

However, in most other cancers, ^{18}F -FDG PET/CT will probably prevail for this purpose for reasons stated in detail elsewhere (2,3). Experts in nuclear medicine and molecular imaging should understand and communicate this, because otherwise how do we make cooperating surgeons and oncologists understand and act accordingly?

REFERENCES

1. Zacho H, Jochumsen MR, Langkilde NC, et al. No added value of ^{18}F -sodium fluoride PET/CT for the detection of bone metastases in patients with newly diagnosed prostate cancer with normal bone scintigraphy. *J Nucl Med*. May 30, 2019 [Epub ahead of print].
2. Høilund-Carlsen PF, Hess S, Alavi A. Bone marrow and not bone metastases is what 21st century diagnostic imaging must focus upon when looking for skeletal metastases. *J Nucl Med*. 2018;59:1165.
3. Høilund-Carlsen PF, Hess S, Werner TJ, Alavi A. Cancer metastasizes to the bone marrow and not to the bone: time for a paradigm shift! *Eur J Nucl Med Mol Imaging*. 2018;45:893–897.
4. Langsteger W, Rezaee A, Pirich C, Beheshti M. ^{18}F -NaF-PET/CT and $^{99\text{m}}\text{Tc}$ -MDP bone scintigraphy in the detection of bone metastases in prostate cancer. *Semin Nucl Med*. 2016;46:491–501.
5. Löfgren J, Mortensen J, Rasmussen SN, et al. A prospective study comparing $^{99\text{m}}\text{Tc}$ -hydroxyethylene-diphosphonate planar bone scintigraphy and whole-body SPECT/CT with ^{18}F -fluoride PET/CT and ^{18}F -fluoride PET/MRI for diagnosing bone metastases. *J Nucl Med*. 2017;58:1778–1785.
6. Basu S, Alavi A. Bone marrow and not bone is the primary site for skeletal metastasis: critical role of [^{18}F]fluorodeoxyglucose positron emission tomography in this setting. *J Clin Oncol*. 2007;25:1297.
7. Basu S, Torigian D, Alavi A. Evolving concept of imaging bone marrow metastasis in the twenty-first century: critical role of FDG-PET. *Eur J Nucl Med Mol Imaging*. 2008;35:465–471.

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Reply: Off-Target Report on ^{18}F -Sodium Fluoride PET/CT for Detection of Skeletal Metastases in Prostate Cancer

REPLY: We thank the authors for the insightful comments on our study (1). We very much agree with the authors that bone metastases are preceded by bone marrow metastases and that both bone scintigraphy and ^{18}F -NaF PET/CT indirectly visualize skeletal metastases via the osteoblastic reaction to metastatic deposits in the bone. However, we do not think an evaluation of the added value of ^{18}F -NaF PET/CT in patients without bone metastases on bone scintigraphy is off-target. First, bone scintigraphy is the recommended method for assessment of bone metastases in prostate cancer across urologic and oncologic guidelines (2,3). This recommendation comes from decades of research showing the ability of bone scans to identify patients for curative and palliative treatments. Second, ^{18}F -NaF PET/CT has replaced bone scintigraphy in many centers around the world for the evaluation of bone metastases in prostate cancer, probably mostly due to superior diagnostic accuracy and capacity. Thus, these methods are well-validated clinically.

Even though cancer cell targeting agents may, in theory, possess advantages over indirect imaging methods, there is a lack of clinical data in the literature showing the superiority of direct over indirect

methods in prostate cancer. Radiolabeled PSMA, choline, and ^{18}F -FDG possess the inherent advantage of depicting the tumor cells directly. However, ^{18}F -FDG is obsolete in the staging of prostate cancer, and it is beyond the scope of this correspondence to discuss imaging in nonprostate cancer.

