# PET in Pediatric Oncology

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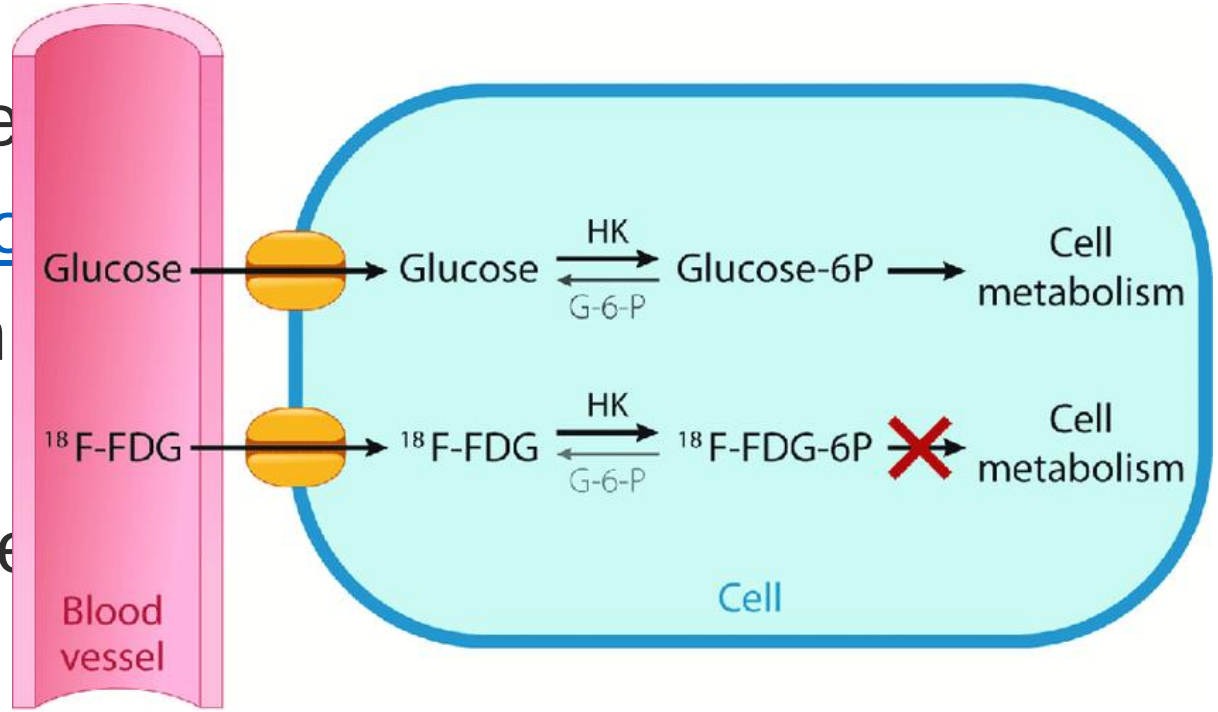
# *PET and Radiotracers:*

***FDG*** is a glucose analogue that is actively transported across the cell membrane and phosphorylated within cells. ***FDG uptake reflects the tissue glucose metabolism.***

***Tumor imaging*** with FDG is base
on the principle of increased gluc
metabolism of cancer cells, which
are more dependent on
anaerobic glycolysis (Warburg effe

