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Application of PET-CT in Medical Diagnosis of Thyroid Tumor

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Abstract: Thyroid tumors are divided into benign and malignant tumors, which are usually found in physical examination without any clinical manifestations in the early stage. When the tumor increases, it can compress the trachea, esophagus, recurrent laryngeal nerve, etc. The correct diagnosis rate of thyroid tumor probably determines the future cure of patients. The purpose of this article is to study the application of PET-CT in the medical diagnosis of thyroid tumors. Thyroid tumors and PET-CT were briefly introduced through literature research and investigation, and the specific application of PET-CT and common diseases causing thyroid nodules were analyzed. Specific applications of PET-CT include epilepsy localization, brain tumor characterization and recurrence judgment, early diagnosis of dementia, brain receptor research, cerebrovascular diseases, drug research, advanced health examination, lung cancer examination, etc. The effects of PET-CT and CT in the medical diagnosis of thyroid tumors were compared through comparative experiments. The results showed that for benign thyroid tumors, the diagnostic accuracy of PET-CT was 14% higher than that of CT. For malignant thyroid tumors, the diagnostic accuracy of PET-CT is 15% higher than that of CT. In addition, PET-CT diagnosis can reduce the probability of thyroid nodules being misdiagnosed as thyroid tumors.

1. Introduction

Thyroid tumors can be divided into benign and malignant types according to their differentiation degree and biological characteristics. Benign tumors can be divided into thyroid adenoma and cyst. More than 95% of malignant tumors are primary thyroid cancer, and very few can have malignant lymphoma and metastatic tumor [1]. Papillary carcinoma accounts for 60% of thyroid carcinoma, mostly occurring in young people, with more females than males. The malignancy is low and the growth is slow. Lymph node metastasis is the main cause. After surgical treatment, the survival period is long and the prognosis is good. Another 15% are undifferentiated cancers, mostly occurring in older patients. The degree of malignancy is high, lymph and hematogenous metastasis can occur in the early stage [2]. Due to obvious symptoms, patients can usually see a doctor in time. Thyroid adenoma is the most common benign thyroid tumor. Pathology is divided into follicular adenoma and papillary adenoma. The former is the most common, accounting for 70% ~ 80% of thyroid adenoma. The latter is relatively rare. Papillary adenoma is relatively rare and mostly cystic. Therefore, it is also called papillary cystadenoma and has a large malignant tendency. The diagnosis should be cautious and should be differentiated from papillary carcinoma. Complete capsule is often found around adenoma. The reason is unknown and may be related to gender, genetic factors, radiation exposure (mainly external radiation) and TSH long-term over stimulation [3].

PET is called positron emission computed tomography (PET), which is an imaging device that reflects the gene, molecule, metabolism and functional status of lesions. It uses positron nuclide labeled glucose and other human metabolites as imaging agents, and reflects its metabolic changes through the uptake of imaging agents by lesions, thus providing clinical biological metabolic information of diseases [4]. PET uses positron nuclides as tracers, which can be used to understand the functional metabolic state of lesions through the uptake of tracers by lesion sites. It can macroscopically display the pathophysiological characteristics of organ functions, metabolism and so on of the whole body, making it easier to find lesions. CT can accurately locate the focus and display the subtle structural changes of the focus. PET-CT fusion images can comprehensively find the focus, accurately locate and judge whether the focus is benign or malignant, so the focus can be found early, quickly, accurately and comprehensively [5]. Medical experts suggest that social elites with heavy work pressure and responsibilities should go to the hospital regularly for physical examination, and it is best to do cancer prevention examination once a year, such as PET-CT examination, to eliminate major hidden diseases, maintain health and create greater value. At the same time, strengthen physical exercise, improve the body's immune system, and adjust the law of life [6].

Li believes that plasmacytoid dendritic cell tumor of mother cell is a rare invasive hematological malignant tumor. FDG PET-CT monitoring was performed on a male with prostatic hyperplasia. FDG PET showed several slight FDG-like skin lesions in chest and back, involving left inguinal lymph nodes, and obvious FDG-like subcutaneous mass in left calf [7]. Sauerland thinks that the statement that "PET is better than tomography" is too optimistic and needs further and more reliable tests to confirm [8]. Ceyrat found high 18F-FDG uptake in breast lesions of a 36-year-old woman who received PET for initial staging of diffuse large b-cell lymphoma. Ultrasound-guided fine needle aspiration of one lesion produced creamy liquid consistent with milk and confirmed the diagnosis of breast cyst [9]. Shao performed 18F-FDG PET on a female with a left inguinal mass to evaluate the nature of the mass. Amplitude-based gating can be used for 90Y PET-CT liver imaging to provide a motion corrected image with higher estimation of activity concentration, thus improving post-treatment dosimetry [10]. Lapa discussed the value of PET-CT quantitative analysis. SUV maximum value can promote the differentiation of tumor metastasis and degenerative lesions, and can be distinguished from soluble metastatic tumors [11]. Zhang evaluated the specificity of CCK-HBS by evaluating the ability of CCK-HBS to exclude diseases in 20 asymptomatic cholecystectomy patients, and explored the application of 18F-FDG PET-CT in hepatic duct lymphoepithelioma-like carcinoma [12].

