

Cost Implication Analysis for the use of PET/CT in treatment monitoring in Head and Neck Cancer

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Abstract

Objective: Evaluate the cost-effectiveness of Positron Emission Tomography/Computed Tomography (PET/CT) in post treatment monitoring for stage III and IV head and neck cancer.

Study Design: Single-center retrospective cohort study

Methods: 33 patients from Boston Medical Center fit the inclusion criteria for the study. Patients were monitored for true positive or false positive PET/CT scans and the number of resulting biopsies, fine needle aspirations (FNA), Computed Tomography (CT), and magnetic resonance images (MRI). The price analysis between the false positive and true positive groups was conducted from the perspective of Medicare reimbursement rates. A two-sample t-test was used to analyze measurable data and the chi-square test and Fisher Exact test were performed on categorical data.

Results: The false positive group with stage III cancer (n=3) had a total reimbursement rate of \$10,400.41 in comparison to the true positive group with stage III cancer (n=4), which had a total reimbursement rate of \$5,502.37, demonstrating an increase of 89% in cost (p=0.141). The false positive group with stage IV cancer (n=10) had a total reimbursement rate of \$10,704.59 in comparison to the true positive group with stage IV cancer (n=16), which had a total reimbursed cost of \$6,878.37, demonstrating an increase of 56% in cost with a statistically significant difference between the two groups (p=0.040).

Conclusion: In an era of Accountable Care Organizations and global payment systems, we have demonstrated the possible financial impact of false-positive PET/CT scans in post treatment monitoring of head and neck cancer.

Results

The false positive group with stage III cancer incurred an average reimbursement that was \$4,898.04±3274.88 higher per patient than that of the true positive group with an increase of 89% in cost. However, there was no significant difference between the true positive and false positive groups in patients with stage III cancer (p=0.141). A similar increase in reimbursement was observed for patients with stage IV cancer with an increase of \$3,826.49±1948.37 corresponding to a 56% increase in cost and there was a significant difference between the two groups with a stage IV diagnosis (p=0.040).

Stage		Biopsy	FNA	CT Scan	MRI scan	PET/CT	Total cost (\$)
III	FP(n=3)	1.67	0.33	2.33	0	5	10,400.41±5530.77
	TP(n=4)	1.25	0.25	1.00	0.5	1.75	5,502.37±1453.75
	p-value	0.54	0.85	0.13	0.44	0.091	0.141
IV	FP(n=10)	2.3	0.2	1.7	1.2	3.9	10,704.59±5481.09
	TP(n=16)	1.25	0.375	1.313	0.625	2.625	6,878.37±3559.57
	p-value	0.025	0.44	0.59	0.16	0.16	0.040

Table 1. Average number of diagnostic procedures and average total cost

Note: FP=false positive rate, and TP=True Positive Rate.

Introduction

Head and neck cancer is a common occurrence, with an estimated 55,000 new cases diagnosed each year and 12,000 deaths occurring as a result in the United States. With the increasing incidence of head and neck cancer in addition to high morbidity and mortality over the past decade, an analysis of recent technological advancements is necessary in providing optimal care to this growing population¹.

For head and neck cancers, PET and PET/CT have recently been suggested to be cost-effective in initial diagnostic work-up²⁻³. However, there currently exists no accepted standard for the use of PET/CT for post treatment monitoring. The National Comprehensive Cancer Network (NCCN) guidelines do not currently include PET/CT scans as part of their follow-up recommendations for head and neck cancer management⁴. Additionally, the Center for Medicare and Medicaid Services (CMS) has limited the number of PET/CT scans to three for post treatment monitoring of malignancy under the Social Security Act⁵. Even without sufficient cost-effectiveness evidence, many institutions routinely use PET/CT in post-therapy surveillance for detection of recurrent cancer.

Therefore, this study was conducted to determine the cost-indications of using PET/CT for post-treatment monitoring in stage III and stage IV head and neck cancer.