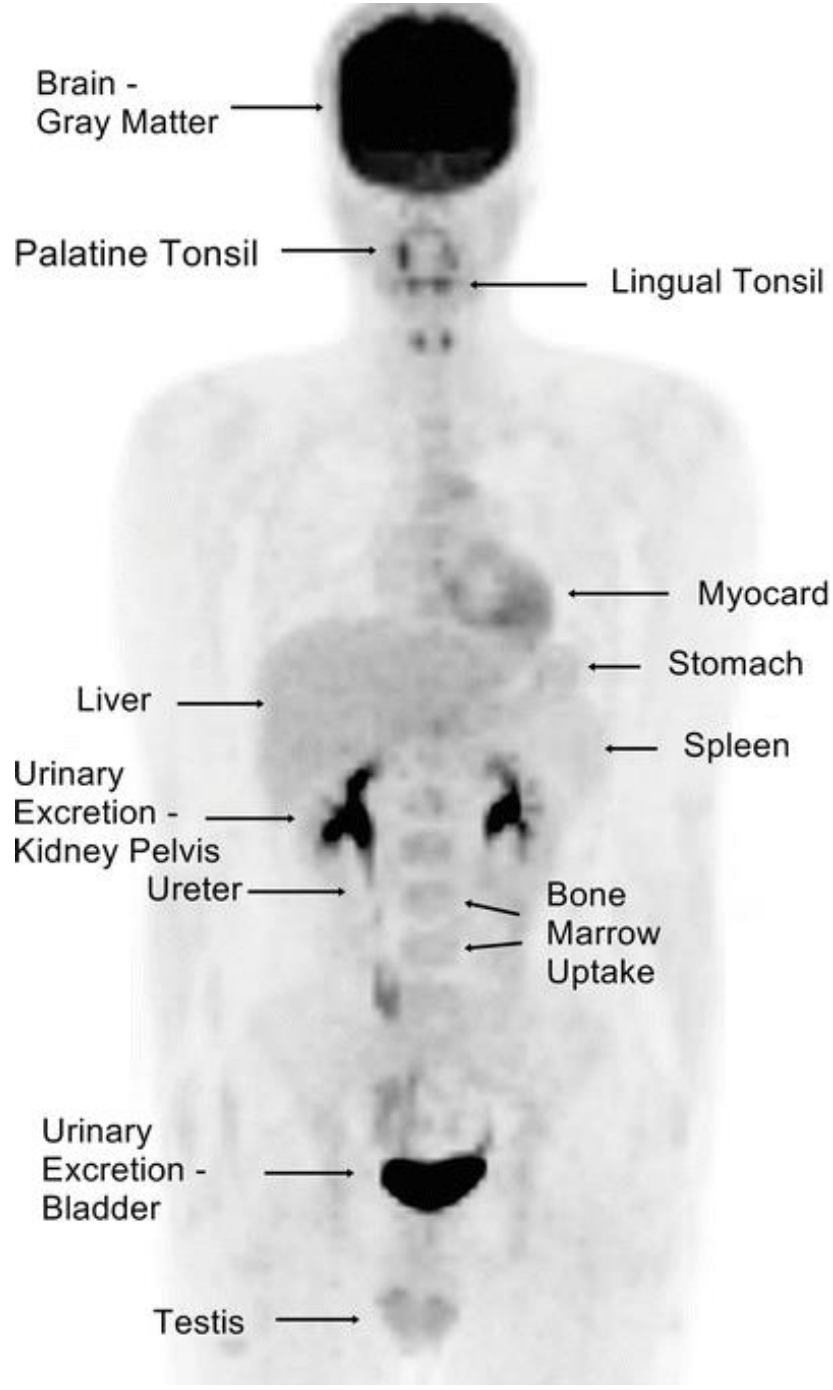


# *PET and Radiotracers:*

## *68Ga-DOTATATE:*

A radio-conjugate consisting of the *somatostatin analogue* tyrosine-3-octreotate (Tyr3-octreotate or TATE) labeled with the positron emission tomography (PET) tracer gallium Ga 68 via the macrocyclic chelating agent dodecanetetraacetic acid (DOTA), which may be used as a somatostatin receptor (SSTR) imaging agent in conjunction with PET to image neuroendocrine tumors (NETs).

Much higher affinity for *type 2 SSTR*, present on the cell membranes of many types of NETs. This allows for visualization of SSTR-positive cells upon imaging. SSTR subtypes have been shown to be present in large numbers on NETs and their metastases, while most other normal tissues express low levels of SSTR subtypes.


Brain -
Gray Matter
Palatine Tonsil
Lingual Tonsil
Myocard
Stomach
Liver
Spleen
Urinary
Excretion -
Kidney Pelvis
Ureter
Bone
Marrow
Uptake
Urinary
Excretion -
Bladder
Testis

# *CLINICAL INDICATIONS:*

*Common indications for 18F-FDG PET/CT imaging in pediatric oncology include, but are not limited to, the following:*

***Lymphoma* (*Hodgkin lymphoma [HL] and non-Hodgkin lymphoma [NHL]):***

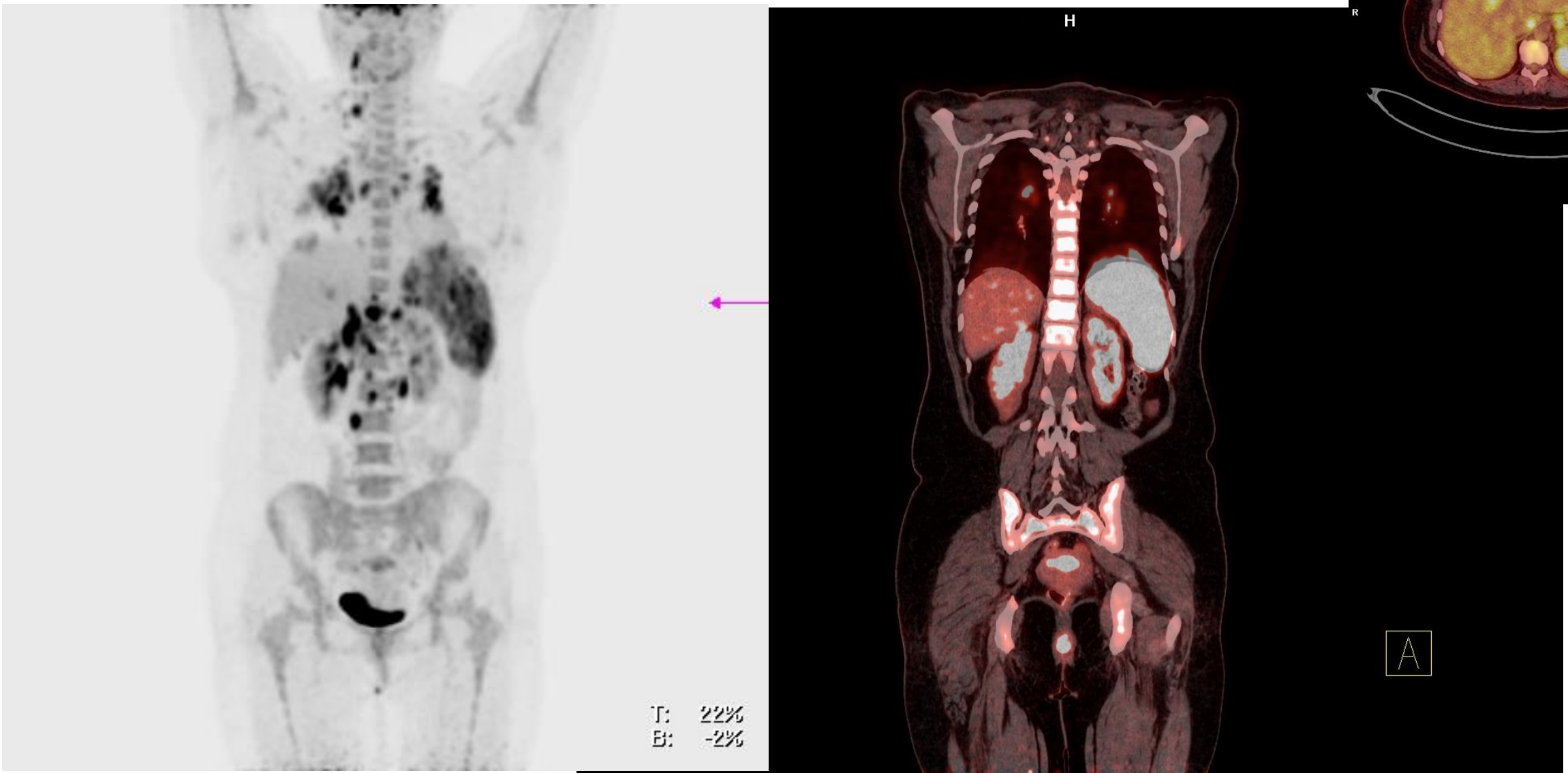
- Initial staging
- Response to therapy (for monitoring response during therapy and also to evaluate response after completion of therapy: Interim and End of Therapy PET, respectively)
- Detection of residual disease
- Restaging
- Planning of radiation therapy
- Providing prognostic information.

