Integrating FDG PET data for lymphoma management

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Combining metabolic data
from baseline, interim or post treatment PET

PET Data can be combined:
1. Together
2. With baseline clinical or biological data
3. With other imaging techniques

Aim of this holistic approach:
- Obtain new prognostic index
- Tailor therapeutic strategy
1. Together

Data from baseline and interim PET combined together
Could give:
  better response assessment at interim
  better risk assessment
Kinetics of tumour destruction (DLBCL) Studied by PET during induction chemotherapy
Reporting interim PET in Diffuse Large B Cell Lymphoma: the Zeno’s paradox

The “freezing” evaluation of the residual tracer uptake by visual scoring (DS) at one moment of this kinetics miss the entire phenomenon and remind us of the paradox of the Greek philosopher Zeno of Elea. At any instant of time the arrow has no motion, since time is composed of multiple freezing instances in succession.

Zeno’s arrow

By contrast the quantitative approach combining SUVmax baseline and after treatment to obtain Δ SUVmax between base line and either of the chemotherapy cycles integrates this kinetic information.
Reporting interim PET by Integrative $\Delta$SUVmax more predictive of outcome than scoring residual activity at one step of the kinetics (DS)

**DLBCL**

![Graphs showing progression-free survival](image)

- Deauville < 4 (n = 63): PFS = 81%
- Deauville ≥ 4 (n = 51): PFS = 59%

**P = 0.003**

$\chi^2 = 8.58$

- $\Delta$SUV > 66% (n = 89): PFS = 79%
- $\Delta$SUV ≤ 66% (n = 25): PFS = 44%

**P = 0.0002**

$\chi^2 = 13.69$

**IVS:** 114 pts, 5 centers, 3 observers, PET 2 cycles; med FU 39 months

*Itti, 2013, Eur J Nucl Med Mol Imaging*
Combining analysis of residual uptake (DS) with ΔSUV kinetic approach at 3-4 cycles in DLBCL (74 patients)

71% patients
Double negative excellent outcome
Double positive poor outcome

Nols et al. Leuk Lymphoma 2013
Combining in HL base line data, TMTV and response data, $\Delta$SUVmax (PET2)

2. With baseline clinical and biological data
Combining Aa IPI and iPET

73 DLBCL, anthracycline based regimen (R-CHOP, ACVBP, mini CHOP)
Positive: DS $\geq$4 and or $\Delta$SUVmax$\leq$66%
Negative:DS<4 and or $\Delta$SUVmax$>$66%

Nols et al, Leuk Lymphoma 2013
Combining GCB/ABC subtypes and $\Delta$SUV$\text{max}$

- **Fast / GCB**
  - Good risk group
  - DLBCL 57 patients
  - PET 3-4 cycles
  - $\Delta$SUV$>70$

- **Fast / ABC**

- **Slow / ABC**
  - Poor risk group
  - Slow GCB and ABC

- **Slow / GCB**

*Lanic, Jardin 2011, Leuk Lymphoma*
Combining BCL2 protein expression and BCL2 gene alteration with early PET response at 2 cycles in DLBCL allows improved stratification.

**BCL2 prot 50%+DS (n=86)**
- 0 (neg-fast response) n=20
- 1 (neg/slow response) n=49
- 2 (pos-slow response) n=17

\[ P = 0.007 \]
\[ \chi^2 = 9.90 \]

3-y PFS: 83.8% vs. 71.1% vs. 43.1%

**BCL2-FISH+DS (n=83)**
- 0 (neg-fast response) n=41
- 1 (neg/slow response) n=35
- 2 (pos-slow response) n=7

\[ P = 0.0002 \]
\[ \chi^2 = 17.50 \]

3-y PFS: 85.7% vs. 55.0% vs. 28.6%

Correlation kinetics of Thymus activation related chemokines (TARC) and PET in relapse/refractory HL

- In 4 patients who relapsed after alloSCT serum TARC increased progressively (median fold increase: 5.2) before PET scan became positive. **TARC can predict metabolic relapse after alloSCT in HL**

Accessory cells show a very high metabolic activity and are responsible for FDG uptake. Ma Y.: Blood 2008; 111, 2339-2346

Farina *Hematol Oncol* 2013; 31: 96-150. Abs 144
3. With other imaging techniques
Combining FDG/PET and CT in HL

739 patients /HD15 with CT residue ≥2.5cm at end treatment

Poor prognosis of patient PET+ and with a ≤40% tumour shrinkage

Kobe J Clin Oncol 2014
Combining FDG/PET and MRI

Xenograft tumour model of a non-small cell lung cancer

Density scatter plots
FDG intensity on x
ADC on y

Initiation of therapy
Decrease of FDG
Stable cellular density
Several components in the tumor
Conclusions

- Holistic approach using PET and other parameters
- Could produce new prognostic index
- Improve understanding
- Validation needed (limited number of patients in these studies)
- Open field for research