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Incidence and Economic Impact of Incidental Findings on ^{18}F -FDG PET/CT Imaging

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Abstract

Purpose: The study sought to determine the incidence of incidental findings on whole-body positron emission tomography with computed tomography (PET/CT) imaging and the average costs of investigations to follow-up or further characterize incidental findings.

Methods: Imaging reports of 215 patients who underwent whole-body PET/CT imaging were retrospectively reviewed. Our provincial picture archiving and communication system was queried and patient charts were reviewed to identify all investigations performed to follow-up incidental findings within 1 year of the initial PET/CT study. Costs of follow-up imaging studies (professional and technical components) and other diagnostic tests and procedures were determined in Canadian dollars (CAD) and U.S. dollars (USD) using the 2015 Ontario Health Insurance Plan Schedule of Benefits and Fees and 2016 U.S. Medicare Physician Fee Schedule, respectively.

Results: At least 1 incidental finding was reported in 161 reports (74.9%). The mean number of incidental findings ranged from 0.64 in patients <45 years of age to 2.2 in patients 75 years of age and older. Seventy-five recommendations for additional investigations were made for 64 (30%) patients undergoing PET/CT imaging, and 14 of those were carried out specifically to follow-up incidental findings. Averaged across all 215 patients, the total cost of investigations recommended to follow-up incidental findings was CAD\$105.51 (USD\$127.56) per PET/CT study if all recommendations were acted on, and CAD\$22.77 (USD\$29.14) based on investigations actually performed.

Conclusions: As the incidence of incidental findings increases with age and a larger proportion of elderly patients is expected as population demographics change, it will be increasingly important to consider incidental findings on PET/CT imaging with standardized approaches to follow-up.

Résumé

Objet : L'étude avait pour objectif de déterminer l'incidence des constatations fortuites sur les examens par TEP-TDM (tomographie par émission de positrons couplée à la tomодensitométrie) du corps entier et les coûts moyens associés aux examens de suivi ou de caractérisation de ces constatations fortuites.

Méthodes : Les rapports d'imagerie de 215 patients ayant subi un examen par TEP-TDM du corps entier ont été analysés de façon rétrospective. Le système provincial d'archivage et de transmission d'images a été interrogé, et les dossiers des patients ont été analysés afin d'y recenser tous les examens de suivi découlant de constatations fortuites dans l'année ayant suivi l'examen par TEP-TDM initial. Les coûts associés aux examens d'imagerie (portions technique et professionnelle) et à d'autres examens et interventions diagnostiques ont été déterminés en dollars canadiens (\$ CA) et américains (\$ US) à partir de la version 2015 du Barème des prestations et des frais du régime d'assurance-santé de l'Ontario ainsi que de la version 2016 du U.S. Medicare Physician Fee Schedule, respectivement.

Résultats : Au moins une constatation fortuite a été consignée dans 161 rapports (74,9 %). Le nombre moyen de constatations fortuites variait de 0,64 chez les patients de moins de 45 ans à 2,2 chez ceux de 75 ans et plus. Au total, 75 recommandations d'examen complémentaires ont été formulées pour 64 patients (30 %) ayant subi un examen par TEP-TDM. De ce nombre, 14 ont été menés dans le but précis de faire le suivi de constatations fortuites. Pour l'ensemble des 215 patients, le coût total des examens de suivi recommandés s'élevait à 105,51 \$ CA (127,56 \$ US) par examen par TEP-TDM si l'ensemble des recommandations étaient suivies, et de 22,77 \$ CA (29,14 \$ US) pour les examens réellement pratiqués.

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Conclusions : Comme l'incidence des constatations fortuites augmente avec l'âge et que les changements démographiques devraient entraîner une hausse de la proportion de patients âgés, il sera de plus en plus important d'adopter des approches normalisées pour faire le suivi des constatations fortuites découlant des examens par TEP-TDM.