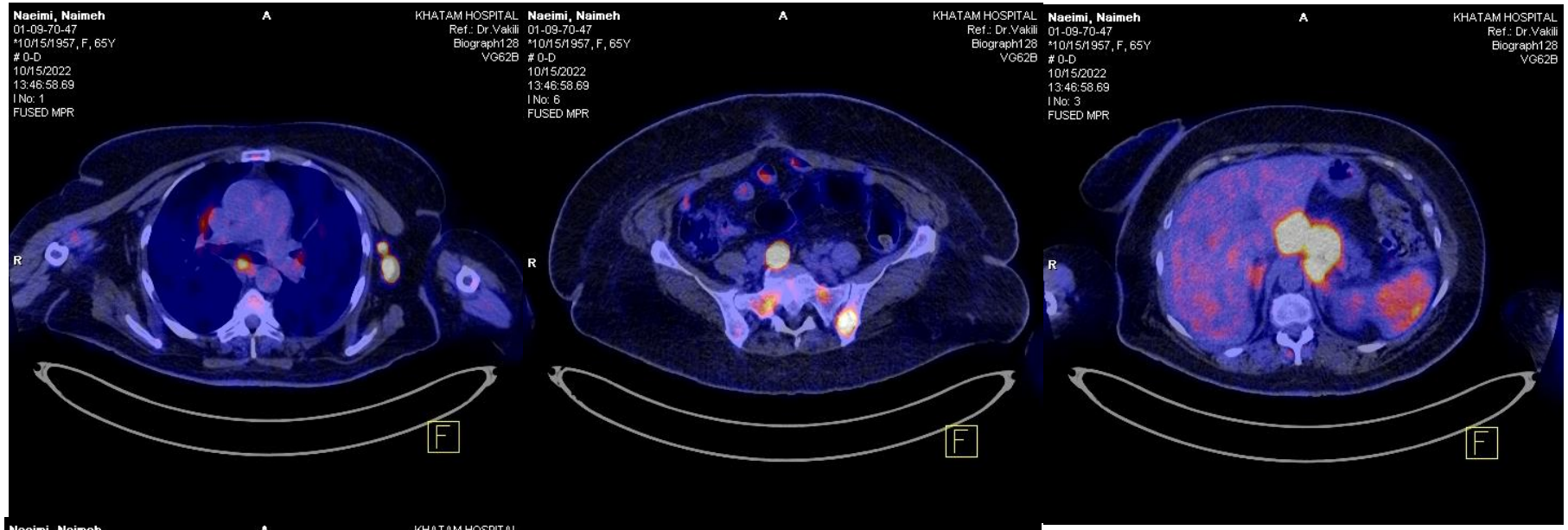
***CLINICAL INDICATIONS:***

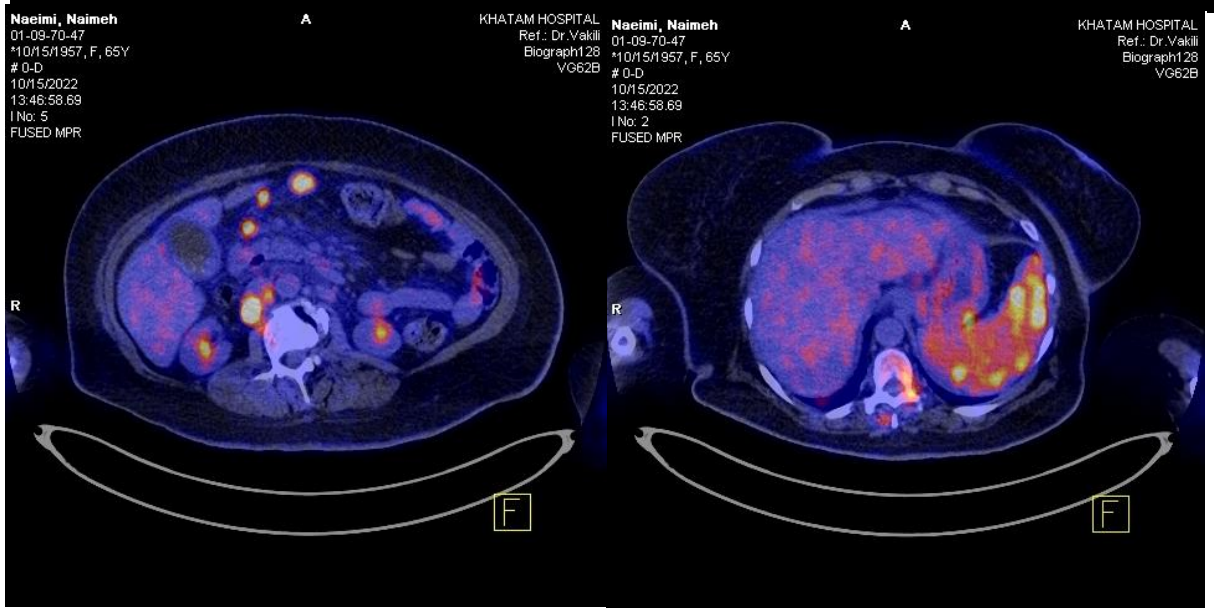
***Lymphoma (cont):***

Routine surveillance imaging with 18F-FDG PET/CT after completion of therapy in patients with lymphoma is not recommended.