Methods and Materials

We reviewed the charts of 120 patients of which 45 patients met inclusion criteria undergoing their first PET/CT imaging for post treatment monitoring for primary malignancy between January 2007 and January 2013. Patients with oral cavity (n=10), nasopharynx (n=7), oropharynx (n=12), and laryngeal cancer (n=9) over the age of 18 were included in the study. Patients with stage I or stage II head and neck cancer were also excluded from the study population because the standard of care for post treatment monitoring in stage I and stage II head and neck cancers does not include the use of PET/CT scans due to the low recurrence rate. All patients were cancer free at the start of the study based on post treatment physical exam findings and PET/CT 12 weeks after treatment. The average number of subsequent procedures for diagnostic purposes including FNA, tissue biopsy, and MRI were then calculated. Costs were determined based on Medicare reimbursement rates for the procedures in the year 2015 based on procedural Ambulatory Prospective Classification codes. Significance was determined at an α level <0.05.

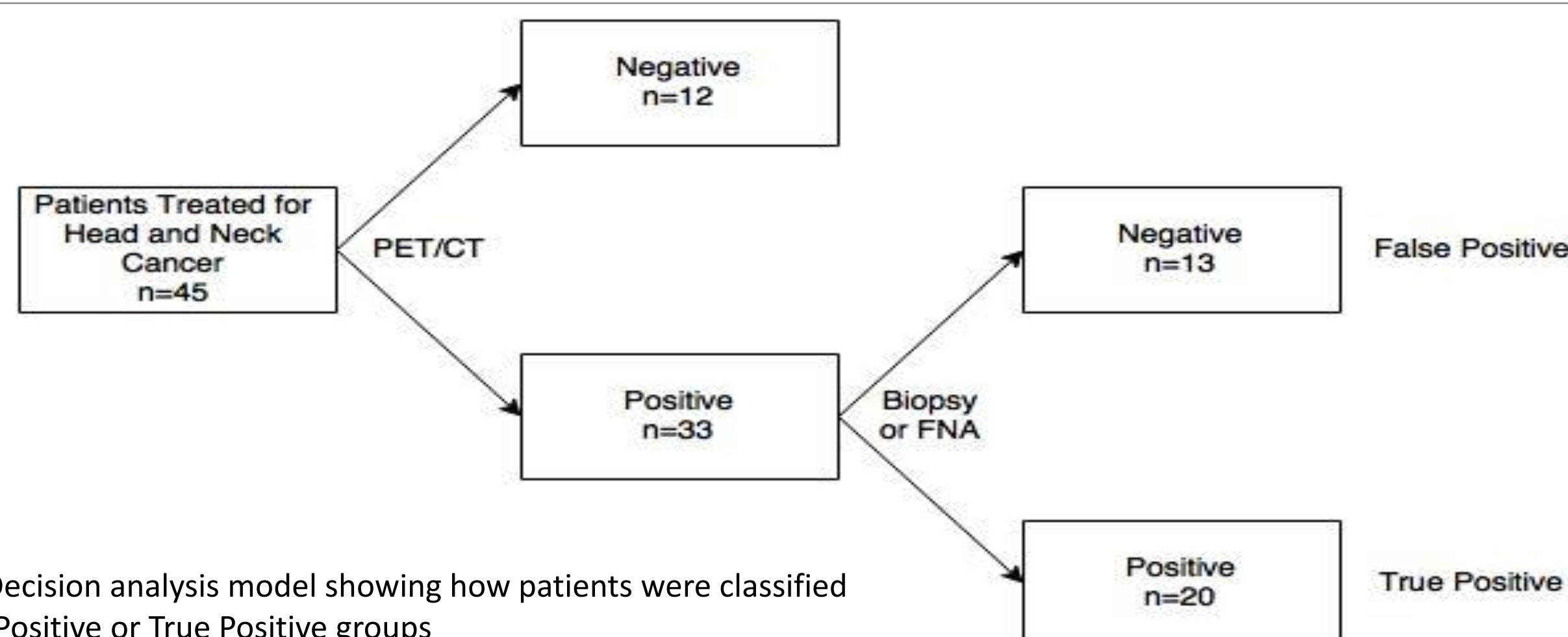


Figure 1. Decision analysis model showing how patients were classified into False Positive or True Positive groups

Discussion

Johnson and Branstetter, in a literature review from 2013, identified the clinical benefit of the use of PET/CT in post treatment monitoring by describing that PET/CT identifies tumor recurrence in 2/3 of cases before clinical identification. Nevertheless, they also concluded, "to date, no good cost-effectiveness data exists regarding the costs related to false positives on PET/CT"⁶.