In brief, this article discusses the application of PET-CT in the medical diagnosis of thyroid tumors. Specifically, the main research content of this paper is roughly divided into six parts: The first part is the introduction part, aiming to make a systematic overview of the main research content of this paper from the research background, research purposes, research ideas and methods. The second part is the theoretical basis, which introduces the basic principles of PET-CT in detail and systematically. The third part introduces the characteristics and application of PET-CT. The fourth part is related research, which analyzes thyroid-related diseases and diagnostic methods through data query and related experiments. The fifth part is the analysis of the data, through specific survey data and research results, comparing the effects of PET-CT and CT in the medical diagnosis of thyroid tumors. The results showed that for benign thyroid tumors, the diagnostic accuracy of PET-CT was 14% higher than that of CT. For malignant thyroid tumors, the diagnostic accuracy of PET-CT is 15% higher than that of CT. In addition, PET-CT diagnosis can reduce the probability of thyroid nodules being misdiagnosed as thyroid tumors. Misdiagnosis between thyroid tumor and thyroid nodule is the most common, and the possible causes include atypical images, too small cancer focus, and insufficient careful image observation. The sixth part is the summary and suggestion part of this article, which is the summary of the results of this article.

2. Basic Principles of PET-CT

2.1. The Basic Principle of PET Imaging

PET is an abbreviation of Positron Emission Tomography. The clinical imaging process is as follows: the radionuclide emitting positrons (such as F-18, etc.) is labeled on compounds that can participate in the blood flow or metabolic process of human tissues, and the radionuclide labeled with positron-bearing compounds is injected into the body of the subject. The subjects were allowed to perform PET imaging within the effective field of view of PET. Positrons emitted by radionuclides move about 1mm in vivo and then combine with negative electrons in tissues to generate annihilation radiation. To produce two equal energy,

The main components of PET system include rack, annular detector, coincidence circuit, examination bed and workstation, etc. The detection system is the main part of the whole positron emission imaging system, and its block detection structure is helpful to eliminate scattering and improve counting rate. Many block structures form a ring, and then dozens of rings form the whole detector. Each block structure consists of about 36 small bismuth germinate (BGO) crystals followed by 2 pairs (4) of photomultiplier tubes (PMT)BGO crystals to convert high energy photons into visible light.

PET uses coincidence detection technology for electronic collimation correction, which greatly reduces random coincidence events and background. The electronic collimator has very high sensitivity (without the influence of lead shielding) and resolution. In addition, the size of . BGO crystal has a positive correlation with sensitivity. PET probe with block structure. Able to perform 2D or 3D acquisition. 2D acquisition is to arrange lead plates or tungsten plates at intervals between rings to reduce the influence of scattering on image quality. In 2D image reconstruction, only the counts in the adjacent rings (generally 2-3 rings) are calculated in accordance with the calculation, with high resolution and low counting rate. 3D data acquisition is different. The interval between rings is cancelled and coincidence calculation is carried out in all rings, which obviously improves the counting rate. However, the scattering is serious, the image resolution is low, and a large amount of data calculation is required during data reorganization. Another important difference between the two acquisition methods is the difference in sensitivity. The sensitivity of 3D acquisition is the highest in the center of the field of view.

2.2. Working Principle of Multi-slice Spiral CT

The basic principle of CT is image reconstruction. According to the characteristic that various tissues of the human body (including normal and abnormal tissues) have unequal absorption of X-rays, a selected layer of the human body is divided into many cube small blocks (also called voxels). After X-rays pass through voxels, the measured density or gray value is called pixels. The X-ray beam passes through the selected layer, and the detector receives the sum of attenuation values of each voxel arranged along the X-ray beam direction after absorbing X-rays, which is a known value, and the X-ray attenuation values of each voxel forming the total amount are unknown values. When the X-ray generating source and the detector make circular arc or circular relative motion around the human body. Using iterative method

The X-ray attenuation value of each voxel is obtained and image reconstruction is carried out to obtain black and white images of tissues with different densities on the layer. Spiral CT breaks through the design of traditional CT and adopts slip ring technology to connect power cables and some signal lines with different metal rings in the fixed frame. The X-ray tube and detector slide brushes and metal ring leads move together. The bulb and detector are not limited by the length of the cable, and rotate continuously and uniformly along the long axis of the human body. The scanning bed advances synchronously and uniformly (the traditional CT scanning bed is stationary during scanning). The scanning track advances spirally, and the volume scanning can be completed quickly and continuously.

Multi-slice spiral CT is characterized by multi-slice arrangement of detectors. It is the best combination of high speed and high spatial resolution. The wide detector of multi-slice spiral CT is made of high-efficiency solid rare earth ceramic materials. Each unit is only 0.5mm thick, 1 mm thick or 1.25mm thick, and the photoelectric conversion efficiency of a scanning detector with a thickness layer of at most 5 mm is as high as 99% and can continuously receive X-ray signals. The afterglow is extremely short and has good stability. Multi-slice spiral CT can complete a large range of volume scanning at high speed, with good image quality, fast imaging speed, high longitudinal resolution and good temporal resolution. The application of CT is greatly expanded.