# Staging of Hodgkin’s Lymphoma:



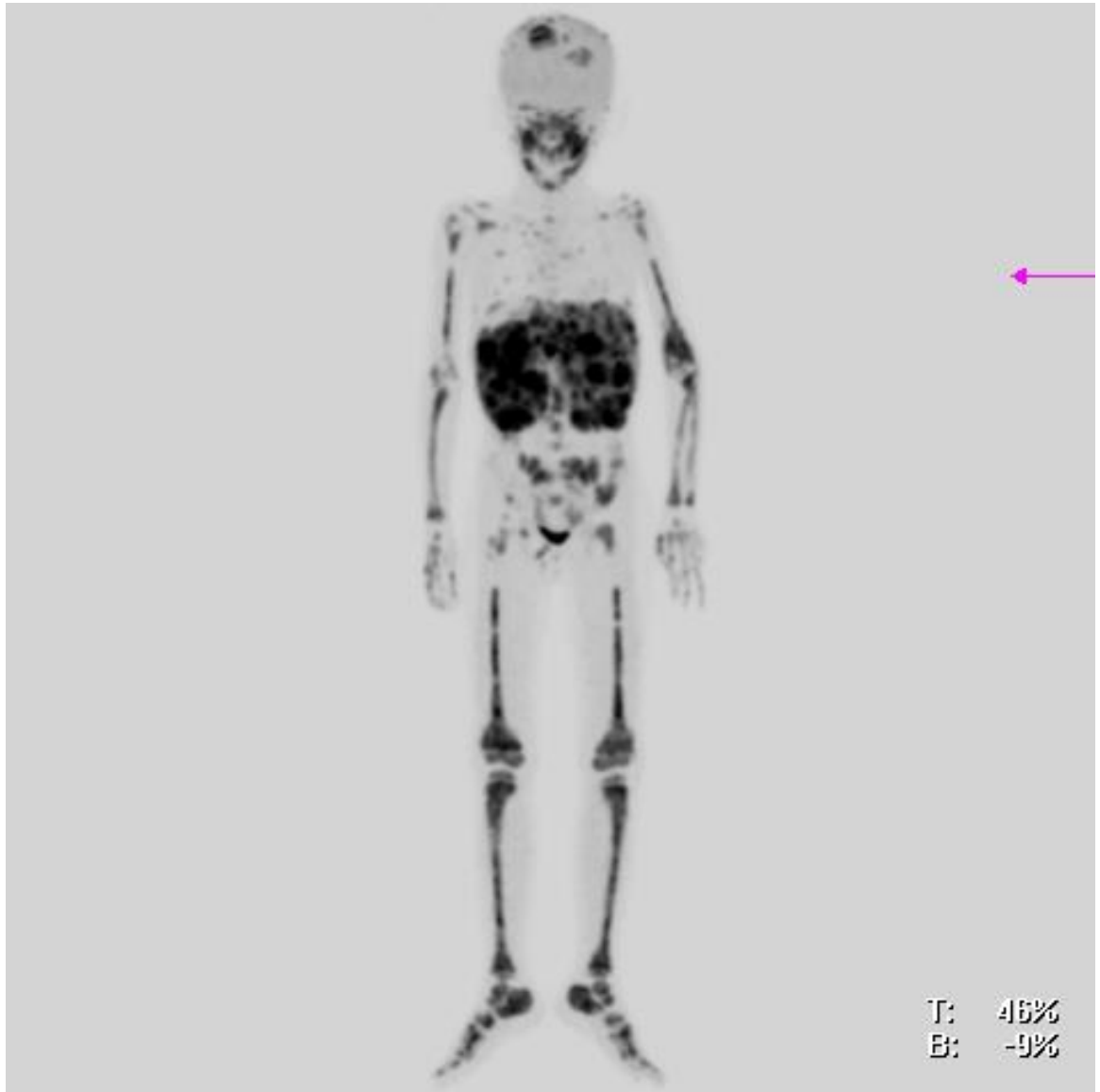





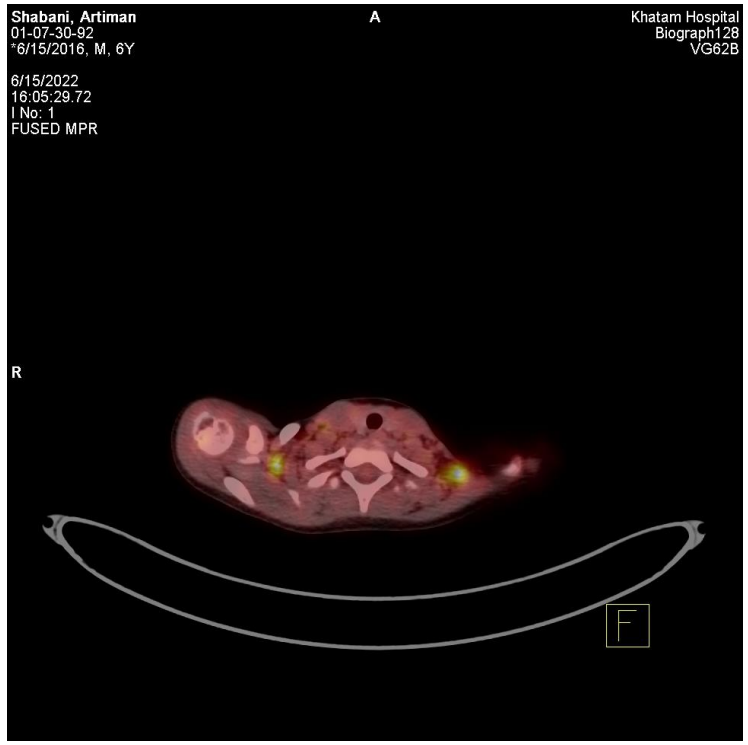


