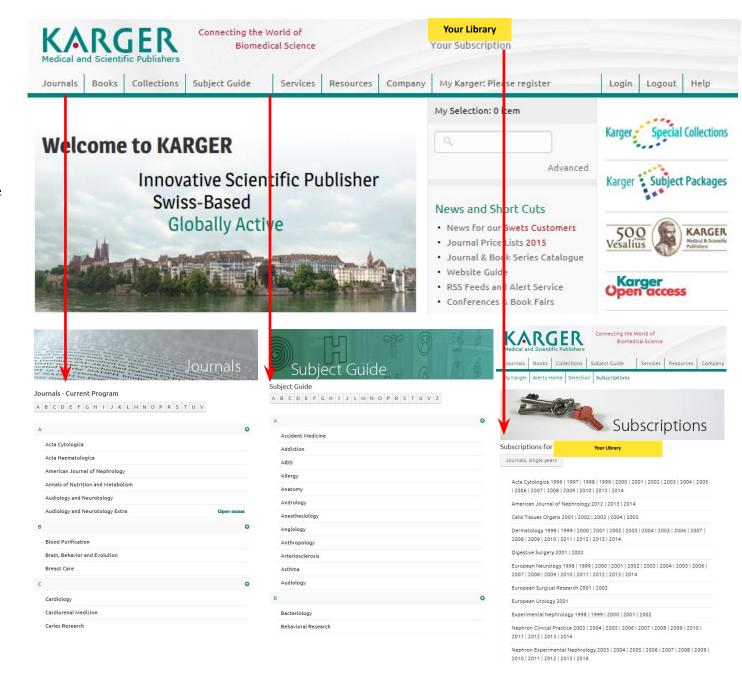


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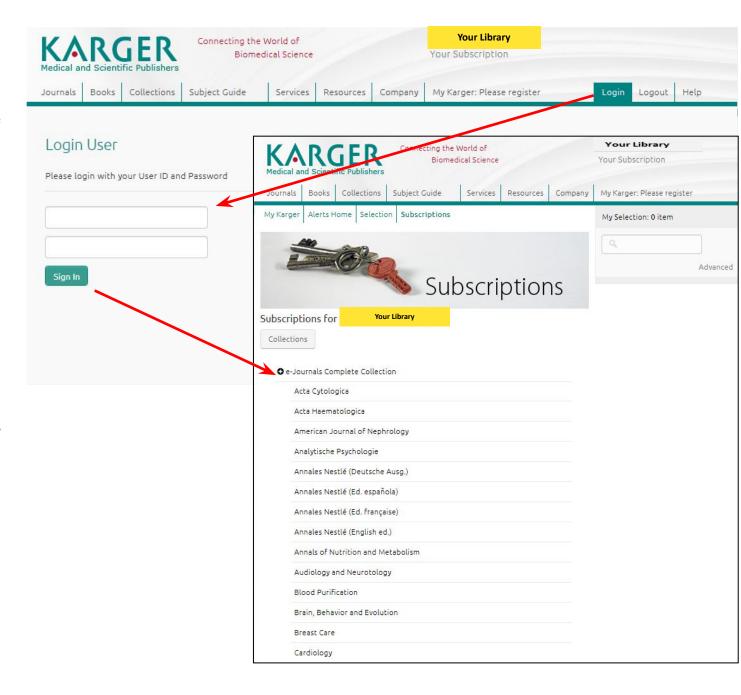
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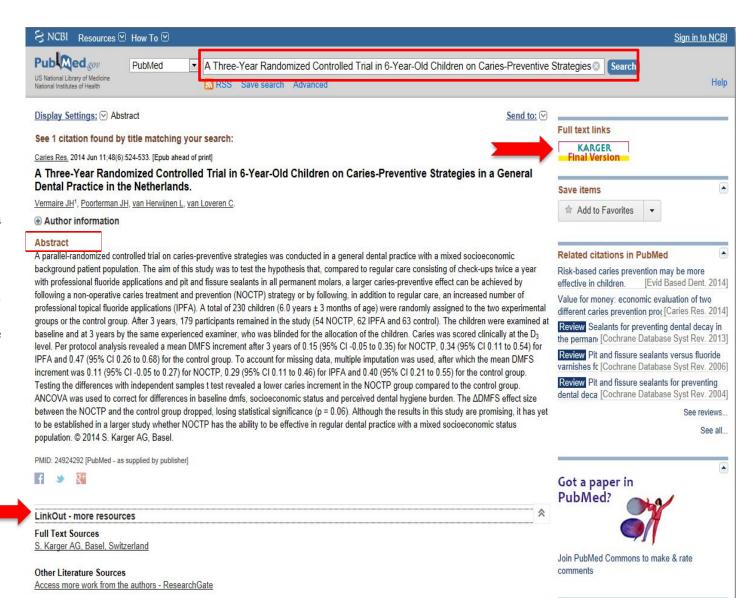


