Gynecol Surg (2011) 8:305–309
DOI 10.1007/s10397-010-0652-6

ORIGINAL ARTICLE

FDG-PET value in deep endometriosis

A. Setubal · S. Maia · C. Lowenthal · Z. Sidiropoulou

Received: 3 December 2010 / Accepted: 15 December 2010 / Published online: 5 January 2011

Abstract Although laparoscopy continues to be the gold standard in the diagnosis of deep endometriosis, non-invasive imaging methods are important for an adequate staging of the disease, as they may determine the site, size, and severity of the lesions and thus contribute to planning the surgical treatment better. An observational study was carried out between April 2008 and June 2009 during which time nine consecutive patients underwent preoperative PET scan examination for clinical suspicion of deep endometriosis. PET scans provide a functional assessment of cellular activity; but in our study, it did not exhibit consistent results.

Keywords Deep endomertiosis · FDG-PET scan · Laparoscopy · Diagnostic immaging

Background

Deep endometriosis, defined as functional endometrial tissue penetrating the peritoneum >5 mm in depth, involves the rectovaginal septum, vagina, uterosacral ligaments, rectum, and bladder [1]. The anatomical distribution of these lesions is asymmetric, and they are more frequently observed in the posterior pelvic compartment and on the left side [2]. For an adequate treatment of the disease, it is essential to evaluate the degree of infiltration of the endometriotic lesions [3]. Clinical examination gives in most of cases an appropriated delimitation of the tumor, but in some cases, some upper disease could be missed. Although laparoscopy continues to be the gold standard in the diagnosis, we do not use it for that purpose. For this reason, non-invasive imaging methods are important to perform an adequate staging of the disease, as they may determine the site, size, and severity of the lesions and thus contribute to planning the surgical treatment better.

In the last years, positron emission tomography (PET) scanning is being used in oncology, namely in the management of patients with lymphoma, breast cancer, and lung cancer, because it provides a functional assessment of cellular activity discriminating normal from neoplastic cells [4].

PET scan is being used in the management of gynecologic malignancies because these tumors present 18 F-FDG avidity. In the literature, there are some reports of intense 2-deoxy-2-[F-18] fluoro-D-glucose (FDG) uptake by endometrioma and myomas, giving false-positive PET scans [5]. The purpose of our study was to assess PET scan findings of deep endometriosis.

Methods and findings

An observational study was carried out between April 2008 and June 2009, during which time nine consecutive patients underwent preoperative PET scan examination for clinical suspicion of deep endometriosis. The principal symptoms related by patients were dysmenorrhea, deep dyspareunia, acyclic pelvic pain, infertility, and cyclic bowel and/or urinary symptoms. Deep endometriotic tumors were clearly present at clinical examination in five patients and suspicious in the other four cases due to a difficult clinical examination in the office set.

FDG-PET imaging

The most commonly used radiopharmaceutical is 18 F-FDG PET that uses a glucose analog, FDG. After

A. Setubal · S. Maia · C. Lowenthal · Z. Sidiropoulou (✉)
Gynecology Department, Hospital da Luz,
Av. Lusiada 100,
Lisbon 1500-650, Portugal
e-mail: zasidiropoulou@sapo.pt

internalization by tumor cells, 18 F-FDG is phosphorylated to FDG-6-phosphate that does not enter glycolysis and accumulates, leading to imaging contrast. The degree of FDG uptake is expressed as the standardized uptake value (SUV) and, when greater than 3.0, is considered suspicious for malignancy [6].

PET was performed on a Siemens Biograph 16 scanner 1 h after intravenous administration of 3.7 MBq/kg of 18 F-FDG, using low-dose CT for attenuation correction. Preparation consisted of a 6-h fast with oral hydration and rest between injection and imaging. In some patients, administration of furosemide (20 mg, i.v.) was necessary to clear urinary activity from the bladder, and patients fasted at least 6 h before the examination. Sixty minutes after intravenous injection of 222–555 MBq of 18 F-FDG, static emission scans of the abdomen and pelvis were obtained.

