (FAPI)-Based Theranostics—Where We Are at and Where We Are Heading: A Systematic Review // Int. J. Mol. Sci. – 2023. – Vol. 24. – Art. no. 3863. https://doi.org/10.3390/ijms24043863

11. Serumula W., Pillay V., Hadebe B., Vorster M. Fibroblast Activation Protein Inhibitor (FAPI)-Based Theranostics // Pharmaceuticals (Basel, Switzerland). – 2025. – Vol. 18 (4). – Art. no. 522. https://doi.org/10.3390/ph18040522

12. Li M., Younis M.H., Zhang Y., Cai W., Lan X. Clinical summary of fibroblast activation protein inhibitor-based radiopharmaceuticals: cancer and beyond // Eur. J. Nucl. Med. Mol. Imaging. – 2022. – Vol. 49 (8). – P. 2844–2868. https://doi.org/10.1007/s00259-022-05706-y

13. Mori Y., Dendl K., Cardinale J., Kratochwil C., Giesel F.L., Haberkorn U. FAPI PET: Fibroblast Activation Protein Inhibitor Use in Oncologic and Nononcologic Disease // Radiology. – 2023. – Vol. 306 (2). – Art. no. e220749. https://doi.org/10.1148/radiol.220749

14. Loktev A., Lindner T., Mier W., Debus J., Altmann A., Jäger D., Giesel F., Kratochwil C., Barthe P., Roumestand C., Haberkorn U. A Tumor-Imaging Method Targeting Cancer-Associated Fibroblasts // J. Nucl. Med. – 2018. – Vol. 59 (9). – P. 1423–1429. https://doi.org/10.2967/jnumed.118.210435

15. Fu H., Fu J., Huang J., Pang Y., Chen H. 68Ga-FAPI PET/CT Versus 18F-FDG PET/CT for Detecting Metastatic Lesions in a Case of Radioiodine-Refractory Differentiated Thyroid Cancer // Clin. Nucl. Med. – 2021. – Vol. 46 (11). – P. 940–942. https://doi.org/10.1097/RLU.0000000000003730

16. Lindner T., Loktev A., Altmann A., Giesel F., Kratochwil C., Debus J., Jäger D., Mier W., Haberkorn U. Development of Quinoline-Based Theranostic Ligands for the Targeting of Fibroblast Activation Protein // J. Nucl. Med. – 2018. – Vol. 59 (9). – P. 1415–1422. https://doi.org/10.2967/jnumed.118.210443

17. Kratochwil C., Flechsig P., Lindner T., Abderrahim L., Altmann A., Mier W., Adeberg S., Rathke H., Röhrich M., Winter H., Plinkert P.K., Marme F., Lang M., Kauczor H.U., Jäger D., Debus J., Haberkorn U., Giesel F.L. 68Ga-FAPI PET/CT: Tracer Uptake in 28 Different Kinds of Cancer // J. Nucl. Med. – 2019. – Vol. 60 (6). – P. 801–805. https://doi.org/10.2967/jnumed.119.227967

18. Alan Selçuk N., Beydağı G., Akçay K., Demirci E., Görmez A., Öven B.B., Çelik S., Şen F., Kapar Ö., Kabasakal L. Impact of 68Ga-FAPi PET/CT on Staging or Restaging Digestive System Tumors in Patients with Negative or Equivocal 18F-FDG PET/CT Findings // Mol. Imaging Radionucl. Ther. – 2025. – Vol. 34 (1). – P. 31-37. https://doi.org/10.4274/mirt.galenos.2024.50470

19. Kuten J., Levine C., Shamni O., Pelles S., Wolf I., Lahat G., Mishani E., Even-Sapir E. Head-to-head comparison of [68Ga]Ga-FAPI-04 and [18F]-FDG PET/CT in evaluating the extent of disease in gastric adenocarcinoma // Eur. J. Nucl. Med. Mol. Imaging. – 2022. – Vol. 49 (2). – P. 743–750. https://doi.org/10.1007/s00259-021-05494-x

20. Zhang S., Wang W., Xu T., Ding H., Li Y., Liu H., Huang Y., Liu L., Du T., Zhao Y., Chen Y., Qiu L. Comparison of Diagnostic Efficacy of [68Ga]Ga-FAPI-04 and [18F]FDG PET/CT for Staging and Restaging of Gastric Cancer // Front. Oncol. – 2022. – Vol. 12. – Art. no. 925100. https://doi.org/10.3389/fonc.2022.925100

