ORIGINAL ARTICLE

Cost-Savings Analysis of Renal Scintigraphy, Stratified by Renal Function Thresholds: Mercaptoacetyltriglycine Versus Diethylene Triamine Penta-Acetic Acid

Kushal R. Parikh, MD, MBA[a,b], *Matthew S. Davenport, MD*[a,b], *Benjamin L. Viglianti, MD, PhD*[a], *David Hubers, RPh*[a], *Richard K. J. Brown, MD*[a]

Abstract

Purpose: To determine the financial implications of switching technetium (Tc)-99m mercaptoacetyltriglycine (MAG-3) to Tc-99m diethylene triamine penta-acetic acid (DTPA) at certain renal function thresholds before renal scintigraphy.

Methods: Institutional review board approval was obtained, and informed consent was waived for this HIPAA-compliant, retrospective, cohort study. Consecutive adult subjects (27 inpatients; 124 outpatients) who underwent MAG-3 renal scintigraphy, in the period from July 1, 2012 to June 30, 2013, were stratified retrospectively by hypothetical serum creatinine and estimated glomerular filtration rate (eGFR) thresholds, based on pre-procedure renal function. Thresholds were used to estimate the financial effects of using MAG-3 when renal function was at or worse than a given cutoff value, and DTPA otherwise. Cost analysis was performed with consideration of raw material and preparation costs, with radiotracer costs estimated by both vendor list pricing and proprietary institutional pricing. The primary outcome was a comparison of each hypothetical threshold to the clinical reality in which all subjects received MAG-3, and the results were supported by univariate sensitivity analysis.

Results: Annual cost savings by serum creatinine threshold were as follows (threshold given in mg/dL): \$17,319 if $\geq$1.0; \$33,015 if $\geq$1.5; and \$35,180 if $\geq$2.0. Annual cost savings by eGFR threshold were as follows (threshold given in mL/min/1.73 m^2): \$21,649 if $\leq$60; \$28,414 if $\leq$45; and \$32,744 if $\leq$30. Cost-savings inflection points were approximately 1.25 mg/dL (serum creatinine) and 60 mL/min/1.73m^2 (eGFR). Secondary analysis by proprietary institutional pricing revealed similar trends, and cost savings of similar magnitude. Sensitivity analysis confirmed cost savings at all tested thresholds.

Conclusions: Reserving MAG-3 utilization for patients who have impaired renal function can impart substantial annual cost savings to a radiology department.

Key Words: Cost analysis, cost minimization, MAG-3, DTPA, renal scintigraphy

J Am Coll Radiol 2016;■:■-■.

INTRODUCTION

In response to the unsustainable growth trajectory of diagnostic imaging [1-4], payers have enacted dramatic reductions in payment for popular imaging services that have exerted negative pressure on imaging growth, and flattened demand [5-7]. Similar downward pressure on imaging is anticipated from the ongoing creation of Accountable Care Organizations (ACOs)—organizations that are stimulated to form by the Affordable Care Act [8]. One of the proposed ways for radiologists to acclimate to this challenging fiscal environment is by taking leadership roles in cost and quality improvement research [9,10].

Radiology cost drivers and reimbursements are traditionally split into two components: professional fees and technical fees. The professional component accounts for approximately 15% of total compensation (with

[a]Department of Radiology, University of Michigan Health System, Ann Arbor, Michigan.

[b]Michigan Radiology Quality Collaborative, city, Ann Arbor, Michigan.

Corresponding author and reprints: Matthew S. Davenport, MD, 1500 E Medical Center Dr, Dept of Radiology B2-A209P, University of Michigan Health System, Ann Arbor, MI 48109; e-mail: matdaven@umich.edu.

Matthew S. Davenport, MD, has received royalties from Elsevier and Wolters Kluwer, and is a paid consultant to the US Food and Drug Administration and the National Cancer Institute. The other authors have no conflicts of interest related to the material discussed in this article.