Results

Patients had a mean age of 39.1 years (age range, 29–52 years). One patient (11%) was found not to have endometriosis at laparoscopy. For the eight patients who had endometriosis detected via surgery, one was found to have the peritoneal form of the disease, one had ovarian endometriosis, one had extraperitoneal endometriosis, and five patients had the deep form of the disease. History of pelvic surgery was found in two of eight patients, one for myomectomy and both for cesarean section. Four patients were nulliparous with history of infertility.

Case	PET scan findings		Endometriosis	
	Site	SUV max	Type	Site
1	Endometrium; USL	4.33, 3.99	No endometriosis found	
2	No pathological findings		Endometrioma	Ovary
3	No pathological findings		Superficial	RV
4	No pathological findings		Deep	RV
5	No pathological findings		Deep	RV, USL
6	Right ovary/ intestine	5.44	Deep	RV, ovary, bowel
7	RV	4.88	Deep	RV, ovary, bowel, bladder
8	Right adnexal area	5.56	Deep	RV, appendix
9	Abdominal muscle	3.52	Extraperitoneal	Rectus abdominal muscle

In one of the patients (case 1; Fig. 1), despite a PET scan showing a linear increase in 18 F-FDG uptake in the endometrium (SUV max, 4.33) and a metabolically active foci at uterosacral ligaments (SUV max, 3.99), laparoscopy did not find any endometriotic lesion (Fig. 2).

Four patients presented no pathological findings on PET scan (Fig. 3), but laparoscopy and histopathological studies revealed an ovarian endometrioma (case 2; Fig. 4), superficial endometriosis on the rectovaginal septum (case 3), deep endometriosis of the rectovaginal septum (case 4), and deep endometriosis of the uterosacral ligaments and rectovaginal septum (case 5).

In two patients, the PET scan showed a metabolically active focus in the right adnexal area involving the ovary and bowel, with no cleavage plane. Laparoscopy confirmed by histopathological study revealed an endometrioma and deep endometriosis of the rectovaginal septum and rectum in one patient (case 6) and endometriosis of the rectovaginal septum and appendix in the other (case 8).

One patient (case 7), who presented a right ovarian endometrioma and deep endometriosis of the rectovaginal septum, intestine, and bladder, only showed at PET scan an increased 18 F-FDG uptake in the rectovaginal septum (SUV max, 4.88).

Another patient (case 9), whose PET scan showed an increased 18 F-FDG uptake at the rectus abdominal muscle near the pubic insertion and anteriorly to the bladder (SUV max, 3.52), in the endometrium (SUV max, 3.34) and in the right ovary (SUV max, 6.86), presented adenomyosis and scar endometriosis.

Discussion

The depth of the lesions of deep endometriosis increases with time and is correlated to the intensity of pain, rendering complete surgical excision of the lesions the best treatment of this disease [7]. Through the years, several classifications of deep endometriosis have been proposed, mainly Koninckx's classification based on the pathogenesis (infiltration, retraction, and adenomyosis externa) and Adamyan's classification based on topography. Chapron et al. even proposed a classification system for deep endometriosis which defines the operative technique by the location of the lesions [8]. Nevertheless, none of these classifications proved to ever be ideal. That is why, at this moment, there is an AAGL Task Force working on a new feasible classification, and PET scan could have a role to play.

For a correct preoperative diagnosis of deep endometriosis in order to define the best treatment strategy, the most common imaging tests used are transvaginal ultrasound and magnetic resonance imaging. Alternative imaging tests