This patient is referred for evaluation of **Hypercalcemia.**

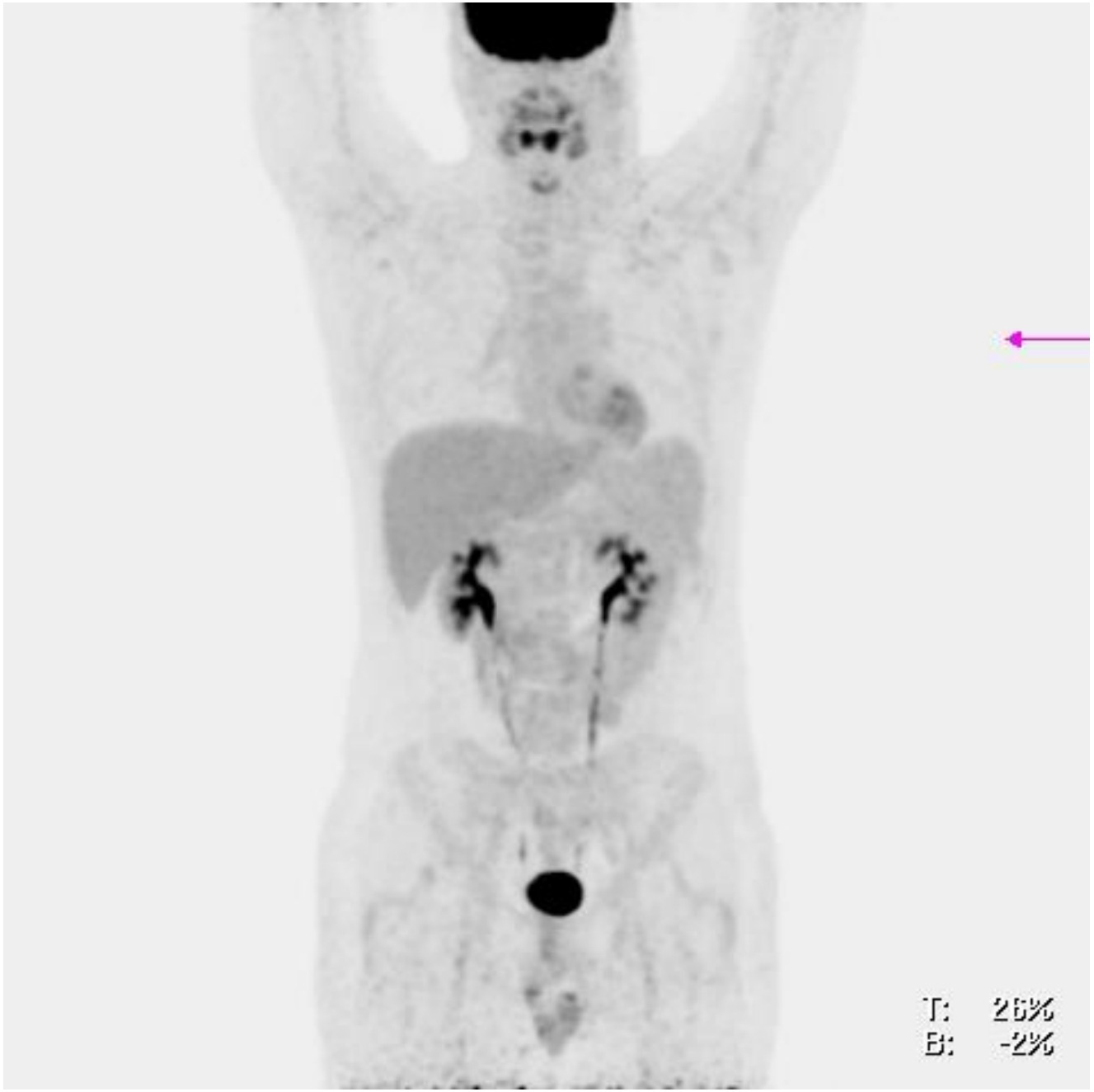
# Staging And Restaging PET/CT after Therapy:





