Mohs Micrographic Surgery and Surgical Excision for Nonmelanoma Skin Cancer Treatment in the Medicare Population

Kate V. Viola, MD, MHS; Mamta B. Jhaveri, MD, MS; Pamela R. Soulos, MPH; Ryan B. Turner, MD; Whitney L. Tolpinrud, MD; Daven Doshi, MD; Cary P. Gross, MD, MPH

Objectives: To identify Medicare use rates of Mohs micrographic surgery (MMS) and surgical excision for the treatment of nonmelanoma skin cancer (NMSC) and to identify patient, lesion, and geographic characteristics associated with treatment type.

Design: A retrospective analysis of Medicare beneficiaries.

Setting: Surveillance, Epidemiology, and End Results database.

Patients: Patients undergoing MMS or other surgical intervention for the treatment of NMSC from January 1, 2001, through December 31, 2006.

Main Outcome Measures: Surgical treatment, patient, and lesion characteristics.

Results: A total of 26,931 operations were performed for the treatment of NMSC from 2001 through 2006, of which 36.4% were MMS. Although the rate of surgical excision slightly increased during this period (1.8 vs 2.1 per 100 Medicare beneficiaries), the rate of MMS doubled (0.75 vs 1.5 per 100 Medicare beneficiaries). In 46.9% of facial lesions, MMS was performed, whereas MMS was used to treat 14.7% of total body lesions. Atlanta, Georgia, had the highest proportion of patients treated with MMS (45.1%); Louisiana had the lowest (11.0%). Age, race, lesion location, and area of country for patient treatment were significantly associated with MMS use (all P < .001).

Conclusions: Surgical treatment of NMSC increased substantially from 2001 through 2006, primarily because of a doubling in the rate of MMS procedures. Significant differences in surgical rates, depending on patient age, race, lesion location, and geographic region, of treatment were found.


MORE THAN 3 MILLION nonmelanoma skin cancers (NMSCs) are diagnosed annually in the United States; 1 in 5 Americans will develop skin cancer during their lifetime.1,2 The NMSC treatment options include electrodessication and curettage, cryosurgery, photodynamic therapy, laser therapy, radiation, medical therapy, surgical excision, and Mohs micrographic surgery (MMS).3 Surgical excision is effective for most primary basal cell carcinomas, but cure rates are higher with MMS in patients with recurrent, infiltrative, and high-risk anatomical site (face) cancers; MMS examines 100% of the surgical margin, which ensures definitive tumor removal and minimal loss of surrounding normal tissue.3,4

In 1995, the American Academy of Dermatology set forth guidelines for the use of MMS in patients with skin cancer, for which adequate excision and negative margins are essential, particularly in lesions at high risk of local recurrence and/or metastasis or located in anatomical locations that require tissue preservation, such as the face.3 The National Comprehensive Cancer Network has identified key characteristics that support treatment of NMSC using MMS and similar criteria for surgical excision.6 Research from both surgical (otolaryngology) and dermatology journals reports optimal outcomes with MMS for NMSC, particularly when determining recurrence rates in basal cell carcinomas over time.7,8 Recent literature has favored the use of MMS for tissue preservation in recurrent skin cancers, particularly on the neck and face, and optimal cosmetic outcomes and increased patient satisfaction, yet there is ongoing debate on the efficacy of surgical treatment (MMS vs surgical excision) for primary NMSC and
the cost-efficacy of MMS. In addition, there has also been research examining variation in surgical treatment environment (private vs academic setting) in addition to anatomical location and type of skin cancer (primary vs recurrent) in MMS use.

Despite the evolving recommendations concerning treatment options, there is a paucity of data examining actual patterns of care for NMSC at the population level. It is particularly important to understand the approach to treating NMSC in the Medicare population because older patients have a higher prevalence of this skin cancer type. Population-level studies can help to identify health-system factors that may be barriers to the dissemination of treatment modalities. We therefore studied trends in the approach to two types of accepted surgical treatment of Medicare beneficiaries with NMSC to identify patient and regional factors associated with the use of MMS and surgical excision over time. This study represents, to our knowledge, the first longitudinal, population-based analysis of surgical excision and MMS use in the United States.

**METHODS**

**DATA SOURCE**

A retrospective analysis of Medicare beneficiaries receiving surgical intervention (MMS vs surgical excision) for the treatment of NMSC from January 1, 2001, through December 31, 2006, using a 5% sample of all Medicare beneficiaries with claims data from the Surveillance, Epidemiology, and End Results (SEER) database was performed. Because the SEER registry does not track NMSC, we were able to use this database to identify a random sample of Medicare beneficiaries living within each SEER registry. This approach enabled us to assess regional variation because each SEER region is represented proportionate to the number of Medicare beneficiaries in that region, regardless of how specific conditions, such as NMSC, are managed. The geographic areas that comprise the SEER regions represent approximately 26% of the US population. Our claims data set captured 1,666,604 patients from 2001 through 2006, of whom 1.6% (n = 26,931) had a diagnosis of NMSC.