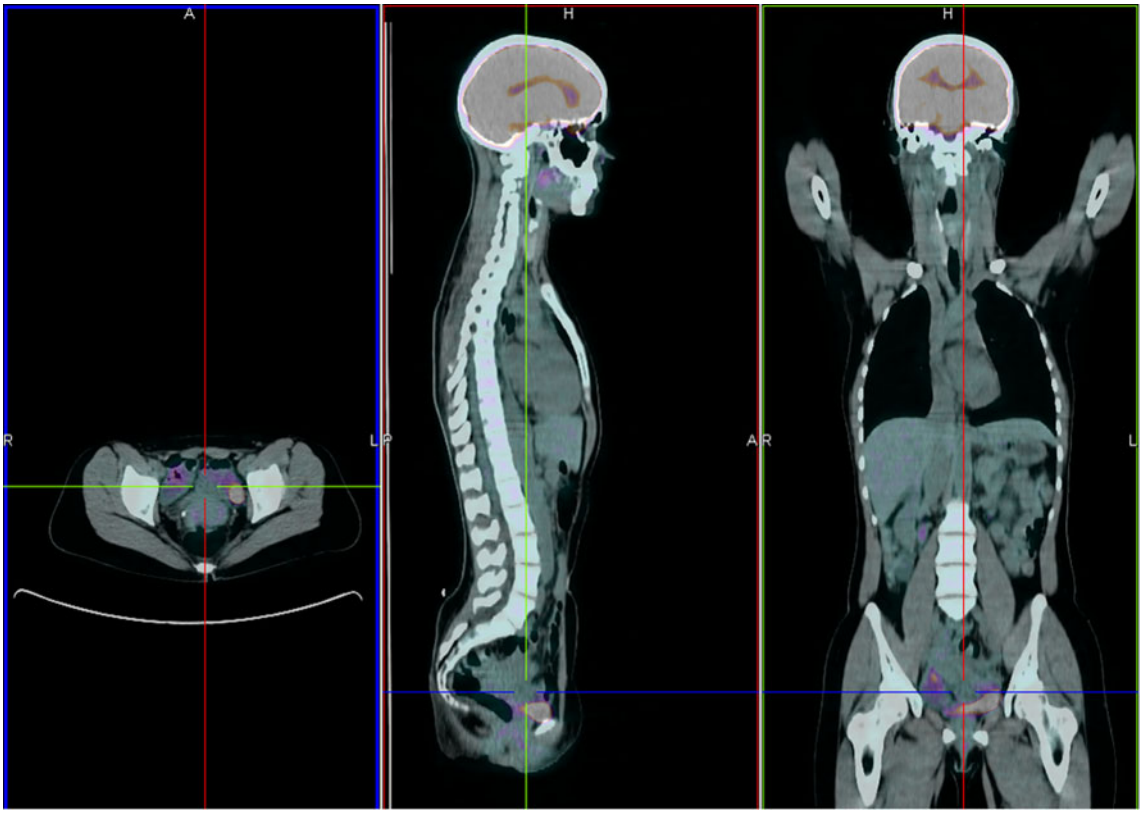

Fig. 1 Patient 1 with no relevant PET findings

could be necessary, like colon enema, uroCT, cistoscopy, and colonoscopy, depending on the type of tumor.

An increased uptake of 18 F-FDG on PET scan usually occurs in malignancy, but benign lesions of high metabolic activity may exhibit this avidity. Normal gynecologic physiology may show increased tracer uptake in premenopausal women, during the menstrual and ovulatory phases of the menstrual cycle [9]. In the lower pelvis, it can also be difficult to differentiate physiologic gastrointestinal activity from FDG accumulation in tumor tissue, since it can present the same intensity of glucose metabolism [10]. The cyclic variation in the normal uptake and the physiologic gastrointestinal activity may explain the PET findings of case 1.