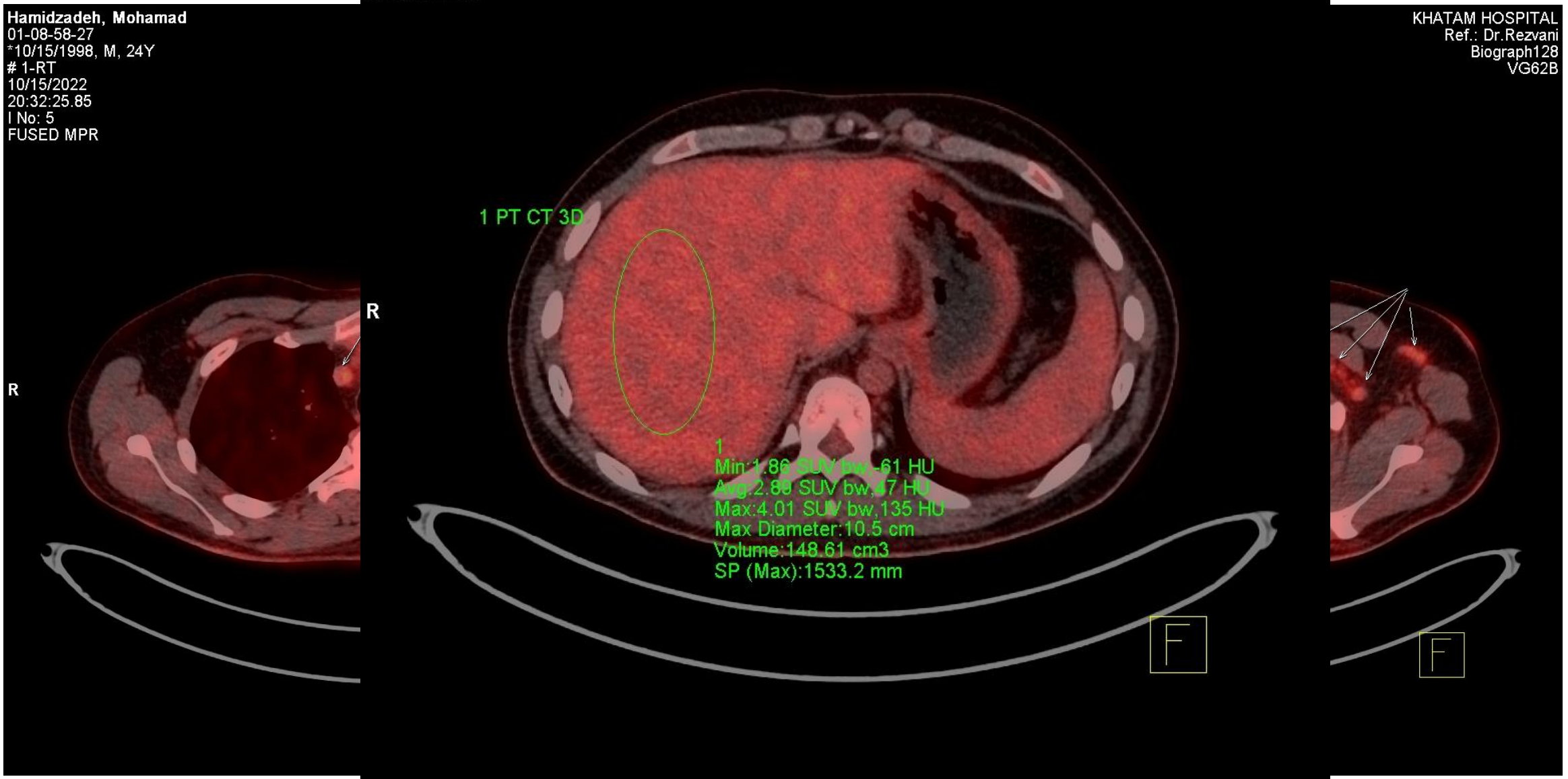




***Brown fat***, also called brown adipose tissue, is **a special type of body fat that is turned on (activated) when you get cold**. Brown fat produces heat to help maintain your body temperature in cold conditions. Brown fat contains many more mitochondria than does white fat.




**Response to Therapy (Deauville score = 3)**

# Respons 3)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10/15/2022
20:32:25.85
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FUSED MPR
R
Hamidzadeh, Mohamad
A
01-08-58-27
*10/15/1998, M, 24Y
# 1-RT
10/15/2022
20:32:25.85
I No: 6
FUSED MPR
KHATAM HOSPITAL
Ref.: Dr.Rezvani
Biograph128
VG62B
1 PT CT 3D
R
1
Min:1.86 SUV bw,-61 HU
Avg:2.80 SUV bw,47 HU
Max:4.01 SUV bw,135 HU
Max Diameter:10.5 cm
Volume:148.61 cm3
SP (Max):1533.2 mm
F
KHATAM HOSPITAL
Ref.: Dr.Rezvani
Biograph128
VG62B
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# *Deauville Score:*

| | |
|---|---|
| 1 | *No uptake or no residual uptake (when used interim)* |
| 2 | *Slight uptake, but equal to or below blood pool (mediastinum)* |
| 3 | *Uptake above mediastinal, but below or equal to uptake in the liver* |
| 4 | *Uptake slightly to moderately higher than liver* |
| 5 | *Markedly increased uptake or any new lesion (on response evaluation)* |

*Some authors also use:*

- *X for any lesion not overtly attributable to lymphoma*

# *Assessment of treatment response:*

***Complete Metabolic Response (CR):***

*Scores 1, 2 or 3 together with the absence of FDG-avid bone marrow lesion(s) are interpreted as complete metabolic response (CR), irrespective of a persistent mass on CT*

***Partial Metabolic Response (PR):***

*Deauville score of 4 or 5, provided:*

- *uptake is decreased compared with baseline and*
- *Absence of structural progression development on CT*

***Stable disease (SD); No Metabolic Response:***

*Deauville score of 4 or 5 without significant change in FDG uptake from baseline.*

***Progressive disease (PD):***

- *Deauville score of 4 to 5 with increasing intensity compared to baseline or any interim scan*
- *And/or any new FDG-avid focus consistent with malignant lymphoma*