21. Ouyang J., Ding P., Zhang R., Lu Y. Head-to-head comparison of 68Ga-FAPI-04 PET/CT and 18F-FDG PET/CT in the evaluation of primary digestive system cancer: a systematic review and meta-analysis // Front. Oncol. – 2023. – Vol. 13. – Art. no. 1202505. https://doi.org/10.3389/fonc.2023.1202505

22. Rizzo A., Racca M., Garrou F., Fenocchio E., Pellegrino L., Albano D., Dondi F., Bertagna F., Annunziata S., Treglia G. Diagnostic Performance of Positron Emission Tomography with Fibroblast-Activating Protein Inhibitors in Gastric Cancer: A Systematic Review and Meta-Analysis // Int. J. Mol. Sci. – 2023. – Vol. 24 (12). – Art. no. 10136. https://doi.org/10.3390/ijms241210136

23. Lindner T., Giesel F.L., Kratochwil C., Serfling S.E. Radioligands Targeting Fibroblast Activation Protein (FAP) //

Cancers. – 2021. – Vol. 13. – Art. no. 5744. https://doi.org/10.3390/cancers13225744

24. Kosmala A., Serfling S.E., Schlötelburg W., Lindner T., Michalski K., Schirbel A., Higuchi T., Hartrampf P.E., Buck A.K., Weich A., Werner R.A. Impact of 68 Ga-FAPI-04 PET/CT on Staging and Therapeutic Management in Patients With Digestive System Tumors // Clin. Nucl. Med. – 2023. – Vol. 48 (1). – P. 35–42. https://doi.org/10.1097/RLU.0000000000004480

25. Koppula B.R., Fine G.C., Salem A.E., Covington M.F., Wiggins R.H., Hoffman J.M., Morton K.A. PET-CT in Clinical Adult Oncology: III. Gastrointestinal Malignancies // Cancers. – 2022. – Vol. 14. – Art. no. 2668. https://doi.org/10.3390/cancers14112668

26. Singh S.B., Shrestha B.B., Gandhi O.H., Shah R.P., Mukhtiar V., Ayubcha C., Desai V., Eberts C.E., Paudyal P., Jha G., Singh A., Shi Y., Kumar T. The comparative utility of FAPI-based PET radiotracers over [18F]FDG in the assessment of malignancies // Am. J. Nucl. Med. Mol. Imaging. – 2024. – Vol. 14 (4). – P. 190-207. https://doi.org/10.62347/JXZI9315

27. Gege Z., Xueju W., Bin J. Head-To-Head Comparison of 68Ga-FAPI PET/CT and FDG PET/CT for the Detection of Peritoneal Metastases: Systematic Review and Meta-Analysis // AJR. – 2023. – Vol. 220 (4). – P. 490–498. https://doi.org/10.2214/AJR.22.28402

28. Dong Y., Zhou H., Alhaskawi A., Wang Z., Lai J., Yao C., Liu Z., Hasan Abdullah Ezzi S., Goutham Kota V., Hasan Abdulla Hasan Abdulla M., Lu H. The Superiority of Fibroblast Activation Protein Inhibitor (FAPI) PET/CT Versus FDG PET/CT in the Diagnosis of Various Malignancies // Cancers. – 2023. – Vol. 15 (4). – Art. no. 1193. https://doi.org/10.3390/cancers15041193

29. Solav S.V., Jagtap R.R., Savale S.V. An Atlas of Gallium-68-fibroblast Activation Protein Inhibitor (FAPI) in Oncology and Nononcology Imaging // IJNM. – 2024. – Vol. 39 (5). – P. 360–369. https://doi.org/10.4103/ijnm.ijnm_70_24

30. Zholdybaj Zh., Zhakenova Zh., Ajnakulova A., Gabdullina M., Amankulov Zh., Filippenko E., Isamatov B., Alakova A., Dauytova Yu. Primenenie 68GA-FAPI PE'T/KT v klinicheskoj praktike – perspektivy dlya vizualizacii zlokachestvennyx opuxolej: obzor literatury // Onkologiya i radiologiya Kazaxstana. – 2023. – № 3(69). – S. 65–71 [Zholdybay Zh., Zhakenova Zh., Ainakulova A., Gabdullina M., Amankulov Zh., Filippenko E., Isamatov B., Alakova A., Dauytova Yu. Application of 68GA-FAPI PET/CT in clinical practice – prospects for visualization of malignant tumors: literature review // Oncology and radiology of Kazakhstan. – 2023. – No. 3(69). – P. 65–71 (in Russ.)]. https://doi.org/10.52532/2521-6414-2023-3-69-65-71

