Are PET and PET/CT Adequate for Inflammatory Bowel Disease Diagnosis

Christiane Franzius

MR- und PET/CT-Center Bremen-Mitte, Bremen, Germany
Inflammatory Bowel Disease (IBD)

• IBD in childhood: >25% of IBD patients*
• diagnostic latency of IBD in children in Germany: \( \geq 22 \) months*
• meantime: malabsorption, retardation of growth and development

wanted: sensitive method detecting early inflammatory changes

* Behrens, IBD in children and adolescents, 2001
Inflammatory Bowel Disease (IBD)

**Further requirements**

- minimally invasive
- not traumatizing
- no or low radiation exposure
- identification of inflamed bowel segments
  - differential diagnosis IBD
  - topic therapy
Inflammatory Bowel Disease (IBD)

Skehan, Lancet 1999:
retrospective study in children
25 patients
standard of reference: colonoscopy, enteroclysis

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<thead>
<tr>
<th></th>
<th>Sens</th>
<th>Spez</th>
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<tbody>
<tr>
<td>FDG PET</td>
<td>0.81</td>
<td>0.85</td>
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Inflammatory Bowel Disease (IBD)

Neurath, Am J Gastroenterol 2002:
prospective comparison MRI vs. FDG PET in adults
54 patients

standard of reference: endoscopy, no histology

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<tr>
<td>FDG PET</td>
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<td>MRI</td>
<td>0.67</td>
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Patients and Method FDG PET

Loeffler, Ann NY Acad Sci 2006: retrospective evaluation,
26 examinations in 23 children with suspected IBD
age: 2-16 years, median 12 years; 14 m, 9 f

comparison with
18 endoscopy (anaesthesia)
19 histology
16 abdominal ultrasound examination
6 enteroclysis
Method FDG PET

Final diagnosis

16 Crohn’s disease
2 ulcerative colitis
1 infectious colitis
3 juvenile arthritis with concomitant enteritis
1 juvenile arthritis without concomitant enteritis
Method: Analysis FDG PET

**bowl segments:** n=8
duodenum, jejunum, ileum, ascending colon, transverse colon, descending colon, sigmoid colon and rectum

**FDG-PET**
- visual evaluation, 4 point score (segments):
  1 not, 2 minimally, 3 moderately, 4 severely inflamed
- SUV (segments and liver)

Loeffler, Ann NY Acad Sci 2006
Method: Analysis FDG PET

- standard of reference:
  - endoscopy
  - histology

- positive reading:
  - Score $\geq 3$
  - $\frac{SUV_{\text{segment}}}{SUV_{\text{liver}}} > 1.2$

Loeffler, Ann NY Acad Sci 2006
## Results FDG PET

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FDG PET

Loffler, Ann NY Acad Sci 2006
## Results FDG PET

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Loeffler, Ann NY Acad Sci 2006
Patients and Method: FDG PET/CT

retrospective evaluation
13 examinations in children with suspected IBD
age: 2-16 years, median 12 years; 6 m, 7 f

comparison with
13 endoscopy / histology
9 abdominal ultrasound examination
Method: FDG PET/CT

FDG PET/CT imaging
scanner: Siemens Biograph Sensation 16,
ultra low-dose CT in the same examination

radiation exposure
FDG-PET/CT: 4-6 mSv
natural exposure per year: 1-10 mSv
enteroclysis: 14 mSv

* Ruiz-Cruzes et. al., BJR 2000
Loeffler, ESPNM 2006
Method: Analysis FDG PET/CT

bowel segments, n=8
duodenum, jejunum, ileum, ascending colon, transverse colon, descending colon, sigmoid colon and rectum

endoscopy, histology and ultrasound:
regional grading of inflammatory activity:
1 no, 2 little, 3 moderate, 4 severe inflammation

FDG PET/CT
visual evaluation and SUV
two-step-analysis: alone and with morphologic correlation by low-dose CT
Method: Analysis FDG PET/CT

- standard of reference:
  - endoscopy
  - histology

- positive reading:
  - score $\geq 3$
  - SUV $>$1.2 (asc. colon $>$ 1.3)
PET/CT: Results of segment-based analysis

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PET/CT: Results: segment-based-analysis of small bowel

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14 y f with known Crohn's disease

conservative systemic treatment without response
serious decrease of body weight
localization? inflammation of small bowel?

FDG-PET-CT: inflammation ranging from transverse colon to sigmoid colon

topic therapy with corticoid enema, girl is disease free
14 y f with suspected Crohn's disease

inflammation of small bowel?
13 y f with suspected Crohn’s disease

prolonged symptoms for 2 years, now first anal bleeding.

FDG-PET-CT: IBD? exclusion/identification of small bowel involvement?
13 y f with suspected Crohn’s disease

prolonged symptoms for 2 years, now first anal bleeding.

FDG-PET-CT: IBD? exclusion/identification of small bowel involvement?
13 y f with suspected Crohn’s disease
13 y f with suspected Crohn’s disease

prolonged symptoms for 2 years, now first anal bleeding.

FDG-PET-CT: IBD? exclusion/identification of small bowel involvement?

FDG-PET-CT: involvement of duodenum, jejunum and ascending colon

systemic therapy leads to clinical remission.
17 y f with Crohn's disease

clinically remission

plan:
end of therapy, inflammatory activity?
16 y m with Crohn's disease

clinically active disease

localization? activity?
Limitations and open questions

• radiation exposure, acceptable?
• prospective studies: performance characteristics of FDG PET and FDG PET/CT?
• comparison with MRI?
• attention: different standards of reference in studies
• preference: histology

MR and PET/CT Center Bremen-Mitte
Conclusion

FDG PET and FDG PET/CT

• not invasive, no anaesthesia
• very high sensitivity, high accuracy
• excellent tool for diagnosis, localization, determination of activity
• PET/CT advantage: small bowel
• improve differential diagnosis
• improve planning of topic therapy
• PET/CT even more sensitive than FDG PET, easier localization