Compared with single-slice spiral CT, the application range is. Collecting data of the same volume greatly shortens the scanning time, and one part can be scanned every 15S or so without increasing the X-ray dose. The whole chest scan with a layer thickness of 3mm can be completed within 5 seconds. The body scan can be completed with a larger pitch P value and one breath hold for 20 seconds. With the same layer thickness and the same time, the scanning range is increased 4 times. The coverage rate per unit time of scanning is obviously improved, the radiation dose received by patients is obviously reduced, the service life of the X-ray bulb is obviously prolonged, meanwhile, the dosage of contrast agent is saved, the low contrast resolution and the spatial resolution are improved, and the noise, artifacts and hardening effects are obviously reduced. In addition, the width of the X-ray cone beam can be automatically adjusted according to different layer thicknesses, and the collimated X-ray beam is focused on a corresponding number of detectors which are connected with four data acquisition systems (DAS) through electronic switches.

2.3. Image Fusion of PET-CT

PET and CT are two different imaging principles of equipment combined on the same machine, not a simple addition of their functions. However, image fusion is carried out on this basis. The fused image has both fine anatomical structure and rich physiological and biochemical function information, which can provide basis for determining and searching accurate location, quantitative and qualitative diagnosis of tumors and other lesions. X-ray can be used to correct attenuation of nuclear medicine images.

The core of PET-CT is fusion. Image fusion means that images of the same or different imaging modes are transformed to match their spatial positions and spatial coordinates. The image fusion processing system uses the characteristics of the respective imaging modes to spatially register and combine the two images, and then combines the image data into a single image after registration. PET-CT co-computer fusion (also called hardware fusion and non-image alignment) has the same positioning coordinate system, so that PET-CT co-computer acquisition can be carried out without changing the position during patient scanning, thus avoiding errors caused by patient displacement. After the acquisition, the two images need not be aligned, converted and registered, and the computer image fusion software can be used conveniently.

Accurate fusion of 2D and 3D, the fused image shows the metabolic activities of human anatomy and organs at the same time, greatly simplifying the technical difficulty in the whole image fusion process, avoiding complex labeling methods and a large number of operations after collection, and solving the registration problem of time and space to a certain extent, thus greatly improving the reliability of the image.

Due to the influence of attenuation factors such as Compton effect, scattering, accidental coincidence, dead time, etc., the collected data are not consistent with the actual situation in PET imaging process, and the image quality is distorted. Effective measures must be adopted to correct the distortion, so as to obtain more real medical images. The resolution of the penetrating image system obtained by isotope correction is generally 12mm, while the resolution of the penetrating image system obtained by X-ray method is about 1 mm. The information content of the image is much larger than that obtained by isotope method. Attenuation correction of PET with CT images greatly improves the clarity of PET images. The image quality is obviously better than that of isotope penetration source correction. The resolution is increased by more than 25%, the correction efficiency is increased by 30%, and it is easy to operate. The corrected PET image and CT image are fused to obtain more information on anatomical structure and physiological function after information complementation, which has extremely important clinical significance for tumor patient surgery and radiotherapy localization.

3. Characteristics and Application of PET-CT

3.1. Characteristics of PET-CT

PET-CT is an organic combination of PET and CT (computer tomography). By using the same examination bed and the same image processing workstation, PET images and CT images can be fused, which can show the pathophysiological changes and morphological structure of lesions at the same time and obviously improve the accuracy of diagnosis. PET-CT can make early diagnosis and differential diagnosis of tumor, identify whether the tumor has recurrence, stage and re-stage the tumor, find the primary and metastatic foci of the tumor, guide and determine the treatment plan of the tumor, and evaluate the curative effect. Among tumor patients, through PET-CT examination, a considerable number of patients have changed their treatment plans due to clear diagnosis. PET-CT can accurately evaluate the curative effect, adjust the treatment plan in time and avoid ineffective treatment. On the whole, medical expenses are greatly saved and valuable treatment time is gained. PET-CT can accurately locate epileptic foci and is also a unique examination method for diagnosing depression, Parkinson's disease, senile dementia and other diseases. Epilepsy treatment is one of the top ten medical problems in the world. The difficulty lies in the accurate location of epileptogenic foci. PET-CT has solved this medical problem. Under the guidance of PET-CT, X-knife or γ-knife was used for treatment, and good therapeutic effect was obtained. PET-CT is also a means of health examination. It can complete the whole body examination by imaging at one time, and can discover tumors and heart and brain diseases that seriously endanger people's health in the early stage, so as to achieve the purpose of early treatment and prevention of diseases.