31. Lin R., Lin Z., Chen Z., Zheng S., Zhang J., Zang J., Miao W. [68Ga]Ga-DOTA-FAPI-04 PET/CT in the evaluation of gastric cancer: comparison with [18F]FDG PET/CT // Eur. J. Nucl. Med. Mol. Imaging. – 2022. – Vol. 49 (8). – P. 2960–2971. https://doi.org/10.1007/s00259-022-05799-5

32. Gege Z., Wang X., Ji B. Head-to-head comparison of ^{68}Ga-FAPI PET/CT and FDG PET/CT for the detection of peritoneal metastases: systematic review and meta-analysis // AJR. – 2023. – Vol. 220 (4). – P. 490–498. https://doi.org/10.2214/AJR.22.28402

33. Ruan D., Wu S., Lin X., Zhao L., Cai J., Xu W., Pang Y., Xie Q., Qu X., Chen H. Current status of FAP-directed cancer theranostics: a bibliometric analysis // Biophysics Rep. – 2024. – Vol. 10 (6). – P. 388–402. https://doi.org/10.52601/bpr.2024.240022

34. Gao C., Liu H., Zhou L., Huang W., Liu X. Head-to-head comparison of 68Ga-FAPI PET/CT with 18F-FDG PET/CT in primary and metastatic lesions of gastric tumor: A systematic review and meta-analysis // Hell. J. Nucl. Med. – 2024. – Vol. 27 (1). – P. 35–45. https://doi.org/10.1967/s002449912703

35. Li M., Younis M.H., Zhang Y., Cai W., Lan X. Clinical summary of fibroblast activation protein inhibitor-based radiopharmaceuticals: cancer and beyond // Eur. J. Nucl. Med. Mol. Imaging. – 2022. – Vol. 49 (8). – P. 2844–2868. https://doi.org/10.1007/s00259-022-05706-y

36. Yang L., Xu S., Cheng L., Gao C., Cao S., Chang Z., Wang K. [18F]AlF-NOTA-FAPI-04 PET/CT as a promising tool for imaging fibroblast activation protein in gastrointestinal system cancers: a prospective investigation of comparative analysis with 18F-FDG // Eur. J. Nucl. Med. Mol. Imaging. – 2023. – Vol. 50 (13). – P. 4051–4063. https://doi.org/10.1007/s00259-023-06351-9

37. Liu X., Liu H., Gao C., Zeng W. Comparison of 68Ga-FAPI and 18F-FDG PET/CT for the diagnosis of primary and metastatic lesions in abdominal and pelvic malignancies: A systematic review and meta-analysis // Front. Oncol. – 2023. – Vol. 13. – Art. no. 1093861. https://doi.org/10.3389/fonc.2023.1093861

38. Chandekar K.R., Prashanth A., Vinjamuri S., Kumar R. FAPI PET/CT Imaging—An Updated Review // Diagnostics (Basel). – 2023. – Vol. 13 (12). – Art. no. 2018. https://doi.org/10.3390/diagnostics13122018

39. Li H., Li Z., Qin J., Huang S., Qin S., Chen Z., Ouyang R. Diagnostic performance of [68Ga]Ga-FAPI-04 PET versus [18F] FDG PET in detecting lymph node metastasis in digestive system cancers: a head-to-head comparative meta-analysis // Front. Med. – 2025. – Vol. 12. – Art. no. 1541461. https://doi.org/10.3389/fmed.2025.1541461

40. Qin C., Shao F., Gai Y., Liu Q., Ruan W., Liu F., Hu F., Lan X. 68Ga-DOTA-FAPI-04 PET/MR in the Evaluation of Gastric Carcinomas: Comparison with 18F-FDG PET/CT // J. Nucl. Med. – 2022. – Vol. 63 (1). – P. 81–88. https://doi.org/10.2967/jnumed.120.258467

41. Chandekar K.R., Prashanth A., Vinjamuri S., Kumar R. FAPI PET/CT Imaging—An Updated Review // Diagnostics (Basel). – 2023. – Vol. 13 (12). – Art. no. 2018. https://doi.org/10.3390/diagnostics13122018

