

The role of FDG PET in the detection of infection and inflammation

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History

Imaging of glucose metabolism using F-18-fluorodeoxyglucose (FDG) was first introduced in the 1970's. In the first decade after its discovery, FDG was mostly used for brain imaging. In the 1990's however, the sensitivity of FDG PET for the imaging of cancer, combined with the wider clinical availability of PET-scanners, led to a real breakthrough in the clinical use of FDG PET. Uptake of FDG in inflammatory lesions was already reported in the late 1980's, which unfortunately meant that FDG PET was not specific for malignancies; however, on the bright side, it also meant that FDG PET could be used in patients to detect the location and extent of infections and inflammations.

Accumulation of FDG in inflammatory processes

FDG accumulates in cells with high glucose metabolism. In inflammatory processes (including infections) a concentration of leukocytes takes place. These cells often exhibit higher metabolic activity than surrounding (healthy) tissue, leading to increased accumulation of FDG in inflammatory foci. This enables us to visualise infections and inflammations by FDG PET.

Clinical indications for FDG PET in inflammation and infection

The fact that many different inflammatory diseases can be visualised using FDG PET does not mean that each patient suspected of an inflammation needs to undergo a PET scan. As yet, the value of FDG PET in the diagnosis of inflammatory conditions has only been studied on a small scale, but evidence for its added value has been found in several conditions.

In fever of unknown origin (FUO), FDG PET has been shown to be very sensitive in identifying the focus of inflammation, infection or malignancy. In suspected focal infections FDG PET can be used to assess the extent of infection or to exclude active infection. FUO and suspected focal infections often occur in immunocompromised patients, such as patients suffering from AIDS or patients on immunosuppressive medication. For these patients FDG PET is a very promising diagnostic modality. FDG PET has also been shown to be useful in imaging of bone infections, especially osteomyelitis of the axial skeleton and spondylodiscitis. In patients with known focal or bloodstream infections, the bacteria may spread to distant sites. FDG PET is very useful for detecting these metastatic infections.

Inflammation of blood vessels is often hard to diagnose using conventional techniques. FDG PET is a promising method to detect vasculitis, thrombophlebitis and infection of aortic or other vessel prostheses. Sarcoidosis, a granulomatous inflammation often found in the lungs and in lymph nodes, is also visualised well on FDG PET. In patients suffering from rheumatoid arthritis, FDG PET can be used to distinguish active arthritis from chronic joint destruction.

In almost all of the abovementioned conditions, FDG PET can also be used to assess the response of the disease to treatment. If the treatment works, the abnormal uptake of FDG will decrease.

When evaluating an FDG PET scan, it is important to realise that wound healing is an inflammatory reaction as well. Locally increased uptake of FDG can be seen up to several weeks after an operation.

Pitfalls in scanning patients

When undergoing a standard FDG PET scan, most patients are scanned from the head to the groin region. To avoid missing clinically important infectious lesions, it is advisable to determine if additional parts of the body need to be scanned. The patient's complaints and clinical data are very important in this respect. If the activity of rheumatoid arthritis needs to be assessed in a patient complaining about pain in his knee and his elbow, including the legs and the arms in the scan would probably be wise. Although this may seem logical, it is often forgotten when every patient gets a 'standard scan'.

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Combined PET-CT scanners, in which a (low dose) CT is being used for attenuation correction of the PET images, are currently replacing the dedicated PET scanners in most centres. To avoid artifacts and difficulties in the interpretation of the images due to breathing and movement of the patient between the PET and the CT scan, it is very important that the patient receives proper instructions before undergoing the scan.

Conclusion

FDG PET is a promising new imaging tool in the diagnosis and follow-up of infection and inflammation. Many studies are currently being done to determine in which conditions FDG PET has significant added diagnostic value compared to conventional nuclear medicine and radiological techniques, and to assess its cost-effectiveness.

References

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