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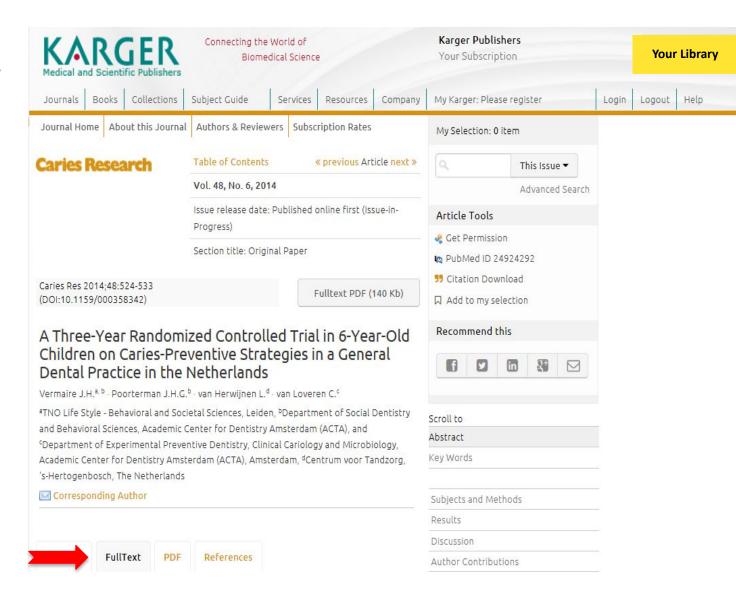
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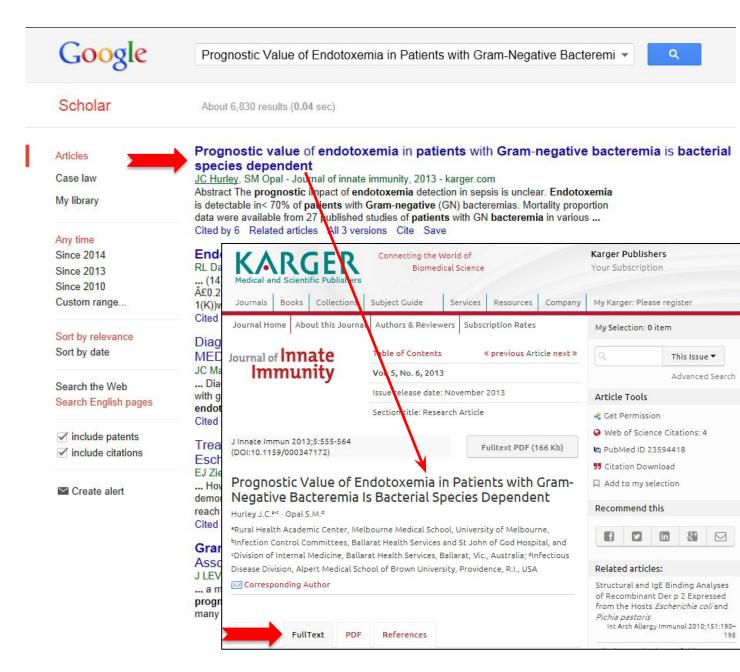


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- Results of the Internal
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- Gastroenteropancrea
- Molecular imaging
- Somatostatin receptor
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Abstract