Patients included in the study sample were at least 67 years of age and were continuously enrolled in fee-for-service Medicare with Part B coverage for 24 months before entry into the study. Because the SEER registry does not track NMSC, this database was used to identify solely a random sample of persons. Patients included had International Classification of Diseases, Ninth Revision (ICD-9) diagnosis codes for NMSC and Current Procedural Terminology (CPT) codes for surgical treatment of NMSC, including MMS, wide excision, and simple excision of lesion. The ICD-9 codes for basal cell carcinoma and squamous cell carcinoma (173.X, where X is the location) were used. The CPT codes were used for type of surgical treatment, including MMS (17304-17310), wide excision (26117), and simple excision of malignant lesion (11600-11646). Simple and wide excision codes were combined to delineate all surgical excision from MMS. Therefore, our dependent variable of interest was procedure type, characterized into surgical excision vs MMS; to avoid confusion, we did not delineate the number of surgical treatments performed per patient (cases in which patients may have had multiple lesions) but rather focused on the overall number of surgical procedures by type.

Variables were characterized into patient (sex, sex, and race), lesion, and regional (area of country where surgery was performed, delineated by SEER site) characteristics. To accurately identify treatment trends within our patient population, we determined the number of Medicare beneficiaries from the Centers for Medicare and Medicaid Services for 2004 by state; this year was chosen as the optimal midpoint of our SEER data, which span 2001 through 2006.

**STATISTICAL ANALYSIS**

The unit of analysis was procedure. A bivariate comparison between our dependent variable (surgical procedure type) and our independent variables (age, sex, race, location of lesion, and area of country treatment was given) was performed using $\chi^2$ analysis. All statistical analyses were performed with the SAS statistical software package (version 9.2; SAS Institute, Inc).

**GEOGRAPHIC ANALYSIS**

Our initial geographic area of analysis was the SEER registry. Within each registry, we calculated the percentage of patients in our sample who were treated with MMS. The registries were then ranked according to the MMS percentage. Because Utah was the registry with the median percentage of MMS performed, it was selected as the reference for subsequent analyses of geographic variation. The percentages of MMS performed in other registries were compared with the percentage of MMS performed in the Utah registry using logistic regression. The number of surgical treatments for NMSC from 2001 through 2006 in each SEER registry was also estimated. The number of MMS procedures was then divided by the total Medicare beneficiaries within each respective region in 2004 to determine MMS treatment.

**RESULTS**

**PATIENT CHARACTERISTICS**

A total of 26,931 patients with NMSC were surgically treated from 2001 through 2006 in our 5% sample of Medicare beneficiaries (Table 1). Of all operations performed, 9820 (36.4%) were MMS and 17,129 (63.6%) were surgical excisions. Of all procedures undergone by men, 5603 (36.9%) were MMS, similar to the proportion for women (35.8%, $P = .07$). A total of 40.6% of procedures received by patients 67 to 79 years old were MMS, which decreased to 33.5% among patients 85 years and older. As a result, there was an increase in the number of procedures that used surgical excision with age (59.4% for those 67-69 years old vs 66.5% for those >85 years old, $P < .001$).

Of all procedures performed on patients identified as white, 9708 (36.5%) were MMS compared with 23.1% for black patients and 28.7% for patients identified as other races. In our bivariate analysis, age ($P < .001$), race ($P = .005$), and location ($P < .001$) were significantly associated with MMS for NMSC treatment.

**LESION CHARACTERISTICS**

When compared with surgical excision, MMS was more likely to be performed on lesions located on the lip (60.1% vs 39.9%) and eyelid (57.2% vs 42.8%) (Table 1). There was a similar proportion of patients with NMSC treated with MMS vs surgical excision in periorcular lesions and those unspecified on the face. In contrast, most malign...
nant neoplasms located below the face were treated with surgical excision. A total of 753 (83.7%) lesions on other specified sites of skin were treated with MMS.

TEMPORAL TRENDS AND REGIONAL CHARACTERISTICS

From 2001 through 2006, the total use of surgical treatment increased, primarily due to the increase in MMS over time (Figure 1). In 2001, every 0.7 of 100 Medicare beneficiaries received MMS treatment for NMSC. This number doubled by 2006 (1.5 per 100 beneficiaries). Surgical excision increased slightly during this period (1.8 per 100 beneficiaries in 2001 to 2.1 in 2006).

Atlanta, Georgia, had the highest proportion of patients with NMSC treated with MMS (45.1%) (Table 2). Regions, including New Jersey (42.7%), Los Angeles, California (41.6%), Iowa (41.0%), and Detroit, Michigan (41.2%), also had comparable MMS use rates in the 6-year period. Areas with fewer MMS performed included Louisiana (11.0%), Hawaii (19.4%), and New Mexico (27.1%).