PET-CT can also be used for good therapeutic effect evaluation: after certain treatments such as surgery, radiotherapy and chemotherapy, PET-CT examination can be used to determine whether the tumor has changed, whether the activity of cancer cells has decreased, and whether other parts of the body have expanded, thus judging the previous therapeutic effect. According to modern medicine, most diseases are the result of imbalance of biochemical process in vivo. PET-CT can dynamically and quantitatively observe biochemical changes of molecular level in vivo under physiological state. With the declassification of human genes, the generation, development and post-treatment outcome of tumors, heart and brain diseases and various hereditary diseases that are harmful to human health will be fundamentally recognized, and an effective treatment plan is expected to be fundamentally found. PET-CT gene imaging is a "bridge" connecting clinical and basic gene research.

PET-CT can diagnose tumor and other diseases in early stage. Due to active metabolism of tumor cells, the ability to absorb imaging agent is 2-10 times that of normal cells, forming obvious "light spots" on the image. Therefore, hidden small lesions (larger than 5mm) can be found before anatomical changes occur in the early stage of the tumor. Check for safety and non-invasiveness. Most of the nuclides used in the examination are basic elements constituting human life or very similar nuclides, and the half-life is very short. The dose received is slightly higher than that of a chest CT scan, which is safe and efficient and can be repeated in a short time. The inspection results are more accurate. Through qualitative and quantitative analysis, valuable functional and metabolic information can be provided, and accurate anatomical information can be provided at the same time, which can help to determine and find the accurate location of tumors. The examination results are more accurate than PET or CT alone, especially the diagnostic ability for small lesions is significantly improved.

Carry out a quick general examination. Other imaging examinations scan selected parts of the body, while a PET-CT whole body scan (neck, chest, abdomen, pelvic cavity) takes only about 20 minutes to obtain PET, CT and their fused whole body cross-section, sagittal and coronal images respectively, which can visually see the affected parts and conditions of the disease in the whole body. It can discover tumor early and determine its nature. Its treatment cost is reduced by 1-5 times and its survival time is increased by 1-5 times or even 10 times. One examination can accurately judge whether most tumors are benign or malignant, and whether there is metastasis, thus preventing various examinations from delaying disease diagnosis or formulating wrong treatment plans; Can accurately stage the tumor, evaluate the treatment effect and reduce unnecessary treatment methods and dosage; Can accurately determine tumor recurrence after tumor treatment, although the single examination cost is slightly higher, but in fact unnecessary surgery, radiotherapy and chemotherapy and hospitalization are avoided, and the overall cost performance is outstanding.

3.2. Application of PET-CT

In recent years, the number of PET-CT instruments in our country has increased rapidly. According to investigation, 54 PET-CT instruments had been installed by the end of August 2006. The existing problems are: uneven development in different regions and unreasonable preparation;

Lack of inspection guidelines and diagnosis and treatment specifications for PET-CT; Lack of innovation in scientific research, lack of multi-center research results, lack of summary reports of large number of cases, research on health economics evaluation has just started. There is obviously a shortage of qualified personnel for comprehensive imaging and radiopharmaceuticals, which should be solved through continuing education. PET-CT is mainly used for malignant tumors, and malignant tumors have become a major killer of people's health in our country. It is not uncommon for families whose relatives suffer from tumors and become poor. The actual situation is that although PET-CT, a high-end equipment, is very helpful to the diagnosis and treatment of patients, a considerable number of patients have to give up using it because they cannot afford expensive examination fees. For this reason, except for a few of the 54 centers mentioned above, it is difficult for one center to carry out more than 1,500 examinations throughout the year, so that most PET-CT and accelerators do not work. It can be expected that with the gradual maturity of the application of PET-CT, the clinical value of PET-CT will be recognized. Once the examination costs of some diseases (such as some malignant tumors) are included in medical insurance, the demand for PET-CT examination will greatly increase and play a greater role in clinic.

PET-CT provides much more prediction and treatment information than single PET and CT. It surpasses the existing fields of single PET and single CT, and can complete all functions of ultra-high-grade CT and PET. The whole-body CT scan can be completed in 20min, which is more than 60% higher than the efficiency of PET alone. It can also provide more accurate and rapid myocardial and cerebral blood perfusion functional images than CT. PET-CT fusion images can well describe the effect of diseases on biochemical processes, identify physiological and pathological uptake, detect early onset symptoms before diseases get anatomical evidence, and even detect subclinical tumors smaller than 2mm, thus providing the best treatment scheme and screening the most effective treatment drugs for correctly determining the planned target area of radiotherapy (clinical target area combined with biological target area), detecting drugs and radiotherapy effects in the treatment process. Anatomical localization and functional imaging for lesion site.

Specific applications of PET-CT include epilepsy localization, brain tumor characterization and recurrence judgment, early diagnosis of dementia, brain receptor research, cerebrovascular diseases, drug research, advanced health examination, lung cancer examination, etc.

Epilepsy localization: accurate localization of epileptic foci in brain, providing basis for surgery or gamma knife resection of epileptic foci;

Qualitative and recurrent judgment of brain tumor: qualitative analysis of benign and malignant brain tumor, determination of malignant glioma boundary, differentiation of radiation necrosis and recurrence after tumor treatment, selection of tumor biopsy site, etc.

Early diagnosis of dementia: early diagnosis and staging of Alzheimer's disease and differentiation from other types of dementia such as vascular dementia.