42. Li T., Jiang X., Zhang Z., Chen X., Wang J., Zhao X., Zhang J. Case Report: 68Ga-FAPI PET/CT, a more advantageous detection means of gastric, peritoneal, and ovarian metastases from breast cancer // Front. Oncol. – 2022. – Vol. 12. – Art. no. 1013066. https://doi.org/10.3389/fonc.2022.1013066

43. Kim I.H., Kang S.J., Choi W., Seo A.N., Eom B.W., Kang B., Kim B.J., Min B.H., Tae C.H., Choi C.I., et al. Korean Practice Guidelines for Gastric Cancer 2024: An Evidence-based, Multidisciplinary Approach (Update of 2022 Guideline) // J Gastric Cancer. – 2025. – Vol. 25 (1). – P. 5–114. https://doi.org/10.5230/jgc.2025.25.e11

44. Treglia G., Muoio B., Roustaei H., Kiamanesh Z., Aryana K., Sadeghi R. Head-to-Head Comparison of Fibroblast Activation Protein Inhibitors (FAPI) Radiotracers versus [18F]F-FDG in Oncology: A Systematic Review // Int. J. Mol. Sci. – 2021. – Vol. 22 (20). – Art. no. 11192. https://doi.org/10.3390/ijms222011192

45. Sun Y., Xu J., Qiao Y., Zhang J., Pan H., Xu X., Song S. Assessing the Value of 68Ga-FAPI PET/CT in Gastric Mucinous Adenocarcinoma or Signet Ring Cell Carcinoma // Radiology: Imaging Cancer. – 2024. – Vol. 6 (6). – Art. no. e230195. https://doi.org/10.1148/rycan.230195

46. Health Commission of the People's Republic of China. National guidelines for diagnosis and treatment of gastric cancer 2022 in China (English version) // Chin. J. Cancer Res. – 2022. – Vol. 34 (3). – P. 207–237. https://doi.org/10.21147/j.issn.1000-9604.2022.03.04

47. Giesel F.L., Kratochwil C., Lindner T., Marschalek M.M., Loktev A., Lehnert W., Debus J., Jäger D., Flechsig P., Altmann A., et al. 68Ga-FAPI PET/CT: Biodistribution and Preliminary Dosimetry Estimate of 2 DOTA-Containing FAP-Targeting Agents in Patients with Various Cancers // J. Nucl. Med. – 2019. – Vol. 60 (3). – P. 386–392. https://doi.org/10.2967/jnumed.118.215913

48. Zhao L., Chen J., Pang Y., Fu K., Shang Q., Wu H., Sun L., Lin Q., Chen H. Fibroblast activation protein-based theranostics in cancer research: A state-of-the-art review // Theranostics. – 2022. – Vol. 12 (4). – P. 1557–1569. https://doi.org/10.7150/thno.69475

49. Liu X., Liu H., Gao C., Zeng W. Comparison of 68Ga-FAPI and 18F-FDG PET/CT for the diagnosis of primary and metastatic lesions in abdominal and pelvic malignancies: A systematic review and meta-analysis // Front. Oncol. – 2023. – Vol. 13. – Art. no. 1093861. https://doi.org/10.3389/fonc.2023.1093861

50. Wu Q., Wang C., Huang C., Li D. Head-to-head comparison of [68Ga]Ga-FAPI-04 PET and [18F]FDG PET in the detection of cancer recurrence: a systematic review and meta-analysis // Transl. Cancer Res. – 2024. – Vol. 13 (6). – P. 2779–2789. https://doi.org/10.21037/tcr-23-2296

АҢДАТПА

^{68}GA-FAPI ПЭТ/КТ-НЫҢ АСҚАЗАННЫҢ ҚАТЕРЛІ ІСІГІНІҢ ДИАГНОСТИКАСЫНДАҒЫ МҮМКІНДІКТЕРІ

А.А. Мэлс[1], Ж.К. Жакенова[1], Г.М. Мұхит[1], Е.З. Амантайев[2], Ж.М. Аманкулов[3]

[1]«С.Ж. Асфендияров атындағы Қазақ ұлттық медицина университеті» КЕАҚ, Алматы, Қазақстан Республикасы;
[2]«Қалалық клиникалық аурухана №8 ҚДСБ» ЖШС, Алматы, Қазақстан Республикасы;
[3]«Қазақ онкология және радиология ғылыми-зерттеу институты» АҚ, Алматы, Қазақстан Республикасы

