^{18}F-Fluciclovine PET uptake in thumb carpometacarpal joint: initial observations

Yasser G. Abdelhafez, MD, PhD[1], Lorenzo Nardo, MD, PhD[1], Simon R. Cherry, PhD[1,2], Ramsey D. Badawi, PhD[1,2], and Abhijit J. Chaudhari, PhD[1]

[1]Radiology, [2]Biomedical Engineering, University of California - Davis, CA, USA

Introduction

Thumb carpometacarpal (CMC) joint osteoarthritis (OA) is a common yet poorly understood condition with high prevalence in the older population[1].

Altered joint metabolism has been hypothesized to contribute to OA pathogenesis, and amino acids (AAs) and their metabolites have been investigated in OA joints. Among the AAs, glutamine was shown to be deficient in the synovial fluid of OA joints[2,3]. **^{18}F-Fluciclovine, a PET radiotracer, is a synthetic amino acid that behaves *in vivo* like glutamine[4].**

In this work we evaluated the frequency of detecting thumb CMC abnormality on ^{18}F-Flucicoclovine PET/CT scans in a cohort of elderly men who received the scan for standard-of-care prostate cancer assessment.

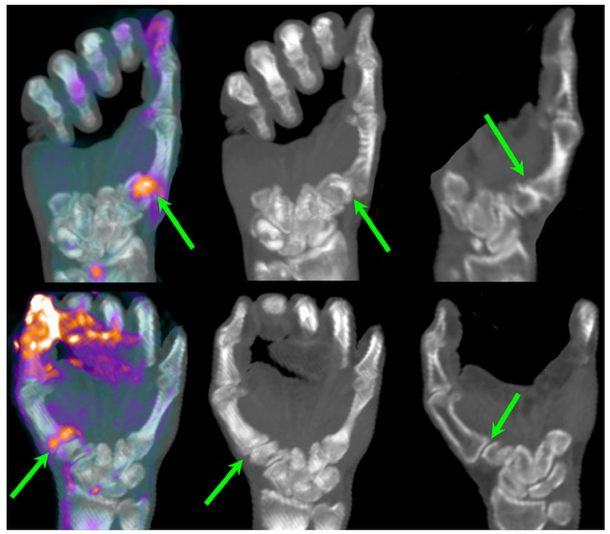


Figure 1. Example images of abnormal ^{18}F-Fluciclovine uptake from two different patients shown as fused PET/CT MIP (left column), CT only MIP (middle column) and cross-section from CT (right column). Top images show CT changes (narrowing & sclerosis) while bottom images demonstrate radial subluxation but no apparent structural damage.

Methods and Materials

The inclusion criteria were male patients with prostate cancer who underwent standard-of-care ^{18}F-Fluciclovine total-body PET/CT scans for evaluation of biochemical recurrence. List-mode PET/CT scans from head-to-toe were acquired using a total-body PET/CT scanner *(uEXPLORER, United Imaging Healthcare)*[5] for 25 minutes immediately after IV injection of 318±19 MBq of the radiotracer. Scans in which the thumb CMC joint was not within the field-of-view or those with significant mis-registration between the PET and CT components or notable hand muscle uptake obscuring the joint were excluded.

Images were read for any abnormal uptake at the thumb CMC joint (defined as visually higher than surrounding background). Laterality was noted and **SUV_{max}** was recorded. In the absence of abnormality, the background SUV was recorded.

The CT portion of the study was reviewed for structural changes of osteoarthritis **(joint space narrowing, sclerosis, osteophytes, cystic changes, and involvement of scaphotrapeziotrapezoid [STT] joint)**. Accordingly, **Eaton-Littler Stage** between I & IV was assigned for each joint.

CT Findings	*PET Fluciclovine Uptake*			
	Negative	*Bilateral*	*Unilateral*	*Total*
Negative	**8**	2	2	**12**
Bilateral	2	**4**	2	**8**
Unilateral	1	1	**6**	**8**
Total	**11**	**7**	**10**	**28**

Table 1. Frequency of abnormal findings on ^{18}F-Fluciclovine PET and CT.

Results

Evaluable 28 scans were performed in 28 male patients, with a **mean age of 73±9 yrs** (range: 54-97 yrs).