# *Recommendations:*

- Prognostic factors should be determined to allocate patients to favourable or unfavourable subgroups (1A).
- Standard of care for patients with early favourable disease is to start with two cycles of ABVD followed by an interim PET scan (1A).
- For early favourable disease and a negative interim PET scan, standard of care is a total of 2–3 cycles of ABVD followed by radiotherapy (1A).
- For early favourable disease and a negative interim PET scan, it may be appropriate to omit radiotherapy following discussion with a radiation oncologist. These patients should receive a total of three or four cycles of ABVD (1A).
- For early unfavourable disease, a standard of care is two cycles of eBEACOPP and two cycles of ABVD followed by a PET. With a positive scan, patients should be offered radiotherapy (1A).
- For early unfavourable disease, an alternative standard is two cycles of ABVD followed by interim PET. If iPET-negative, patients have 1–2 further cycles of ABVD with radiotherapy or complete a total of six cycles of chemotherapy with the last four being AVD without radiotherapy (1A).
- For early-stage disease with a positive PET scan after two cycles of ABVD, consider two cycles of eBEACOPP followed by radiotherapy (1A).
- ***DS1–3 is considered commetabolic response plete.***

- *Guideline for the first-line management of Classical Hodgkin Lymphoma — A British Society for Haematology guideline*
- *George A. Follows,Sally F. Barrington,Kaljit S. Bhuller,Dominic J. Culligan,David J. Cutter,Eve Gallop-Evans,Shireen Kassam,Wendy Osborne,Shalal Sadullah,William Townsend,Benjamin J. Uttenthal,Graham P. Collins,British Society for Haematology*

# *Leukemia:*

- The commonest childhood malignancy
- ALL more common than AML
- The use of PET/CT in patients with leukemia can aid in the detection of ***EMD*** (extramedullary disease), especially in detecting sub-clinical, multifocal disease. But its use in clinical practice is limited due to the lack of definitive treatment options.

# *Sarcoma (osteosarcoma, Ewing sarcoma, rhabdomyosarcoma, and other soft-tissue sarcomas):*

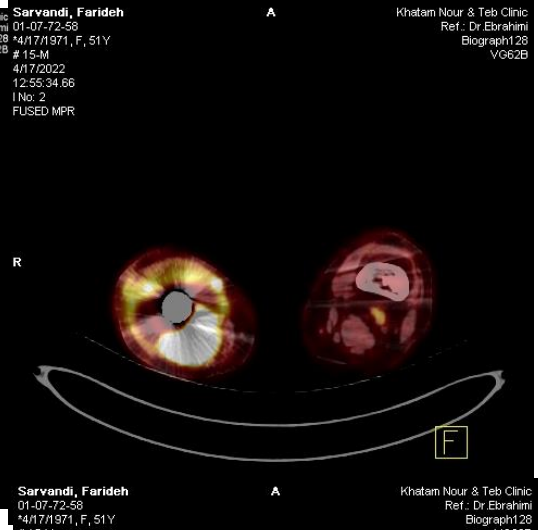
- Initial staging
- Response to therapy in osteosarcoma rhabdomyosarcoma, and Ewing sarcoma
- Providing prognostic information

- And potentially for restaging and detection of relapse

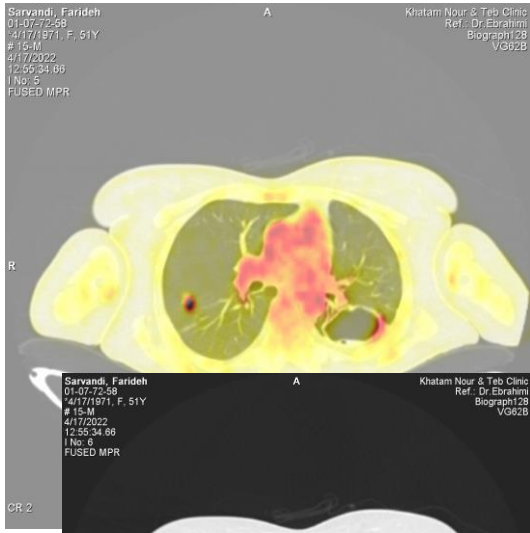

# Suspected local Recurrence in Osteosarcoma:

# Osteosarcoma:










# *Less common indications:*

- ***Neuroblastoma*** (in 123I-MIBG–negative cases, and preoperative or pretherapy prognostic information).
- ***Central nervous system tumors:***
  - Grading
  - Evaluation of response to therapy
  - Prognosis
  - Differentiation of viable tumor tissue versus post-radiation changes
- ***Head and neck cancer*** including nasopharyngeal cancer
- ***Langerhans cell histiocytosis (LCH)***
- ***Posttransplant lymphoproliferative disorder***
- ***Germ cell tumors*** (staging and recurrence)