Brain receptor research: brain receptor analysis of Parkinson's disease, diagnosis and treatment of diseases.

Cerebrovascular diseases: PET-CT can sensitively capture brain metabolic changes caused by cerebral ischemic attack, so it can make early diagnosis and localization of transient ischemic attack (TIA) and cerebral infarction, and make therapeutic effect evaluation and prognosis judgment.

Drug research: to carry out pharmacological evaluation of neuropsychiatric drugs and guide drug use, observe the changes of cerebral glucose metabolism in patients with obsessive-compulsive disorder, etc., and provide preoperative basis and postoperative follow-up for stereotactic surgery.

Advanced health examination: early tumors can be cured, but most tumors are found in the middle and late stages, so routine screening of tumors cannot be ignored. PET-CT is simple, safe, comprehensive and accurate, and is the best means of health examination for people.

Lung cancer examination: 70% of lung cancer has reached the middle and advanced stage when it is diagnosed. The middle and advanced lung cancer has passed the optimal treatment period. The most advanced imaging instrument capable of finding lung cancer lesions in the early stage is obviously PETCT. The ultra-high inspiration degree of PET-CT makes it possible to detect micro-functional metabolism of human nervous system, which not only improves the definition and specificity of lesions, but also greatly improves the detection ability and diagnosis rate of micro-lesions and makes the positioning more accurate.

4. Experiments

4.1. Experimental Content

In order to study the effect of PET-CT in the medical diagnosis of thyroid tumors. In this experiment, thyroid tumor patients were selected as the research object to investigate the diagnosis of PET-CT.

The thyroid gland is located under the thyroid cartilage in the neck of the human body, on both sides of the trachea, shaped like a butterfly, like shield armor, so it is called thyroid gland. The thyroid gland is divided into left and right lobes and isthmus. The left and right leaves are located on the two sides of the lower part of the larynx and the upper part of the organ. The upper end extends from the midpoint of the thyroid cartilage to the 6th tracheal cartilage ring, sometimes reaching the suprasternal fossa or posterior to the sternum. Thyroid gland has the function of synthesizing, storing and secreting thyroxine, and its structural unit is follicular. Thyroxine is organically bound iodine containing iodine tyrosine, including tetraiodothyronine (T4) and triiodo tyrosine (T3). After synthesis, thyroxine is combined with thyroglobulin and stored in thyroid follicles. Thyroxine released into blood is bound to serum protein, 90% of which is T4 and 10% is T3. The main function of thyroxine is to accelerate the efficiency of whole-body cells in using oxygen, accelerate the decomposition of protein, carbohydrate and fat, comprehensively increase the metabolism of human body, and increase heat generation. Promote the growth and development of the human body, mainly affecting the brain and long bones after birth.

Iodine 131 is the most commonly used radioisotope tracer in thyroid scanning, which is a method to detect the properties of goiter by using the close relationship between thyroid and iodine metabolism. One of the important functions of the thyroid gland is that iodine it ingests synthesizes thyroid hormones that exert various important physiological functions on the human body through a series of chemical reactions. Thyroid scanning is to measure the iodine absorption capacity of the mass in the thyroid gland with a counter after the patient ingests the isotope iodine 131, so as to judge the benign and malignant nature of the mass. When the iodine absorption function is strong, there are "hot" nodules with dense iodine absorption on the scan. On the contrary, when the iodine absorption function is weak, there are sparse or even blank areas of iodine absorption, called "cold" nodules. Clinically, according to the strength of iodine absorption function, there are four grades, namely hot nodules, warm nodules, cold nodules and cold nodules. A large number of thyroid scans and the results of comparison tests with pathological resection show that the proportion of cancer in cold nodules is quite high, about 30-50%, while there is no cancer in hot nodules. Compared with warm nodules, cold nodules have a significantly increased chance of cancer. In short, the incidence of cancer increases from hot nodule, warm nodule, cool nodule to cold nodule.

However, although the cold and hot nodules shown by thyroid scan have important reference value, there are also many exceptions. It is not very accurate, especially cold nodules and cold nodules, which can be considered as cancer, sometimes turned out to be general benign masses. For example, thyroid cyst is a hollow fluid-containing cyst. There is no gland tissue or solid cancer tumor in the so-called "mass", so it does not absorb iodine or cannot reflect the strength of iodine absorption function. A blank area appears on the scan, which is regarded as a "cold nodule." In fact, it is just a benign cyst. Another example is a small number of thyroid adenomas, which will be easily misdiagnosed as thyroid cancer due to the "cold nodule" changes on the scan due to the extremely weak iodine absorption capacity of the tumor tissue. Therefore, thyroid scanning is not the most reliable diagnostic basis. The most authoritative diagnostic basis is still biopsy. It can accurately judge the nature of the tumor from the cell morphology and the structural relationship between tissues. Clinically, it is usually not advocated to cut living tissue from thyroid gland before operation and send it to pathological examination, but to puncture it with needle when necessary, or to cut living tissue for frozen quick section during operation to obtain pathological diagnosis.