Molecular imaging modalities pathophysiology for both dia characteristic metabolic path visualization. In this review, w molecular imaging studies, prenters globally, and finally m those modalities in specific cl (SRS) continues to have a cen as it is also widely available. His studies, many NET experts promography (PET) techniques technical advantages, but also disease, in patients with skele Carbon-11 (11C)-5-hydroxy-L-t

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Introduction

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inferior to that of 68Ga-DOTA PET. Glucagon-like-peptide-1 (GLP-1) receptor imaging seems promising for localization of the primary in benign insulinomas, but is currently available only in a few centers. Fluorine-18 (18F)-fluorodeoxyglucose (18F-FDG) PET was initially thought to be of limited value in NET, due to their usually slow-growing nature. However, according to subsequent data, ¹⁸F-FDG PET is particularly helpful for visualizing the more aggressive NET, such as poorly differentiated neuroendocrine carcinomas, and well-differentiated tumors with Ki67 values >10%. According to limited data, ¹⁸F-FDG-avid tumor lesions, even in slow-growing NET, may indicate a more aggressive disease course. When a secondary malignancy has already been established or is strongly suspected, combining molecular imaging techniques (e.g. 18) -FDG PET and ⁶⁸Ga-DOTA PET) takes advantage of the diverse avidities of different tumor types to differentiate lesions of different origins. All the above-mentioned molecular imaging studies should always be reviewed and interpreted in a multidisciplinary (tumor board) meeting in combination with the conventional crosssectional imaging, as the latter remains the imaging of choice for the evaluation of treatment response and disease follow-up.

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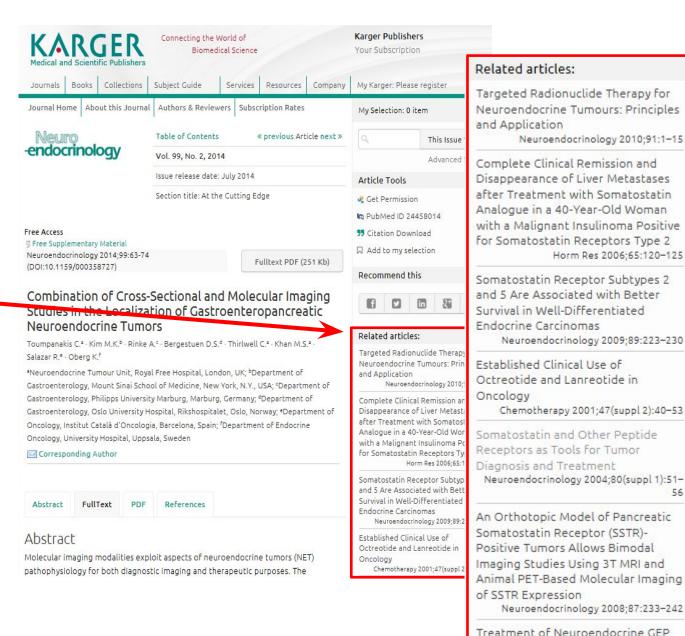
Key Words

- Gastroenteropancreatic neuroendocrine tumors
- Molecular imaging
- · Somatostatin receptor scintigraphy
- Positron emission tomography

Introduction

Neuroendocrine tumors (NET) represent a very heterogeneous group of neoplasms despite having a shared origin from neuroendocrine cells. Although they are characterized by relatively slow tumor growth, they have malignant potential and, in fact, many of them are diagnosed only after distant metastases have developed. The primary tumor is most commonly located in the gastrointestinal (GI) tract or the pancreas. in which case the tumors are collectively referred to as

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Tumours with Somatostatin

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optained whenever possible [4].

Many different imaging techniques are used to (calize GEP-NP). Cross-sectional (anatomical) imaging modalities, such as ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) have been used to localize primary lesions and to stage the extent of the disease. In addition, endoscopic techniques, such as endoscopic ultrasound, have been used with great success to identify lesions that may otherwise have been missed on imaging modalities [5].