In addition to the importance in determining the cost impact of using PET/CT at the patient level, this study is also significant at a national or public health level. In an era of Accountable Care Organizations and pay for performance, it is necessary for CMS and other insurance companies to quantify the risk/benefit of the use of PET/CT in post treatment monitoring and create standard imaging guidelines. The development of a standard protocol for PET/CT for head and neck cancer may be created by identifying the necessary field of view, slice thickness on CT, and clear SUV cutoff values to define false positive scans. For example, defining any image with an SUV <3.0 as a negative finding.

Identifying the increased cost associated with the false positive group will also provide financial and clinical incentive for physicians to improve communication between multiple providers methods such as interdisciplinary tumor boards⁷. Wheless et al. described the importance of an interdisciplinary tumor board for head and neck cancer when he described a significant change in treatment plans and escalation in management, adding multimodality care⁸. With continuous improvement and development of new technology, it is even more crucial for optimal communication amongst providers.

Even though we have demonstrated that there is a significant difference in the cost for follow up testing in patients with false positive PET/CT in post treatment monitoring, we are unable to claim whether the use of the test or not is cost effective method for post treatment monitoring. Rather, we are able to emphasize the importance of increased communication between members of an interdisciplinary tumor board to potentially minimize false positive results. As technology improves over time and more doctors begin to practice interdisciplinary medicine, the rate of false positive PET/CT scans should decrease, which will increase the cost-effectiveness of this imaging technique.

Conclusions

With an increase in the incidence of head and neck cancer caused by HPV and the growing population, it is necessary to utilize all technological advancements to improve cancer management. However, it is also crucial to prove the clinical efficacy and cost effectiveness of using technological advancements, such as PET/CT for post treatment monitoring. The high sensitivity and specificity of using PET/CT for monitoring were previously described, and we have demonstrated the cost-indications of using PE/CT for post treatment monitoring. We have described the importance of interdisciplinary teams to optimize communication and minimize false positive rates. Continuous monitoring of cost-effectiveness for PET/CT in post treatment monitoring is necessary as technology improves.

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References

- Siegel R., Ma J., Zou Z., Jemal A. Cancer statistics, 2014. *CA Cancer J. Clin.* 64(1):9-29.
- Pryor, D.I., Porceddu S.V., Schuffham P.A., et al. Economic analysis of FDG-PET-guided management of the neck after primary chemoradiotherapy for node-positive head and neck squamous cell carcinoma, 2013. *Head & Neck.* 35(9):1287-1294.
- Hollenbeak C.S., Lowe V.J., Stack B.C. The Cost-Effectiveness of Fluorodeoxyglucose 18-F-Positron Emission Tomography in the N0 Neck, 2001. *Cancer.* 92(9):2341-2348.
- Pfister D.G., Spencer S., Brizel D.M. NCCN Clinical Practice Guidelines in Oncology: Head and Neck Cancers, Version 2.2014. *National Comprehensive Cancer Network.*
- Jacques L., Jensen T.S., Rollins J. et al. Decision Memo for Positron Emission Tomography (FDG) for Solid Tumors (CAG-00181R4), 2013. Centers for Medicare & Medicaid Services.
- Johnson J.T., Branstetter B.F. PET/CT in Head and Neck Oncology: State-of-the-Art 2013, 2014. *The Laryngoscope.* 124(4), 913-915.
- Shah BA, Qureshi MM, Jalisi S, Grillone G, Salama A, Cooley T, Zaner K, Sakai O, Truong M. Analysis of decision making at a multidisciplinary head and neck tumor board incorporating evidence-based NCCN guidelines. *International Journal of Radiation Oncology.* 2014;90(1):S593.
- Wheless SA, Mckinney KA, Zanation AM. A prospective study of the clinical impact of a multidisciplinary head and neck tumor board. *Otolaryngol Head Neck Surg.* 2010;143(5):650-4.