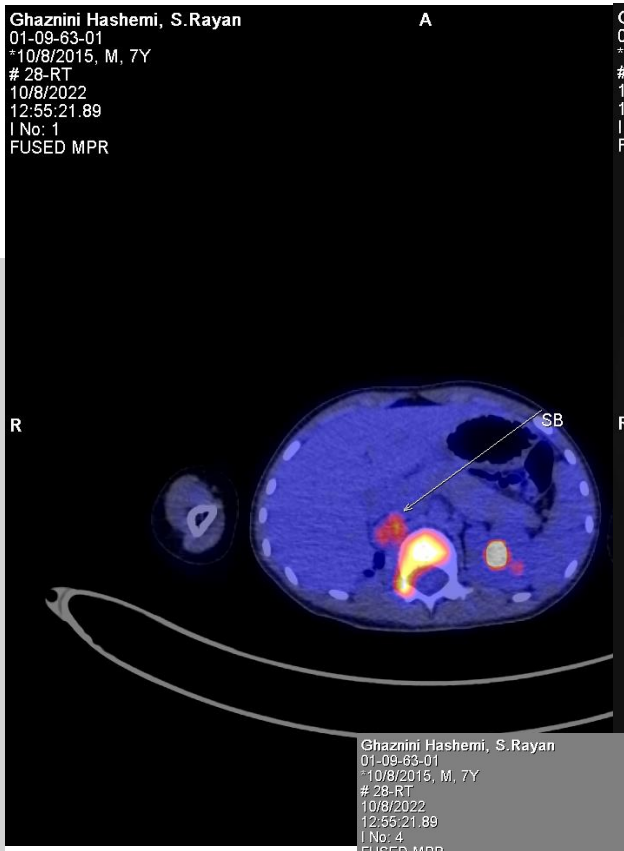
# *Less common indications (cont):*

- ***Suspecting malignant transformation of neurofibroma***
- ***Thymic neoplasia***
- ***Thyroid cancer*** (negative iodine scan with rising serum thyroglobulin level)
- ***Wilms tumor***

***18F-FDG PET/CT may be beneficial in other specific clinical scenarios in children, and the decision to perform this examination should be a multidisciplinary team decision.***

# Wilms tumor


T: 9%
B: -2%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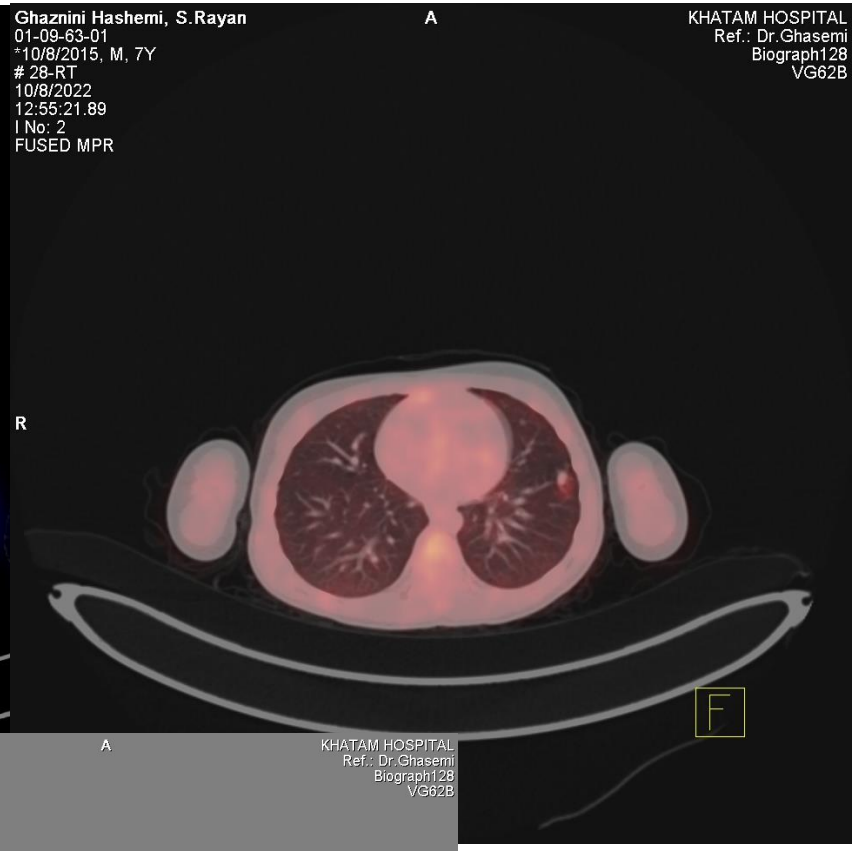
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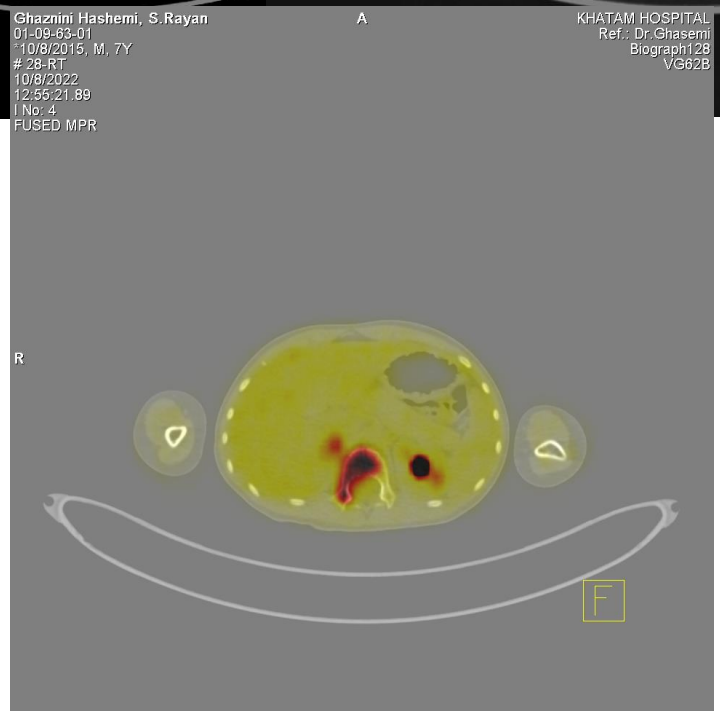
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*With Special Thanks*