Quantitative Nuclear Medicine Imaging in Oncology

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Disclosures

• None
Objectives

Describe scoring systems used in oncologic nuclear medicine imaging

- Deauville scoring in lymphoma
- Curie and SIOPEN scoring in neuroblastoma

Discuss use of SUV measurements in oncologic FDG PET scans
Scoring Systems
Deauville Scoring in Lymphoma

Developed in 2009 by hematologists and nuclear medicine experts

Provides a simple and reproducible system for interpretation of interim FDG PET scans

- good or very good agreement between readers

Deauville Scoring System

Five point scale based on visual assessment:
1 = no residual uptake above background
2 = residual uptake $\leq$ mediastinum
3 = residual uptake $>$ mediastinum, but $<$ liver
4 = residual uptake moderately $>$ liver
5 = residual uptake markedly $>$ liver
or new disease sites

Deauville Score = 2

At diagnosis

After initial chemotherapy
Deauville Score = 3

At diagnosis

After initial chemotherapy
Deauville Score = 5

At diagnosis

After initial chemotherapy
Deauville Scoring System

Negative:
1 = no residual uptake above background
2 = residual uptake \leq \text{mediastinum}
3 = residual uptake > \text{mediastinum}, but < \text{liver}

Positive:
4 = residual uptake moderately > \text{liver}
5 = residual uptake markedly > \text{liver}
or new disease sites

Interim PET in Hodgkin Lymphoma
3-year Failure Free Survival

MIBG Scoring Systems

Semi-Quantitative

Developed to

• quantitate disease extent and response
• improve precision and concordance between readers

Curie scoring system used in North America
SIOPEN scoring system used in Europe

Curie Scoring System

Total of 10 compartments:
• skeleton compartments 1 - 9
• soft tissue compartment 10

Each compartment scored for disease extent on a 3 point scale

Total score = sum of compartment scores (maximum score of 30)

Curie Scoring System

Compartment scores:
0 = no disease sites
1 = one disease site
2 = more than one disease site
3 = diffuse disease involvement

SIOPEN Scoring System

Total of 12 compartments:
- skeleton compartments 1 - 12
- no soft tissue compartment

Each compartment scored for disease extent on a 6 point scale

Total score = sum of compartment scores (maximum score of 72)

SIOPEN Scoring System

Compartment scores:
0 = no disease sites
1 = one disease site
2 = two disease sites
3 = three disease sites
4 = more than three disease sites, but less than 50% involvement
5 = 50-95% involvement
6 = diffuse involvement

MIBG Scoring Systems

Curie and SIOPEN score highly correlated

Scores correlate with response/survival in some studies
- at diagnosis
- after initial chemotherapy

Curie Score > 2 after induction $\rightarrow$ worse event free survival

SUV Measurements
FDG PET Assessment

Qualitative – comparison to blood pool, liver, or brain

Quantitative – measurement of absolute regional radiopharmaceutical concentrations

• SUVmax
• percent change in SUVmax
• metabolic tumor volume
• tumor-to-non-tumor uptake ratios
SUVmax

Widely used and reported

SUV measurements are variable and dependent on multiple factors
• patient preparation
• scan technique and timing
• region of interest

Studied to determine relationship to histologic response during therapy and survival

Progression Free Survival Based on Tumor Uptake After Neoadjuvant Chemotherapy

Ewing Sarcoma

Osteosarcoma

Overall Survival Estimates Based on Primary Tumor Uptake Intensity

Rhabdomyosarcoma

Conclusions

Scoring systems developed to better quantify treatment response and improve concordance between readers

- Deauville scoring in lymphoma
- Curie and SIOPEN scoring in neuroblastoma

PET allows measurement of absolute regional radiopharmaceutical concentrations

- parameters such as SUVmax studied to determine ability to predict tumor necrosis and patient survival