On PET, **24 joints from 17 subjects were positive** for abnormal ^{18}F-Fluciclovine uptake; 14 joints from 7 subjects affected bilaterally, 10 joints from 10 subjects affected unilaterally (7 left & 3 right). On the corresponding CT, 24 joints were positive; 16 joints from 8 subjects affected bilaterally and 8 joints from 8 subjects affected unilaterally (6 left & 2 right) **(Table 1). Concordance between PET and CT was seen in 42 joints (25 negative, 17 positive).**

PET was positive in 7 joints that were negative on CT for OA (Figure 1) while CT was positive in 7 joints (all were Eaton Littler stage II) that showed no abnormal uptake on PET images.

The **kappa** agreement between qualitative PET and CT findings was **0.49 (95%CI: 0.26-0.72).**

SUV_{max} for the joints scored as **Eaton Littler stage** II (n=12), III (n=6), and IV (n=6) were, respectively, 1.5±0.8, 2.2±0.7, and 2.5±1.7, with Spearman correlation coefficient of **0.55 (95%CI=0.39-0.74, p <0.001**) (**Chart 1**).

Conclusion

- ^{18}F-Fluciclovine total-body PET/CT scans show accumulation of the synthetic amino acid radiotracer, indicative of glutamine deficiency, in thumb CMC joints with OA.
- The uptake intensity showed a moderate correlation with Eaton-Littler CMC OA stage.

Discussion

The premise of this work was that ^{18}F-Fluciclovine is transported into cells by the amino acid transporters and is indicative of glutamine metabolism[4]. Therefore, elevated ^{18}F-Fluciclovine uptake in an OA joint may suggest **glutamine deficiency, hence T-cell activation**[6], a likely bellwether for downstream joint degeneration.

Published literature has shown that administration of glutamine has suppressed OA progression in a rat model, and supplementation of glutamine could provide a novel therapeutic approach to OA[3].

Our findings, if prospectively validated, **can be utilized towards developing treatment selection strategies, such as local glutamine supplementation**. However, the current work is limited by its retrospective nature, non-standard hand positioning, and lack of clinical endpoint correlation (e.g., pain and assessment of hand function). Future research is needed to further validate the current findings and address these limitations.

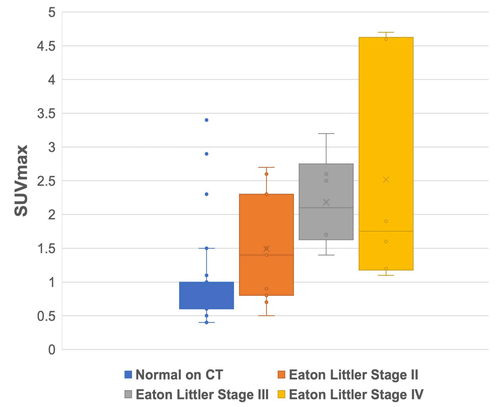
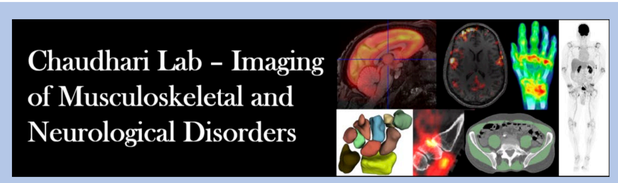


Chart 1. Boxplots of PET SUV_{max} for different Eaton-Littler stages of thumb CMC OA compared to those normal on CT.

Contact

Yasser G. Abdelhafez & Abhijit J. Chaudhari
University of California Davis
4860 Y street, Department of Radiology
Email: yabdelhafez@ucdavis.edu
Email: ajchaudhari@ucdavis.edu



Funding

National Institutes of Health (NIH R01 AR076088 and R01 CA206187) and the National Psoriasis Foundation

Disclosure: University of California Davis has both research and revenue-sharing agreements with United Imaging Healthcare, the manufacturer of the PET/CT

References

1. Ladd AL, et al. Instr Course Lect. 2013;62:165-179.
2. Akhbari P, et al. Bone Jt Res. 2020;9(3):108-119.
3. Zheng K, et al. J Orthop Res. 2017;35(9):1973-1981.
4. Oka S, et al. Mol Imaging Biol. 2014;16(3):322-329
5. Spencer BA, et al. J Nucl Med. 2021;62(6):861-870.
6. Dorota K, et al. Sci Signal. 2015;8(396):ra97-ra97.