In comparison with choline PET/CT, ^{18}F -NaF PET/CT has been shown to have premium diagnostic accuracy in prostate cancer (4,5). Moreover, every comparison of PSMA PET/CT and ^{18}F -NaF PET/CT has consistently shown that ^{18}F -NaF PET/CT is noninferior to PSMA PET/CT in terms of diagnostic accuracy for the detection of bone metastases in prostate cancer (5–9).

Our recent study showed that a bone scan is indeed a robust tool for evaluation of the skeletal system in patients with newly diagnosed, predominantly intermediate-risk prostate cancer undergoing radical prostatectomy; ^{18}F -NaF-PET/CT did not identify any bone metastases missed by bone scintigraphy. Two years of follow-up among the 6 patients with biochemical failure after radical prostatectomy confirmed these findings; no bone metastases developed. Five of these patients underwent PSMA PET/CT, which was negative for bone marrow metastases.

While awaiting further clinical evidence for imaging methods of the bone marrow, bone scintigraphy, and ^{18}F -NaF PET/CT remain potent tools in the diagnostic armamentarium in prostate cancer. The low cost, availability, and diagnostic performance of bone scan in prostate cancer emphasizes the guideline recommendation.

REFERENCES

1. Zacho H, Jochumsen MR, Langkilde NC, et al. No added value of ^{18}F -sodium fluoride PET/CT for the detection of bone metastases in patients with newly diagnosed prostate cancer with normal bone scintigraphy. *J Nucl Med*. May 30, 2019 [Epub ahead of print].
2. Mottet N, Bellmunt J, Bolla M, et al. EAU-ESTRO-SIOG guidelines on prostate cancer: part 1—screening, diagnosis, and local treatment with curative intent. *Eur Urol*. 2017;71:618–629.
3. Mohler JL, Antonarakis ES, Armstrong AJ, et al. Prostate cancer, version 2.2019, NCCN clinical practice guidelines in oncology. *J Natl Compr Canc Netw*. 2019;17:479–505.
4. Wondergem M, van der Zant FM, van der Ploeg T, Knol RJ. A literature review of ^{18}F -fluoride PET/CT and ^{18}F -choline or ^{11}C -choline PET/CT for detection of bone metastases in patients with prostate cancer. *Nucl Med Commun*. 2013;34:935–945.
5. Zhou J, Gou Z, Wu R, Yuan Y, Yu G, Zhao Y. Comparison of PSMA-PET/CT, choline-PET/CT, NaF-PET/CT, MRI, and bone scintigraphy in the diagnosis of bone metastases in patients with prostate cancer: a systematic review and meta-analysis. *Skeletal Radiol*. May 24, 2019 [Epub ahead of print].
6. Zacho HD, Nielsen JB, Afshar-Oromieh A, et al. Prospective comparison of ^{68}Ga -PSMA PET/CT, ^{18}F -sodium fluoride PET/CT and diffusion weighted-MRI at for the detection of bone metastases in biochemically recurrent prostate cancer. *Eur J Nucl Med Mol Imaging*. 2018;45:1884–1897.
7. Uprimny C, Sviriydenka A, Fritz J, et al. Comparison of [^{68}Ga]Ga-PSMA-11 PET/CT with [^{18}F]NaF PET/CT in the evaluation of bone metastases in metastatic prostate cancer patients prior to radionuclide therapy. *Eur J Nucl Med Mol Imaging*. 2018;45:1873–1883.
8. Dyrberg E, Hendel HW, Huynh THV, et al. ^{68}Ga -PSMA-PET/CT in comparison with ^{18}F -fluoride-PET/CT and whole-body MRI for the detection of bone metastases in patients with prostate cancer: a prospective diagnostic accuracy study. *Eur Radiol*. 2019;29:1221–1230.
9. Harmon SA, Bergvall E, Mena E, et al. A prospective comparison of ^{18}F -sodium fluoride PET/CT and PSMA-targeted ^{18}F -DCFBC PET/CT in metastatic prostate cancer. *J Nucl Med*. 2018;59:1665–1671.

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