Өзектілігі: *Асқазанның қатерлі (АҚ) ісігі аурушаңдық пен өлім-жітімділік деңгейінің жоғары болуына байланысты медицинаның өзекті мәселесі болып табылады. Гибридті визуализация, соның ішінде ПЭТ/КТ қатерлі ісіктердің, сонымен қатар АҚ ісігінің диагностикасында маңызды орын алады. Онкологияда қолданылатын радиофармацевтикалық препараттарды әзірлеу және зерттеу жұмыстары жалғасуда.*

Зерттеудің мақсаты *– асқазанның қатерлі ісігінде [^{68}Ga]FAPI-ПЭТ/КТ диагностикалық мүмкіндіктерін зерттеу.*

Әдістері: *Зерттеуге гистологиялық түрде расталған АҚ ісігі бар науқастарға жүргізілген [^{68}Ga]FAPI-ПЭТ/КТ және [^{18}F]FDG-ПЭТ/КТ диагностикалық көрсеткіштері салыстырмалы аспектіде зерттелген 8 клиникалық зерттеудің (проспективті және ретроспективті) нәтижелері енгізілді. Зерттеулердегі науқастар саны 13-тен 112-ге дейін, жалпы саны – 379 пациентті құрады. SUVmax, TBR мәндері, асқазанның алғашқы ісігін, лимфа түйіндеріндегі және ішпердедегі метастатикалық зақымдануды анықтаудағы сезімталдық талданды.*

Нәтижелері: *Бірқатар клиникалық зерттеулердің мәліметтері бойынша, [^{68}Ga]FAPI визуализация кезінде [^{18}F]FDG-мен салыстырғанда жоғары SUVmax және TBR көрсеткіштерін көрсетті, әсіресе диффузды, муцинозды және шырышты жасушалы АҚ жағдайларында. Бұл FAP ақуызының ісік стромасында жоғары экспрессиясымен түсіндіріледі, нәтижесінде препарат зақымданған ошақтарда тиімді жинақталады. Сонымен қатар, [^{68}Ga]FAPI-ПЭТ/КТ [^{18}F]FDG-ПЭТ/КТ-мен салыстырғанда асқазандағы алғашқы ісік ошақтарын (100% қарсы 53%), лимфа түйіндеріндегі метастаздарды (79% қарсы 54%) және ішперделік метастаздарды (96% қарсы 55%) визуализациялауда жоғары сезімталдық көрсетті. [^{68}Ga]FAPI-ПЭТ/КТ зерттеуінен кейін науқастардың 11-67%-ында ісік процесінің сатысы нақтыланып, ем жоспарын даралау мүмкін болды.*

Қорытынды: *[^{68}Ga]FAPI-ПЭТ/КТ әдісі [^{18}F]FDG-ПЭТ/КТ-мен салыстырғанда АҚ сатыландыруда анағұрлым ақпараттылығы жоғары болды, әсіресе гликолитикалық метаболизмі төмен ісік гистотиптері жағдайында. Бұл әдіс ішперделік, висцералдық және лимфогендік метастаздарды жоғары сезімталдықпен анықтауға мүмкіндік береді және емдеу тактикасын анықтауда маңызды рөл атқарады.*

Түйінді сөздер: *фибробласттардың белсендену ақуызының тежегіші, галлий-68-мен таңбаланған ([^{68}Ga]FAPI), асқазан обыры (АҚ), позитрон-эмиссиялық томография/компьютерлік томография (ПЭТ/КТ), қатерлі ісік сатысы, фибробласттардың белсендену ақуызы (FAP).*

АННОТАЦИЯ

ДИАГНОСТИЧЕСКИЕ ВОЗМОЖНОСТИ 68GA-FAPI ПЭТ/КТ ПРИ РАКЕ ЖЕЛУДКА

А.А. Мэлс[1], Ж.К. Жакенова[1], Г.М. Мұхит[1], Е.З. Амантайев[2], Ж.М. Аманкулов[3]

[1]НАО «Казахский национальный медицинский университет им. С. Д. Асфендиярова», Алматы, Республика Казахстан;
[2]ТОО "Городская клиническая больница №8 УОЗ", Алматы, Республика Казахстан;
[3]АО «Казахский научно-исследовательский институт онкологии и радиологии», Алматы, Республика Казахстан

