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Original Research

Cost-effectiveness analysis of PET-CT-guided management for locally advanced head and neck cancer

A.F. Smith [a,b,*], P.S. Hall [b,c], C.T. Hulme [a], J.A. Dunn [d], C.C. McConkey [d], J.K. Rahman [e], C. McCabe [f], H. Mehanna [e]

[a] *Academic Unit of Health Economics, Leeds Institute of Health Sciences, University of Leeds, UK*
[b] *National Institute of Health Research (NIHR) Diagnostic Evidence Cooperative (DEC) Leeds, UK*
[c] *Edinburgh Cancer Research Centre, University of Edinburgh, Edinburgh, UK*
[d] *Warwick Clinical Trials Unit, University of Warwick, Coventry, West Midlands, UK*
[e] *Institute of Head & Neck Studies and Education, University of Birmingham, UK*
[f] *Department of Emergency Medicine, University of Alberta, Edmonton, Canada*

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Abstract ***Background:*** A recent large United Kingdom (UK) clinical trial demonstrated that positron-emission tomography–computed tomography (PET-CT)-guided administration of neck dissection (ND) in patients with advanced head and neck cancer after primary chemo-radiotherapy treatment produces similar survival outcomes to planned ND (standard care) and is cost-effective over a short-term horizon. Further assessment of long-term outcomes is required to inform a robust adoption decision. Here we present results of a lifetime cost-effectiveness analysis of PET-CT-guided management from a UK secondary care perspective.

Methods: Initial 6-month cost and health outcomes were derived from trial data; subsequent incidence of recurrence and mortality was simulated using a *de novo* Markov model. Health benefit was measured in quality-adjusted life years (QALYs) and costs reported in 2015 British pounds. Model parameters were derived from trial data and published literature. Sensitivity analyses were conducted to assess the impact of uncertainty and broader National Health Service (NHS) and personal social services (PSS) costs on the results.

Results: PET-CT management produced an average per-person lifetime cost saving of £1485 and an additional 0.13 QALYs. At a £20,000 willingness-to-pay per additional QALY threshold, there was a 75% probability that PET-CT was cost-effective, and the results remained cost-effective over the majority of sensitivity analyses. When adopting a broader NHS and PSS perspective, PET-CT management produced an average saving of £700 and had an 81% probability of being cost-effective.

* *Corresponding author*: Leeds Institute of Health Sciences, Level 11, Worsley Building, Clarendon Way, Leeds LS2 9NL, UK.
E-mail address: a.f.c.smith@leeds.ac.uk (A.F. Smith).

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Conclusions: This analysis indicates that PET-CT-guided management is cost-effective in the long-term and supports the case for wide-scale adoption.

1. Introduction

Chemo-radiotherapy (CRT) has become a mainstay of primary treatment for many patients with squamous-cell carcinoma of the head and neck. However, for patients with advanced nodal disease (stage N2 or N3), there remains variation in subsequent treatment management. Evidence of persistent disease in nodes after neck dissection (ND) in up to 40% of patients, combined with some evidence of a survival advantage resulting from surgery, has led to many centres maintaining ND as the preferred treatment strategy [1–3]. However, in the 30–45% of patients exhibiting complete response on imaging after CRT, less than 10% go on to experience disease recurrence [4,5]; combined with recent improvements in imaging technology, this has led to the sporadic adoption of image-guided treatment strategies in some countries as a means of sparing low-risk patients from the morbidity and expense of unnecessary surgery.

A recent United Kingdom (UK) clinical trial (PET-Neck) was conducted to assess the clinical utility and cost-effectiveness of a combined 18F-fluorodeoxyglucose positron-emission tomography and computed tomography (PET-CT)-guided management for patients with advanced squamous-cell carcinoma [6]. The study found that over the trial 2-year follow-up period, overall survival (OS) was similar among patients in the PET-CT arm compared to those who underwent planned ND (84.9% versus 81.5%, respectively). In addition, mainly as a result of fewer operations (54 versus 221), the intervention was associated with a 2-year cost-saving of £1492. Combined with a small increase (+0.08) in quality-adjusted life years (QALYs), PET-CT-guided management was found to be cost-effective over the 2-year trial horizon.

Uncertainty remains over the long-term cost-effectiveness of image-guided management. Initial cost-savings associated with PET-CT (largely attributable to the lower procedural cost compared to ND; currently £649 versus £3548, respectively in the UK [7]) may not translate into long-term cost-savings if surgery is merely delayed or if the rate of late-stage recurrence events requiring more aggressive treatments is increased. Wide-scale adoption of new and potentially expensive technologies requires robust evidence on both long-term clinical effectiveness and cost-effectiveness, and local decision makers need to have a clear idea of financial implications. Full consideration of the downstream cost consequences of PET-CT, as well as the impact on patient mortality and quality of life, therefore, needs to be addressed.

Here we report results of the PET-Neck study lifetime cost-effectiveness analysis that, together with previously published clinical outcomes [6], provides vital evidence for the viability of a PET-CT-guided management strategy for this patient group.

2. Methods

2.1. Clinical trial

The PET-Neck study was a UK pragmatic multi-centre phase III randomised non-inferiority trial (ISRCTN 13735240). Full details of the trial have been previously published [6]. Briefly, between October 2007 and August 2012, 564 adult patients with head and neck (including oropharyngeal, laryngeal, oral, hypopharyngeal or occult) squamous-cell carcinoma with nodal stage N2 or N3 and no distant metastasis (stage M0) disease were recruited across 43 UK National Health Service (NHS) hospitals. Patients were randomised 1:1 to receive either (a) standard care, consisting of planned ND either before (within 4 weeks of randomisation) or after (within 4–8 weeks of CRT completion) primary CRT treatment or (b) PET-CT management, consisting of CRT followed by PET-CT scan after 10–12 weeks, with ND administered within 4 weeks of a positive or equivocal PET-CT scan. No surgery was undertaken if patients did not have evidence of residual disease. All patients received subsequent ongoing follow-up including regular clinical examinations. The primary outcomes of the trial were OS and cost-effectiveness, and all patients were followed up for a minimum of 2 years post randomisation. Requests for survival and recurrence status at the end of the trial provided additional follow-up up to 5 years. Ethical approval for this trial was provided by the Oxfordshire Multi-Research Ethics Committee in May 2007 (Ref No: 07/Q1604/35).

2.2. Health economic analysis

The PET-Neck health economic evaluation consisted of two components: (i) a previously reported within-trial (2 year) analysis [6]; and (ii) a lifetime analysis (the focus of this paper), in which the cost-effectiveness of PET-CT management versus planned ND is assessed over a lifetime horizon using a modified Markov model.