4.2. Experimental Results

Benign thyroid tumors are very common. Among cervical tumors, thyroid tumors account for about 50%. Generally, there are no obvious symptoms. When the tumor is large, it will cause dyspnea, dysphagia, hoarseness and other symptoms due to compression of trachea, esophagus and nerve. When the tumor is complicated with hemorrhage and rapidly increases, it will cause local swelling and pain. Because benign thyroid tumors have the possibility of malignant transformation, some of them are benign but present "hot nodules" (i.e. high functionality), so active treatment is required.

Benign thyroid tumors are often misdiagnosed. It is easy to misdiagnose benign thyroid tumors as thyroid nodules and thyroid cancer, etc. It is also easy to misdiagnose thyroid nodules and thyroid cancer as benign thyroid tumors. Improving the correct diagnosis rate can timely find the disease and prescribe the right medicine. This experiment will compare the accuracy of PET-CT and CT in the diagnosis of thyroid diseases.

The medical records of 100 patients with benign and 100 patients with malignant thyroid tumors examined by PET-CT and 100 patients with benign and 100 patients with malignant thyroid tumors examined by CT were selected. The correct diagnosis, misdiagnosis and missed diagnosis were sorted out, and the results are shown in Table 1.

Table 1. Diagnosis of thyroid tumor

Projects	Correct	Missed Diagnosis	Misdiagnosis	Correct	Missed Diagnosis	Misdiagnosis
	Benign			Malignant		
PET-CT	94	2	4	97	1	2
CT	80	5	15	82	8	10

5. Discussion

5.1. Analysis of Diagnostic Effect of PET-CT for Thyroid Tumor

Thyroid tumors often show thyroid nodules as their obvious manifestations. Therefore, when nodular goiter is encountered clinically, it is of great significance to distinguish benign from malignant nodules. Common diseases causing thyroid nodules include simple goiter, thyroiditis, thyroid tumor, thyroid cyst, etc. In order to explore the misdiagnosis of thyroid tumors and find more effective diagnostic methods, it is necessary to compare the diagnosis of PET-CT and CT.

Firstly, the diagnosis of benign tumors is plotted as a bar graph, as shown in Figure 1.

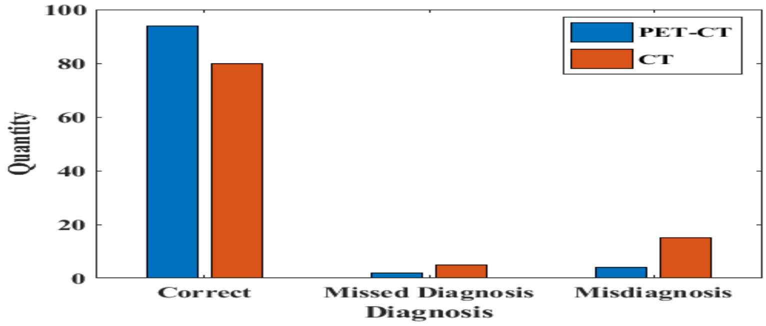

Figure 1. Diagnostic effect of benign thyroid tumor

From the data in the above figure, it can be seen that in the diagnosis of benign thyroid tumors by PET-CT, the correct rate is as high as 94%, the missed diagnosis rate is 2%, and the misdiagnosis rate is 4%. Among benign thyroid tumors diagnosed by CT, the correct rate is 80%, the missed diagnosis rate is 5%, and the misdiagnosis rate is 15%. For benign thyroid tumors, the diagnostic accuracy of PET-CT is 14% higher than that of CT. Thyroid tumor is the most common benign thyroid tumor. Pathology is divided into follicular tumor and papillary tumor. The former is the most common, accounting for 70% ~ 80% of thyroid tumor. The latter is relatively rare. Papillary tumors are relatively rare and mostly cystic. Therefore, they are also called papillary cystic tumors and have a large malignant tendency. The diagnosis should be cautious and should be differentiated from papillary carcinoma. The diagnosis of malignant tumor is plotted as a bar graph, as shown in Figure 2.

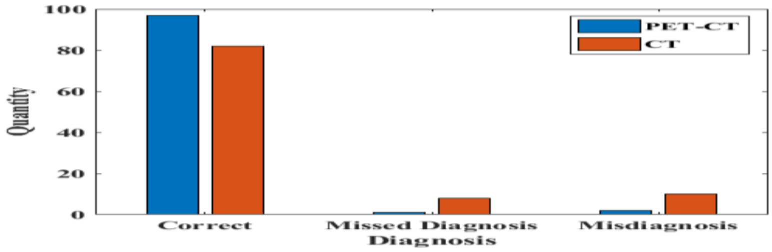

Figure 2. Diagnostic effect of thyroid malignant tumor

As can be seen from the data in the above figure, in the diagnosis of thyroid malignant tumors by PET-CT, the correct rate is as high as 97%, the missed diagnosis rate is 1%, and the misdiagnosis rate is 2%. Among thyroid malignant tumors diagnosed by CT, the correct rate is 82%, the missed diagnosis rate is 8%, and the misdiagnosis rate is 10%. For malignant thyroid tumors, the diagnostic accuracy of PET-CT is 15% higher than that of CT. Thyroid cancer is the most common thyroid malignant tumor, and a very small number of malignant lymphoma and metastatic tumors can be found. Thyroid cancer accounts for 1% of all malignant tumors. Except medullary carcinoma, most thyroid carcinoma originated from follicular epithelial cells. The incidence of thyroid cancer is related to region, race and sex. It can occur at any age, mostly in the elderly, but it is not uncommon for young women. The prevalence of thyroid cancer has increased in recent years.

