

Detection of brown adipose tissue by ^{18}F -FDG PET/CT in pheochromocytoma/paraganglioma: A systematic review

Brown Adipose Tissue (BAT) is densely innervated by the sympathetic nervous system, and the release of norepinephrine stimulates thermogenesis via UCP-1. BAT has been detected in the mediastinum, cervical, and paravertebral areas in adults using ^{18}F -FDG PET/CT.¹ Although cold exposure activates BAT, infusion of a nonselective β agonist, isoprenaline, failed to activate BAT, though energy expenditure increased as in cold-activated BAT.² However, it is unclear whether chronic catecholamine elevation in pheochromocytoma or paraganglioma results in systemic changes in ^{18}F -FDG consistent with BAT activation. Therefore, we performed a systematic literature search and review of BAT detection by ^{18}F -FDG-PET/CT in patients with pheochromocytoma and paraganglioma (Pheo/PGL).

The following research string was used to search PUBMED and SCOPUS—(brown) and ((fat) or (adipose) or (BAT)) and ((pheochromocytoma) or (pheochromocytomas) or (paraganglioma) or (paragangliomas) or (neuroblastoma) or (neuroblastomas) or (neuroendocrine) or (carcinoid)). All the results were reviewed and data abstracted.

The search yielded 268 results out of which there were 241 reviews or editorials or letters, 24 case reports of BAT detection, and only 3 original research studies.³⁻⁵ Case reports were excluded from the analysis because they are inherently affected by selection bias. The pooled cohort had 179 patients of whom 146 were positive for Pheo/PGL. Thirty-three patients had been evaluated for pheochromocytoma, but the final diagnosis was not a catecholamine-secreting tumor.

Brown Adipose Tissue was detected by ^{18}F -FDG PET/CT in 27.4% (40/146) of patients with Pheo/PGL, whereas only 6.1% (2/33) persons with no evidence of Pheo/PGL had BAT activation. Patients with BAT activation were younger. There was no difference in the serum catecholamine levels in BAT positive Pheo/PGL patients compared to BAT negative patients in the study by Puar and colleagues.⁴ However, the other 2 studies showed significantly higher catecholamine levels in persons with BAT detected via ^{18}F -FDG PET/CT.^{3,5}

We could not perform a meta-analysis because of the small number of studies and the overall low level of pooled cohort. There was also significant heterogeneity in the study population with respect to genetic mutations, patterns of measured catecholamine elevations, and other risk factors.

In conclusion, there is a higher BAT detection rate in persons with catecholamine-secreting tumors. Further research is needed to

determine whether this phenomenon is an adaptive or a maladaptive mechanism. Also, detection of BAT by ^{18}F -FDG PET/CT may imply an underlying sympathetic overactivity with physiological and sometimes pathological consequences.

CONFLICT OF INTEREST

The authors report no conflict of interest.

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