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Key Words: Cost analysis; Economic impact; Incidental findings; Incidentalomas; PET/CT

¹⁸F-fluorodeoxyglucose (FDG) positron emission tomography with computed tomography (PET/CT) imaging is increasingly used in cancer staging, monitoring response to therapy, identifying tumours of unknown primary origin, and diagnosis and monitoring of inflammatory and infectious diseases [1]. In addition to imaging findings specifically related to the clinical indication for a given PET/CT study, incidental findings (IFs)—findings that are unrelated to the clinical indication for the imaging examination performed—are frequently identified. The identification of some of these findings may be of specific benefit to patients, such as in cases where a second primary malignancy or large aortic aneurysm is detected. However, in other cases, follow-up imaging or procedures related to IFs may result in increased patient anxiety, increased radiation exposure, complications from procedures or treatment, and increased health care costs without defined patient benefit [2–5].

There is a significant body of literature surrounding the incidence and economic impact of IFs identified in many imaging modalities [4,6–10]. However, there is a paucity of data regarding the incidence of IFs on PET/CT and the economic impact of follow-up. The dual-modality nature of PET/CT imaging, the many body systems imaged in each study, and the patient characteristics of those undergoing PET/CT imaging—many with a known malignancy—are considerations unique to this modality and which warrant further study of IFs, specifically on PET/CT imaging. Previous studies investigating the incidence of IFs on PET/CT have limited their scope to either FDG-avid or non-FDG-avid findings, to the identification of a second primary malignancy [11–17], or to specific clinical indications (melanoma, lung, and gastric cancers) [18–21]. Thus, the objectives of this study were to determine: 1) the incidence of IFs in a nonselected patient population undergoing PET/CT imaging; 2) associations between identification of IFs and patient demographics; 3) the number of recommendations for follow-up investigations; and 4) the additional average cost related to follow-up investigations for IFs. This study may help inform the modeling of health care costs, assessment of the value of PET/CT imaging, and the development of guidelines for standardized follow-up of incidental findings.

Methods

Patient Population

Patients of any age who underwent whole-body PET/CT imaging at our institution over a 14-month period were

eligible to be included in this retrospective study. Our PET/CT imaging facility serves the entire province; however, only patients residing within our health region were included in the study to allow us to accurately track follow-up investigations. For patients who had 2 or more PET/CT exams during the study period, only the initial exam was included in analysis. Of the 215 patients included, 125 (58.1%) were men and 90 (41.9%) were women. The mean age of all patients was 59.8 years (range 1.9–89.7 years). Indications for the imaging study were related to malignancy (n = 213), infection (n = 1), and fever of unknown origin (n = 1). For examinations in which the indication was malignancy, the known or suspected primary was lung (n = 60), lymphoma (n = 37), colorectal (n = 26), head and neck (n = 13), esophageal (n = 8), melanoma (n = 7), breast (n = 6), cervical (n = 6), sarcoma (n = 6), gastric (n = 4), hepatocellular (n = 3), pancreatic (n = 3), renal (n = 3), endometrial (n = 3), ovarian (n = 3), prostatic (n = 3), testicular (n = 3), other (n = 8), or unknown (n = 11). This study was approved by our institutional research ethics board.

Image Acquisition and Interpretation

Following the administration of ¹⁸F-FDG, images were obtained from the base of the brain to the mid thighs or from the vertex of the skull to the bottom of the feet with a GE Healthcare Discovery 710 scanner (GE Healthcare, Little Chalfont, UK). Images were reconstructed tomographically in axial, sagittal, and coronal planes. A low-dose, contrast, or noncontrast CT was obtained for attenuation correction and anatomic correlation. All images were interpreted by a board-certified nuclear medicine physician or dual board-certified diagnostic radiologist and nuclear medicine physician.

Data Abstraction

Imaging reports were retrospectively reviewed to identify reported IFs and to determine recommendations provided by the reporting physician for follow-up or further characterization of the IF. IFs were defined as either a significant area of hypermetabolism or hypometabolism, or an abnormality on the CT component of the PET/CT scan considered unrelated to the clinical indication for imaging as provided by the referring physician. Findings were considered IFs if they had a location, pattern, or intensity that was considered atypical for metastasis as determined by the reporting physician [17]. Expected sites of direct extension or

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