When examining the United States, the West and Northeast regions had the greatest proportion of surgically treated patients undergoing MMS, whereas patients were less likely to undergo this procedure type in the Midwest and Pacific areas (Figure 2).

Our study demonstrated that surgical treatment of NMSC increased substantially from 2001 through 2006, primarily due to a doubling in the rate of MMS procedures. Although there was no sex discrimination with respect to surgery type, the age of the patient was significant; a higher proportion of MMS was performed in younger patients.
In addition, as age increased, the number of surgical excisions for NMSC increased. We hypothesize that younger patients and their physicians may be more concerned with cosmetic outcome, tissue preservation, and minimizing recurrence compared with older individuals, who may have comorbidities or other medical needs in which MMS would not be an appropriate treatment option.

It is difficult to assess the role of race because most patients surgically treated with NMSC were white in this study (approximately 99%). However, the proportion of surgical excisions vs MMS in blacks and other minorities with NMSC was far greater when compared with whites. This finding may imply that minorities may not have access or are not referred as often to surgeons who perform MMS. Although our research does not examine nonsurgical NMSC treatments or NMSC incidence by race, further research is needed to assess the potential underdiagnosis and surgical treatment in these patient populations. Consistent with the core principles of tissue preservation and aesthetic outcome, we found that most MMS procedures were performed on the face. Our findings reveal that 46.9% of all facial lesions were surgically treated with MMS; we were not able to identify, however, whether these lesions were primary or recurrent. The overall validity of Medicare claims data for tracking billable procedures has been studied and represents an accurate data source for the study of population-based patterns of surgical treatment.21,22

Factors that influence the regional variation not accounted for by this study could be cumulative sun exposure, regional incidence of NMSC, and the percentage of the population older than 65 years (Medicare beneficiaries). The West and Northeast may also represent regions of the country with several academic settings, a greater likelihood of surgeons trained to perform MMS, and therefore a greater proportion of MMS procedures being performed. There may also be geographic variation due to dermatologists and/or other physicians practicing MMS without formal training or a small group representing a monopoly on the MMS procedures performed in that specific region. Variations in care may also result from lack of consensus (eg, whether to perform MMS on primary lesions) or are influenced by the medical environment in which the patient has sought treatment. Future studies are needed to further evaluate the cause of this regional variation and to identify regional disparity.

In the past decade, the total proportion of MMS procedures has doubled. Recent studies1,23,24 demonstrated that the number of NMSCs diagnosed and the number of procedures (an increase of 16% from 2002-2006) in Medicare beneficiaries has increased significantly since the early 1990s. Our study revealed that although the rate of surgical excision slightly increased during this period (1.8 vs 2.1 of 100 Medicare beneficiaries), the rate of MMS doubled (0.75 vs 1.5 of 100 Medicare beneficiaries). However, the increase in NMSC incidence does not explain the increase in MMS use. This trend mirrors the increase in the number of members trained by the American College of Mohs Surgery (ACMS), which has quadrupled in the past 15 years. The ACMS has approximately 1000 members and reports approval of 79 procedural dermatology fellowships in 2009 throughout the country for, on average, 1 physician per year through the San Francisco match. The American Society of Mohs Surgery has 1235 members, of whom 900 are dermatologists and the remaining members are MMS technicians.

Although our study has the strength of analyzing the national trends of MMS use using a large database, it is limited in its scope because we only use Medicare beneficiaries and cannot assess the patterns of use of other patients. This limitation could underestimate the use of MMS for NMSC because MMS is a costly procedure and may be favored by patients younger than 65 years who are willing to pay out of pocket or have other insurance. However, because the incidence of NMSC increases with age, most patients older than 65 years have some degree of Medicare coverage, and therefore our study is a good starting point for analyzing MMS for NMSC throughout the United States. Additional variables play a role in the decision to use MMS for NMSC, including histopathologic findings and tumor size, which we have not accounted for in this study. We have only examined surgical excision and MMS treatment options and have not included other surgical therapy types in this study (eg, electrodessication and curettage) for the treatment of NMSC. Although the SEER registry is an accepted and widely used representation of cancer prevalence in the United States, it does not include states such as Florida and New York. In addition, because most current SEER data are restricted to the year 2006, we were unable to make any conclusions regarding MMS intensity for 2009 through 2010.

The use of MMS has been steadily increasing during the past decade, with MMS representing approximately one-third of all surgical procedures for NMSC. To our knowledge, this is the only study to examine the national patterns of use of MMS for NMSC over time. Patient age and lesion location were significantly associated with type of surgery (MMS vs surgical excision), yet there were wide variations in regional MMS use and geographical disparity that warrant further investigation. Additional large, prospective studies are needed to further identify surgical treatment outcomes for NMSC.