5.2. Analysis of Diagnostic Effect of PET-CT for Thyroid Nodules

Thyroid tumors are mostly solitary nodules with complete fibrous capsule. The tissue structure and cytological characteristics are different from those of surrounding glands. The structure of tumor tissue in capsule is relatively consistent. The surrounding thyroid gland is often under pressure. Nodular goiter is usually multiple. Nodules have various structures such as proliferative phase, involution phase, mixed changes of proliferative phase and involution phase, and the surrounding thyroid gland has no extrusion atrophy. Misdiagnosis between thyroid tumor and thyroid nodule is the most common. Therefore, we investigated the diagnostic effect of PET-CT on thyroid nodules, and the results are shown in Table 2.

Table 2. Diagnosis of thyroid nodules

Projects	Correct Rate	Misdiagnosed as Malignant Tumor	Misdiagnosed as Benign Tumor	Missed Diagnosis Rate
PET-CT	83%	9%	4%	4%
CT	68%	14%	7%	11%

Thyroid nodules may be caused by iodine deficiency in diet or enzyme deficiency in thyroid hormone synthesis. The history of thyroid nodules is generally relatively long and tends to grow up unconsciously, which is occasionally discovered during physical examination. Most of them are multinodular and a few are single nodules. Most nodules are gelatinous, including cysts formed due to hemorrhage and necrosis. There may be more fibrosis or calcification or even ossification in some areas of patients with chronic diseases. Thyroid hemorrhage often has a history of sudden pain and cyst-like masses in glands. For those with gelatinous nodules, the texture is relatively hard. Calcification or ossification is hard. Generally, conservative treatment is available, but surgical treatment should be performed when the nodule has compression symptoms (dyspnea, dysphagia or hoarseness), malignant tendency or hyperthyroidism due to its large size. Timely discovery can provide favorable opportunities for treatment. The diagnosis of thyroid nodules by PET-CT is drawn into a fan chart, as shown in Figure 3.

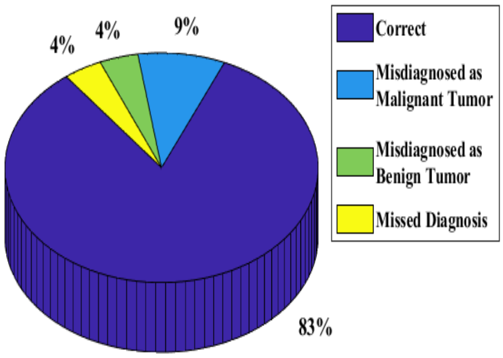

Figure 3. PET-CT diagnosis of thyroid nodules

From the data in the above figure, 9% of thyroid nodules diagnosed by PET-CT were misdiagnosed as thyroid malignant tumors and 4% as thyroid benign tumors. Thyroid tumors generally have a single component, uniform density in the lesions, clear boundaries, smooth and complete capsule in most lesions, and less calcification. Nodular goiter has many components, uneven density in the lesion, often accompanied by hemorrhage, cystic degeneration and calcification, with ring calcification quite characteristic. However, there are still some difficulties in the differential diagnosis of the two in practical work, which is easy to cause single homogeneous low density foci and misdiagnosis as tumors. For comparison, CT diagnosis of thyroid nodules is drawn into a fan chart, as shown in Figure 4.

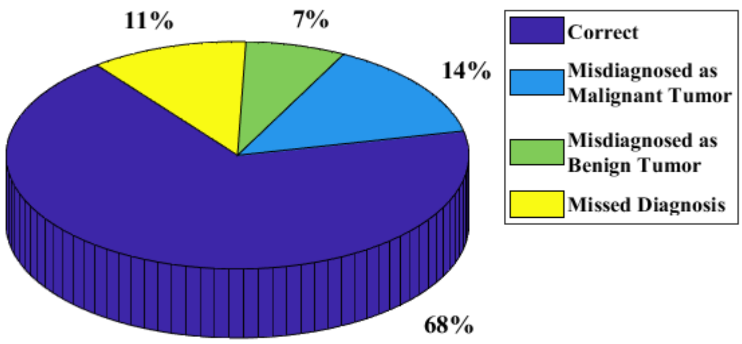

Figure 4. CT diagnosis of thyroid nodules

As can be seen from the data in the above figure, 14% of thyroid nodules diagnosed by CT were misdiagnosed as thyroid malignant tumors and 7% as thyroid benign tumors. PET-CT diagnosis can reduce the probability of thyroid nodules being misdiagnosed as thyroid tumors. In addition, the multisource of thyroid lesions is the main cause of missed diagnosis. Due to the existence of multi-source lesions, the images are diversified and complicated. Typical lesions cover up the features of other minor and minor lesions. The main reasons are: the image is not typical, the cancer focus is too small, and the image observation is not careful enough. When observing images, nodule foci should be comprehensively analyzed one by one. In daily work, when multiple nodules are encountered, the possibility of multiple lesions should be considered.

