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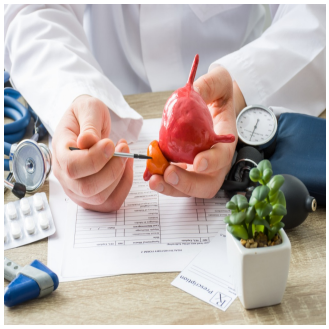
BUMP Score: Diagnostic Accuracy for Prostate Cancer Bone Metastasis



Prostate cancer (PCa) remains one of the most common malignancies among men worldwide, and accurate staging is crucial for effective treatment planning. Recently, positron emission tomography/computed tomography (PET/CT) using prostate-specific membrane antigen (PSMA) tracers has improved the detection of PCa metastases. One of the newer tracers, [18F]PSMA-1007, has garnered attention due to its superior diagnostic capabilities compared to conventional imaging methods. However, [18F]PSMA-1007 is associated with a significant challenge: unspecific bone uptake (UBU). UBU, which is not related to metastatic lesions, complicates the interpretation of scans, potentially leading to overstaging and inappropriate treatment escalation. Researchers have developed a composite prediction tool called the Bone Uptake Metastatic Probability (BUMP) score to overcome this challenge. This article explores how the BUMP score improves the interpretation of [18F]PSMA-1007 PET/CT results, offering a solution for clinicians facing the complexities of UBU.

Understanding the Challenge of Unspecific Bone Uptake

The use of [18F]PSMA-1007 PET/CT has significantly enhanced the detection of PCa metastases, especially in hormone-sensitive patients. However, one of the most significant drawbacks of [18F]PSMA-1007 is its tendency to accumulate in non-malignant bone tissue, leading to what is termed UBU. This phenomenon complicates the differentiation between benign bone lesions and actual bone metastases. Clinical studies have shown that UBU can occur in as many as 72% of patients undergoing [18F]PSMA-1007 scans, making it one of the most frequent pitfalls in PCa imaging. The lack of a reliable method to distinguish between UBU and bone metastases has previously led to overdiagnosis, resulting in unnecessary treatments for patients. Such diagnostic challenges highlight the need for a more refined tool that combines clinical, biochemical, and imaging data to enhance accuracy in PCa staging.

The Development of the BUMP Score

To address the issue of UBU, researchers developed the BUMP score, a predictive model designed to improve diagnostic precision in patients with hormone-sensitive PCa. The BUMP score combines various clinical and imaging parameters to estimate the probability that a focal bone uptake detected by [18F]PSMA-1007 PET/CT is a true metastasis. The critical determinants of the BUMP score include the maximum standardised uptake value (SUVmax), mean Hounsfield unit (HUmean) from the CT portion of the PET/CT scan, and whether the patient is undergoing androgen deprivation therapy (ADT) at the time of imaging. These variables are all associated with the presence of bone metastases and help provide a more accurate diagnosis.

In a large-scale study, the BUMP score was applied to 448 bone uptake specimens across multiple centres, showing an area under the receiver-operating characteristic curve (AUC) of 0.87, indicating high accuracy in predicting true metastatic lesions. This score was further validated externally, demonstrating consistent performance with an AUC of 0.92. Integrating ADT status, SUVmax, and HUmean allows the BUMP score to surpass traditional visual assessments, particularly for less experienced radiologists. This tool has become essential in reducing the risk of overstaging due to UBU.

Clinical Application and Decision Support

The clinical utility of the BUMP score lies in its ability to support decision-making by providing a probabilistic estimate of bone metastasis, which is especially beneficial for clinicians with limited experience in reading [18F]PSMA-1007 PET/CT scans. A decision-curve analysis of the BUMP score showed that using the score to guide clinical intervention provides greater net benefit than treating all patients based solely on visual assessments. This is particularly true when dealing with cases where the visual assessment alone may lead to overstaging.

The BUMP score has proven especially useful for patients undergoing ADT, as the therapy is associated with higher levels of bone metastasis detection. The BUMP score adjusts for these factors, providing a more individualised assessment of metastatic probability. Its application in real-world settings ensures clinicians can make more informed decisions regarding treatment plans, such as whether to proceed with metastasis-

directed therapy or explore other management strategies.

Moreover, the BUMP score addresses the challenge of interobserver variability in interpreting PET/CT scans. Inexperienced PET readers often struggle to differentiate between benign bone lesions and metastases, but the BUMP score offers objective guidance that increases diagnostic specificity. This reduces unnecessary treatment escalations and improves patient outcomes by preventing overtreatment and overstaging.

Conclusion

The BUMP score represents a significant advancement in prostate cancer imaging, particularly in addressing the complexities associated with [18F]PSMA-1007 PET/CT scans. By integrating clinical, biochemical, and imaging factors into a single predictive model, the BUMP score allows for more accurate differentiation between benign bone uptake and metastatic lesions. Its validation across multiple centres underscores its reliability and utility in clinical practice. For clinicians, mainly those less experienced with PSMA PET/CT imaging, the BUMP score is essential to reduce the risk of overstaging and ensure that patients receive appropriate treatment based on more accurate staging information. As prostate cancer diagnosis and treatment continue to evolve, tools like the BUMP score will play an increasingly important role in enhancing diagnostic accuracy and patient care.

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