1546-1440/16/$36.00 ■ http://dx.doi.org/10.1016/j.jacr.2016.01.009

physician work constituting 55% of that 15%), and thus provides little room for aggressive cost reduction [11]. The technical component, on the other hand, which represents the remaining 85%, may provide substantial opportunities. For example, in the field of nuclear medicine, technologist wages and contrast-media utilization often account for >40% of total examination costs [12]. Despite this fact, published radiotracer/contrast media-centric cost studies in nuclear medicine are lacking, compared with those for CT or angiography [13-17].

One of the nuclear medicine examinations for which potential cost savings could be realized is renal scintigraphy. These examinations are routinely ordered to evaluate renal anatomy, renal perfusion, and renal function, and can be performed with various radiopharmaceuticals [18]. The two most common—mercaptoacetyltriglycine (MAG-3) and diethylene triamine penta-acetic acid (DTPA)—are labeled with the same radionuclide (technetium-99m [Tc 99m]) and are ideally suited for cost-benefit analysis. In patients who have compromised renal function, MAG-3 is preferred to DTPA, because it has higher renal extraction efficiency and better image resolution. But in patients who have normal or mildly impaired renal function, both tracers seem to be equally reliable for the evaluation of renal function [19].

List pricing for MAG-3 is higher than list pricing for DTPA (Mallinckrodt Pharmaceuticals & Jubilant Drax-Image, personal communication, 2015). Historically, we have administered MAG-3 to all patients who receive renal scintigraphy at our institution; this practice avoids the need for pre-procedure renal function assessment, and eliminates the possibility of administration error. But to date, we have not analyzed the financial implications of this practice systematically. The purpose of our study was to exercise our role as cost-mindful stewards, by analyzing the potential financial impact of switching from MAG-3 to DTPA in patients who met certain renal function thresholds before undergoing renal scintigraphy.

METHODS

Subjects

Institutional review board approval was obtained, and informed consent was waived for this HIPAA-compliant, retrospective, cohort study. The institutional RIS was queried to identify all adult (age ≥18 years) inpatients and outpatients who underwent dynamic renal scintigraphy between July 1, 2012 and June 30, 2013, using intravenous Tc99m MAG-3 (a fixed, 10-mCi [370-MBq] dose), and who had at least one pre-procedure serum creatinine measurement. For patients who had multiple studies that met the criteria, only the earliest was used. No other inclusion or exclusion criteria were used. The final study population consisted of 151 adult patients (median age, in years, with interquartile range): 56.1 (41.0-67.0), including 27 inpatients (68.5 [56.3-73.8]); 124 outpatients (53.6 [39.7-64.1]); 73 men (58.2 [42.5-67.8]); and 78 women (54.5 [40.7-66.5]) (Table 1).

Table 1. Population characteristics, by inpatient vs outpatient status

Characteristic	Inpatient	Outpatient
Number of subjects	27	124
Men	14	59
Women	13	65
Median age (y)	68.5 (56.3-73.8)	53.6 (39.7-64.1)
Median pre-procedure creatinine (mg/dL)	1.3 (0.9-2.3)	1.0 (0.8-1.2)
Median pre-procedure eGFR (mL/min/1.73 m^2)	50.0 (27.5-81.0)	81.0 (53.8-100.3)
Median time between pre-procedure renal function assessment and MAG-3 renal scintigraphy (d)	0.4 (0.2-0.5)	40.6 (10.5-162.1)

Note: Values in parentheses indicate interquartile range. eGFR = estimated glomerular filtration rate; MAG-3 = mercaptoacetyltriglycine.

Renal Function Estimates

The most proximate pre-procedure serum creatinine-level referent to each dynamic renal scan was obtained for each patient. An estimated glomerular filtration rate (eGFR) was calculated for each patient, using the CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration) equation from the National Kidney Foundation (www.kidney.org). The length of time between the most proximate pre-procedure serum creatinine level and each dynamic renal scan was determined as well.

Cost Data

The cost of the MAG-3 and DTPA pharmaceutical agents were estimated in two ways: (1) list pricing from vendors; and (2) institutional contractual agreements. List pricing was used to perform the primary analysis because the institutional contractual agreements contained proprietary pricing information. A secondary analysis was