Molecular (functional) imaging studies, which are based on NET pathophysiology and especially the presence of SSTR-2 and SSTR-5, have proven superior to standard anatomic imaging in terms of more accurate disease staging and selection of eligible patients for certain treatments. Somatostatin receptor scintigraphy (SRS) is the most established functional imaging for NET worldwide, although its value may be limited by several factors, such as its relatively low resolution for small tumors and background binding in normal tissues. It seems that those limitations have been overcome recently by the introduction of newer analogs and chelators [such as DOTA-[Tyr3] -octreotide (TOC)] suitable as tracers for positron emission tomography (PET) imaging. Also, traditional PET scanning using fluorine-18-fluorodeoxyglucose PET (18F-FDG PET) could be useful in NET with higher Ki67 [6]. Many studies are investigating whether those new imaging modalities alone or in combination are able to provide more precise information about disease extent, patients' response to treatment, and disease course, taking into account the heterogeneity of NET.

In this review, we summarize the available molecular imaging studies and present data for newer techniques of imaging GEP-NET. We also report on the current use of molecular imaging in NET centers globally, evaluating data gathered by questionnaire. Finally, we recommend the techniques most appropriate in specific clinical scenarios.

Methods

An electronic literature search of the PubMed database was performed using the following search terms: 'somatostatin receptor scintigraphy' (Title/Abstract), 'OctreoScan' (Title/Abstract), '123 MIBG' (Title/Abstract), 'PET scan' (Title/Abstract), 'FDG-PET' (Title/Abstract), '68 Gallium-PET' (Title/Abstract), 'neuroendocrine tumor' (Title/Abstract), and 'carcinoid' (Title/Abstract). Only full articles published in peer-reviewed journals and in English were included.

A Web-based survey was constructed comprising of 14 questions with multiple choice answers, gathering information on: (1) the local availability of biomarkers and molecular imaging studies, (2) the choice of appropriate diagnostic modalities for different types of NET, and (3) intervals for following assessments. It was

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FIGS-DOTA-TATE PET (fig. 1) seems to be superior to aff-FDG PETIII the detection of G1- and G2-grade NET, with median SUV_{max} values for ⁶⁸Ga-DOTA-TATE PET of 29 and 15.5, respectively, compared with values for ¹⁸F-FDG PET of 2.9 and 10.5. In contrast, there is a much higher uptake of ¹⁸F-FDG than ⁶⁸Ga-DOTA-TATE in high-grade (G3) NET (SUV_{max} of 11.7 for FDG vs. 4.4 for DOTA-TATE) [26]. Only one small study has compared ⁶⁸Ga-DOTA-NOC with ¹⁸F-DOPA directly; in this study, ⁶⁸Ga-DOTA-NOC revealed more lesions and more occult primary tumors [27]. Compared with CT, 68Ga-DOTA-NOC PET has demonstrated a higher sensitivity (80 vs. 100%, respectively) and specificity (98 vs. 100%) in the detection of NET bone metastases [30]. Finally, Kabasakal et al. [31] compared ⁶⁸Ga-DOTA-TATE and ⁶⁸Ga-DOTA-NOC in the same NET patient group. Both tracers demonstrated physiologic uptake in SSTR-2-expressing organs (e.g. pituitary, salivary, thyroid, and prostate glands), but the physiologic uptake in pituitary and salivary glands was much higher for 68Ga-DOTA-TATE than ⁶⁸Ga-DOTA-NOC. Although the tracers seem to have similar diagnostic accuracy, ⁶⁸Ga-DOTA-TATE seems to provide a significantly higher lesion uptake than 68Ga-DOTA-NOC [31].

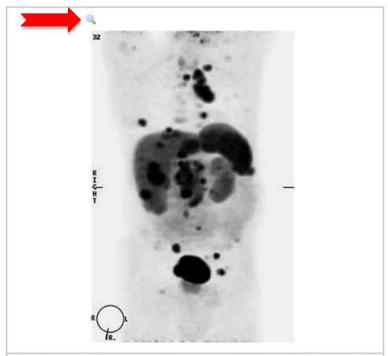


Fig. 1.68Ga-DOTA-TATE PET scan of a patient with a metastatic pNET, demonstrating the pancreatic primary tumor, multiple hepatic, lung, and bone metastases, and intraabdominal and mediastinal lymphadenopathy.

Novel Imaging Techniques

A number of new people are correctly under investigation to a study by Cattherds at

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