6. Conclusion

(1) The introduction of thyroid tumor and PET-CT, the purpose and significance of the research and the current research situation. Thyroid tumors can be divided into benign and malignant types according to their differentiation degree and biological characteristics. PET-CT is an organic combination of PET and CT (computed tomography). Using the same examination bed and the same image processing workstation, PET images and CT images can be fused to show the pathophysiological changes and morphological structures of lesions at the same time.

(2) Through literature research and investigation, the specific application of PET-CT and common diseases causing thyroid nodules are introduced. Specific applications of PET-CT include epilepsy localization, brain tumor characterization and recurrence judgment, early diagnosis of dementia, brain receptor research, cerebrovascular diseases, drug research, advanced health examination, lung cancer examination, etc. Common diseases causing thyroid nodules include simple goiter, thyroiditis, thyroid tumor, thyroid cyst, etc.

(3) Experiments and data analysis show that for benign thyroid tumors, the diagnostic accuracy of PET-CT is 14% higher than that of CT. For malignant thyroid tumors, the diagnostic accuracy of PET-CT is 15% higher than that of CT. In addition, PET-CT diagnosis can reduce the probability of thyroid nodules being misdiagnosed as thyroid tumors. Misdiagnosis between thyroid tumor and thyroid nodule is the most common, and the possible causes include atypical images, too small cancer focus, and insufficient careful image observation.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

References

[1] Li, P., Liu, P., & Zhang, H. (2017). "Ultrasonic Diagnosis for Thyroid Hürthle Cell Tumor", Cancer Biomarkers, 20(3), pp.235-240. https://doi.org/10.3233/CBM-160544

[2] Abrosimov, A. Y., Dvinskikh, N. Y., & Sidorin, A. V. (2016). "Cells of Benign and Borderline Thyroid Tumor Express Malignancy Markers", Bulletin of Experimental Biology & Medicine, 160(5), pp.698-701. https://doi.org/10.1007/s10517-016-3253-1

[3] Oka, K., Iwamuro, M., & Otsuka, F. (2017). "Neck Schwannoma Mimicking a Thyroid Tumor", Journal of General and Family Medicine, 18(6), pp.473-474. https://doi.org/10.1002/jgf2.121

[4] Li, L., Zhao, X., Lu, W., & Tan, S. (2019). "Deep Learning for Variational Multimodality Tumor Segmentation in PET/CT", Neurocomputing, 42(1), pp.1-6.

[5] Kanthan, G. L., Izard, M. A., Emmett, L., Hsiao, E., & Schembri, G. P. (2016). "Schwannoma Showing Avid Uptake on 68Ga-Psma-Hbed-Cc PET/CT", Clinical Nuclear Medicine, 41(9), pp. 703.

[6] Artigas, C., Alexiou, J., Garcia, C., Wimana, Z., Otte, F. X., & Gil, T. (2016). "Paget Bone Disease Demonstrated on 68Ga-Psma Ligand PET/CT", European Journal of Nuclear Medicine & Molecular Imaging, 43(1), pp.195-196. https://doi.org/10.1007/s00259-015-3236-x

[7] Li, Z. G., & Mu, H. Y. (2017). "Blastic Plasmacytoid Dendritic Cell Neoplasm Evaluated by FDG PET/CT", Clinical Nuclear Medicine, 42(7), pp.551-552.

[8] Sauerland, & Stefan. (2017). "Randomized Trial on Pet/Ct Imaging Requires Adequate Follow-up", Journal of Nuclear Medicine, 58(11), pp.1881. https://doi.org/10.2967/jnumed.117.191346

[9] Ceyrat Quentin, Ziade Caroline, Tlili Ghoufrane, Fernandez Philippe, Meyer Marie. (2018). "Galactocele, Pitfall for the Evaluation by 18F-FDG PET/CT", Clinical Nuclear Medicine, 43(7), pp.237-238.

[10] Shao, F., Zhang, M., Wang, Y., Zou, Y., & Chen, Y. (2017). "Widespread Amyloidosis Around Major Joints on 18F-FDG PET/CT", Clinical Nuclear Medicine, 42(1), pp.76-78.

[11] Lapa, P., Marques, M., Costa, G., & Lima, J. P. (2016). "The Value of Quantitative Analysis in 18F-NAF PET/CT", Revista Espanola De Medicina Nuclear E Imagen Molecular, 36(2), pp.78. https://doi.org/10.1016/j.remn.2016.08.002

[12] Li, B., Zhang, Y., Hou, J., & Shi, H. (2017). "18F-FDG PET/CT of Common Hepatic Duct Lymphoepithelioma-Like Carcinoma", Revista Espaola De Medicina Nuclear E Imagen Molecular, 36(1), pp.63-64. https://doi.org/10.1016/j.remn.2016.06.009