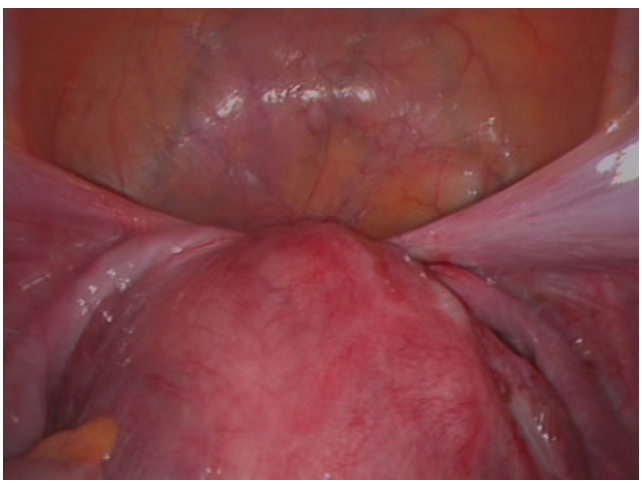

Fig. 2 Laparoscopic findings on patient 1

There are several reports in the literature showing an elevated FDG uptake in endometriomas. In Rieber's study, four of 22 endometriomas showed false-positive FDG-PET results [11]. Fenchel et al. observed elevated FDG uptake in five of 23 endometriomas [10]. Jeffry et al. reported a 32-year-old woman with left ovarian endometrioma and FDG uptake in the right paravesical area, assumed to be associated with inflammation rather than a cyst [12]. Recently, Derman et al. reported a 47-year-old woman who had a pulmonary endometriosis with intense FDG uptake [9]. However, most of the reports in the literature reveal that the majority of endometriotic severe lesions have low FDG metabolism. In our study, three women presented endometriomas, but none of them showed a clear FDG uptake.

Three of the five patients with deep endometriosis presented pathological findings on PET scan, and all of them had bowel involvement by endometriosis. As FDG uptake can be secondary to a triggered inflammation, a possible mechanism that can explain those findings is the fact that these patients would present a more aggressive form of the disease, with more inflammation. However, a

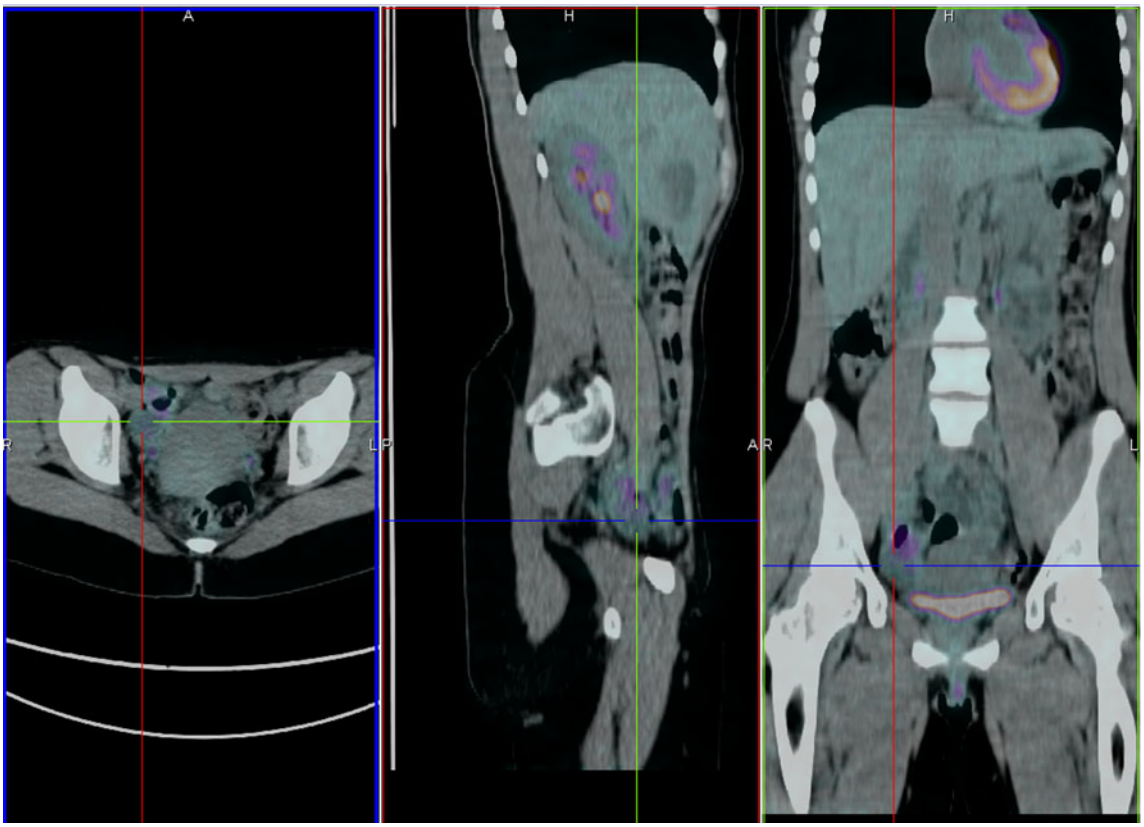

Fig. 3 Patient 2 with no relevant PET findings

PET scan did not demonstrate all extensions of the disease in any of the cases.