Актуальность: *Рак желудка (РЖ) является актуальной проблемой медицины, в связи с высокими показателями заболеваемости и смертности. Гибридная визуализация, в том числе позитронно-эмиссионная томография/компьютерная томография (ПЭТ/КТ), имеет важное значение в диагностике злокачественных опухолей, включая РЖ. Разработка и изучение возможностей радиофармпрепаратов, применяемых в онкологии, продолжаются.*

Цель исследования *– изучить диагностические возможности ПЭТ-КТ с применением ингибитора белка активации фибробластов, меченного галлием-68 ([68Ga]FAPI-ПЭТ/КТ) при раке желудка.*

Методы: *Проведено сравнение результатов 8 клинических проспективных и ретроспективных исследований, в которых приведены диагностические показатели ПЭТ/КТ с применением ингибитора белка активации фибробластов, меченного галлием-68 ([68Ga]FAPI-ПЭТ/КТ) и фтордезоксиглюкозы, меченной фтором-18 ([18F]FDG-ПЭТ/КТ) при гистологически верифицированном РЖ. Количество пациентов в исследованиях было от 13 до 112 пациентов, общее количество составило – 379. Проанализированы значения максимального стандартизованного накопления (SUVmax), отношения опухоли к фону (TBR),*

чувствительность обнаружении первичного очага в желудке, а также метастатических изменений в лимфатических узлах и брюшине.

Результаты: *Согласно данным проанализированных клинических исследований, [68Ga]FAPI продемонстрировал более высокие значения SUVmax и TBR по сравнению с [18F]FDG, особенно при визуализации диффузных, муцинозных и перстневидноклеточных форм РЖ. Это связано с выраженной экспрессией FAP в опухолевом строме, что обеспечивает эффективное накопление препарата в поражённых участках. Кроме того, [68Ga]FAPI-ПЭТ/КТ характеризуется более высокой чувствительностью при визуализации первичных очагов РЖ (100% против 53% для [18F]FDG-ПЭТ/КТ), метастатического поражения лимфатических узлов (79% против 54%), перитонеальных метастатических очагов (96% против 55%). У 11-67% пациентов проведение [68Ga]FAPI-ПЭТ/КТ позволило уточнить стадию опухолевого процесса и повлияло на формирование индивидуального плана лечения.*

Заключение: *Применение [68Ga]FAPI-ПЭТ/КТ показало более высокую информативность по сравнению с [18F]FDG-ПЭТ/КТ при стадировании злокачественных опухолей желудка, особенно при гистологических подтипах с низким гликолитическим метаболизмом. [68Ga]FAPI-ПЭТ/КТ обеспечивает более высокую чувствительность и более качественную визуализацию перитонеальных, висцеральных и лимфогенных метастатических очагов, что играет важную роль в определении тактики лечения.*

Ключевые слова: *ингибитор белка активации фибробластов, меченный галлием-68 ([68Ga]FAPI), рак желудка (РЖ), позитронно-эмиссионная томография/компьютерная томография (ПЭТ/КТ), стадирование рака, белок активации фибробластов (FAP).*

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Information about the Authors:
A.A. Mels (Corresponding author) – Resident at the Radiological Diagnostic Department, resident of Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, tel.: +77074171728, e-mail: ablai1999@gmail.com, ORCID: 0009-0002-5239-4542;
Zh.K. Zhakenova – PhD doctoral student, Professor at the Radiological Diagnostic Department, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, tel.: +77754983950, e-mail: zhakenova.zh2020@gmail.com, ORCID: 0000-0002-6764-6821;
E.Z. Amantayev – Radiologist, Consultative and Diagnostic Department of City Clinical Hospital No. 8, Almaty, Kazakhstan, tel.: +77472838868, e-mail: Eldos.aman@gmail.com, ORCID: 0009-0007-8810-6967;
G.M. Mukhit – Resident at the Radiological Diagnostic Department, Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan, tel.: +77088419645, e-mail: gauhar.muhit@yandex.ru, ORCID: 0009-0002-0994-974X;
Zh.M. Amankulov – PhD doctoral student, Head of the Radiology and Nuclear Medicine Department, Kazakh Institute of Oncology and Radiology, Almaty, Kazakhstan, tel.: +77013514213, e-mail: zh.amankulov@kaznmu.kz, ORCID: 0000-0001-7389-3119.

Address for Correspondence: A.A. Mels, Raimbek St. 351/1, 050061, Almaty, the Republic of Kazakhstan.