Conclusions

As a result of the preoperative diagnosis of deep endometriosis, it is important to have a morphologic assessment of the lesions. This can be done by less expensive complementary exams, although PET scans appear to have no value as a major tool to evaluate deep endometriosis tumors or other forms of endometriotic disease. PET does not seem to be useful, neither for diagnosis nor for the extension of deep endometriosis, though it might have some value on bowel invasion. However, the number of patients enrolled in this study was too small; perhaps new data in the future will be revealed by a study based on a larger number of patients.

PET scans provide a functional assessment of cellular activity, but in our study, it did not exhibit consistent results, possibly because FDG uptake by endometriotic lesions may possibly differ with the menstrual phase.

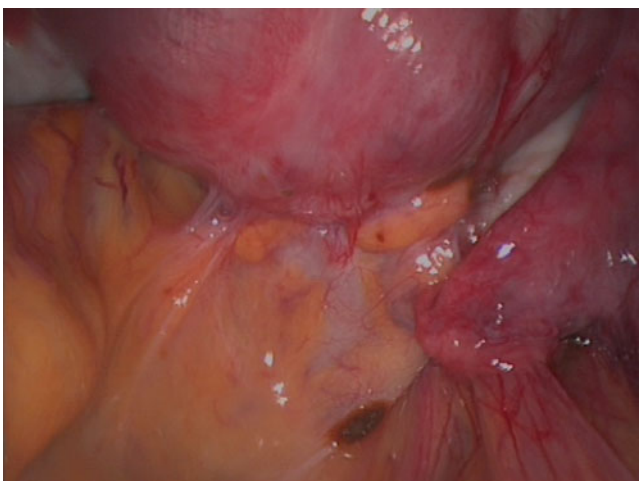

Fig. 4 Laparoscopic findings on patient 2

Declaration of interest The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

1. Koninckx PR et al (1992) Deep endometriosis: a consequence of infiltration or retraction or possibly adenomyosis externa. Fertil Steril 58:924–928

2. Chapron C et al (2006) Deeply infiltrating endometriosis: pathogenetic implications of the anatomical distribuition. Hum Reprod 21(7):1839–1845
3. Abrao MS et al (2007) Comparison between clinical examination, transvaginal sonography and magnetic resonance imaging for the diagnosis of deep endometriosis. Hum Reprod 22:3092–3097
4. Chura JC et al (2007) Positron emission tomography and leiomyomas: clinicopathologic analysis of 3 cases of PET scan—positive leiomyomas and literature review. Gynecol Oncol 104:247–252
5. Lin JH et al (2008) FDG-PET findings in an ovarian endometrioma: a case report. Ann Nucl Med Sci 21:109–113
6. Peterson TE, Manning HC (2009) Molecular imaging: 18F-FDG PET and a whole lot more. J Nucl Med Technol 37:151–161
7. Kinkel K, Chapron C et al (1999) Magnetic resonance imaging characteristics of deep endometriosis. Hum Reprod 14:1080–1086
8. Chapron C et al (2003) Anatomical distribution of deeply infiltrating endometriosis: surgical implications and proposition for a classification. Hum Reprod 18(1):157–161
9. Derman AY et al (2007) Endometrioma presenting as a cavitary lung mass with intense 18F-FDG uptake on PET-CT. J Thorac Imaging 22(2):172–175
10. Fenchel S et al (2002) Asymptomatic adnexal masses: correlation of FDG PET and histopathologic findings. Radiology 223:780–788
11. Rieber A et al (2001) Preoperative diagnosis of ovarian tumors with MR Imaging: comparison with transvaginal sonography, positron emission tomography, and histologic findings. AJR 177:123–129
12. Jeffry L et al (2004) Endometriosis with FDG uptake on PET. Eur J Obstet Gynecol Reprod Biol 117:236–239
13. Lerman H et al (2004) Normal and abnormal 18F-FDG endometrial and ovarian uptake in pre- and postmenopausal patients: assessment by PET/CT. J Nucl Med 45:266–271