ORIGINAL ARTICLES

A Retrospective Case-Matched Cost Comparison of Surgical Treatment of Melanoma and Nonmelanoma Skin Cancer in the Outpatient Versus Operating Room Setting

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BACKGROUND To date, no study has used authentic billing data in a case–control matched fashion to examine the cost of treating skin cancer in different settings.

OBJECTIVE To compare the cost of surgical treatment of skin cancer in the outpatient versus operating room setting using matched cases based on patient and skin cancer characteristics.

METHODS ICD-9 diagnosis codes for skin cancers were used to find patients who had a malignant excision current procedural terminology code in the operating room setting during 2010 to 2014. Patient and skin cancer characteristics were used to match cases to those treated as an outpatient. A total of 36 cases (18 operating room and 18 outpatient) had the required information and characteristics to be matched and analyzed for cost. Health status was determined using the American Society of Anesthesiologists anesthesia grading scale.

RESULTS No statistically significant differences were found in the age ($p > 0.9$) or American Society of Anesthesiologists scores ($p > 0.6$) of the outpatient and operating room cases. The median cost for outpatient cases was $1,745. For operating room cases, the median cost was $11,323. This was a statistically significant difference ($p < 0.001$).

CONCLUSION The outpatient setting remains a cost-effective location to treat skin cancer compared with the operating room.

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Skin cancer is the most common cancer diagnosed in the United States, and its incidence is increasing. According to Guy and colleagues, there were nearly 5 million adults treated for skin cancer annually from 2007 to 2011, costing 8.1 billion dollars a year.[1] This high and rising economic impact is certainly a cause for concern and reason to determine the most cost-effective therapy for skin cancer.

Many treatment options exist for skin cancer including Mohs micrographic surgery (MMS), surgical excision, radiation, electrodessication and curettage, cryotherapy, photodynamic therapy, and topical chemotherapy. MMS provides the highest cure rates for both primary and recurrent skin cancer while sparing tissue compared with surgical excision. However, its cost-effectiveness has come under scrutiny in today's health care economy, prompting many authors to publish research on the subject.[2,3] Some studies have compared the cost of MMS with other treatment options for skin cancer using extrapolated data. To date, no study has used authentic billing data in a case–control matched fashion.

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Materials and Methods

ICD-9 diagnosis codes for skin cancers were used to find patients through hospital billing who had a malignant excision current procedural terminology code in the operating room setting during 2010 to 2014. Hospital records detailing patient age, gender, and skin cancer characteristics were used to match cases of those treated as an outpatient either with MMS or traditional excision. A total of 36 cases (18 operating room and 18 outpatient) had the required information and characteristics to be matched. Matched cases then went through a billing analysis of charges, and the two were compared. Health status analysis was performed using the American Society of Anesthesiologists (ASA) anesthesia grading scale for the matched cases.

Inclusion/Exclusion Criteria

Patients who have ICD-9 diagnosis codes for basal cell carcinoma (BCC), squamous cell carcinoma, or melanoma along with malignant excision current procedural terminology codes in 2010 to 2014 were included for initial analysis. Matched patients who received MMS or traditional excision of BCC, squamous cell carcinoma, or melanoma at Cooper University Hospital Center for Dermatologic Surgery were also included. Patients who had characteristics (skin cancer size, skin cancer location, ASA physical status characteristic) or limited electronic medical record data that were unable to be matched were excluded.

Statistical Analysis

A total of 111 malignant excisions were performed in the operating Room setting from 2010 to 2014. There were 85 melanomas, 8 BCCs, 5 squamous cell carcinomas, and 13 unspecified skin malignancies. Twenty nine of these cases had sufficient information to determine patient age, sex, health status, tumor size, tumor type, tumor depth, and sentinel lymph node biopsy status. For the outpatient cases, the authors reviewed 5,583 dermatologic surgeries from 2010 to 2014 and provided 18 case matches for cost analysis and 17 case matches for ASA scoring. These cases were scored using 3 blinded anesthesiologists. A Wilcoxon Signed-Rank Test was used to analyze the cost data (Figure 1).

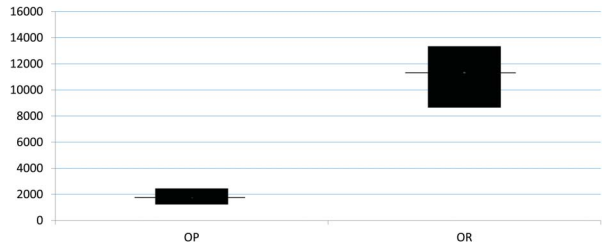

Figure 1. The Wilcoxon Signed-Rank Test (comparing 25th–75th percentiles) indicated that the ranked outpatient costs for treating skin cancer were statistically significantly different than the ranked operating room costs ($p < 0.001$). The median costs differed by $9,578. OR, operating room; OP, outpatient.

Results

A total of 18 matched pairs were included in the study (Table 1). Seventeen of the matched pairs had enough information for the 3 blinded anesthesiologists to determine ASA scores. The outpatient cases had a mean age of 58.32 years and mean ASA score of 1.924. The operating room cases had a mean age of 58.21 years and mean ASA score of 2.018. No statistically significant differences were found in the age ($p > 0.9$) or ASA scores ($p > 0.6$). The median cost for outpatient cases was $1,773. For operating room cases, the median cost was $11,589. This was a statistically significant difference ($p < 0.001$).

Discussion

Skin cancer incidence, treatments, and costs are all on the rise.[1] Rising health care costs continue to be a significant economic burden to the United States. Effective treatments such as MMS are under scrutiny given their relative expense and increased use.[4] This study will provide a case-matched comparison for the cost of care for skin cancer treatment in the office setting versus the operating room. Previous studies have looked into the cost of treating skin cancer in the office setting versus an ambulatory surgical center and the operating room.[3,5–10] However, this has never been done as a retrospective, case-matched analysis including melanoma and nonmelanoma skin cancer.

Cook and colleagues published the first study to compare the cost-effectiveness of MMS with office excision with permanent sections, office excision with frozen sections, and ambulatory surgical center excision with frozen section. After factoring in likely recurrence rates, MMS for tumors on the head and

TABLE 1. Matched Cases

Case	Age	Sex	Tumor	Location	Defect Size	ASA	Procedure	Charges
OR 1	61	F	BCC	Left forearm	8 × 8 cm	4, 3, 4	WLE	$12,846.50
OP 1	58	F	BCC	Left shoulder	9 × 5.3 cm	3, 3, 3	MMS	$3,267
OR 2	67	M	BCC	Left arm	4.5 cm	2, 2, 2	WLE	$11,057
OP 2	67	M	BCC	Left arm	5.3 × 2.5 cm	1, 1, 1	MMS	$1,855
OR 3	42	F	BCC	Right cheek	0.9 cm	2, 2, 3	WLE	$330,187
OP 3	49	F	BCC	Right upper cheek	0.6 × 0.8 cm	1, 2, 1	MMS	$2,001
OR 4	57	F	SCC	Left foot dorsum	3 × 3 cm	3, 2, 3	WLE	$13,287
OP 4	58	F	SCC	Left shin	3.9 × 3.6 cm	2, 3, 2	MMS	$2,144
OR 5	65	F	MIS	Left leg	2 cm	1, 2, 1	WLE	$11,842
OP 5	66	F	MIS	Right anterior lower leg	2.5 × 2.4 cm	1, 1, 1	WLE	$571
OR 6	26	F	MIS	Left breast	3.5 cm	1, 1, 1	WLE	$13,660
OP 6	24	F	MIS	Left anterior shoulder	2 × 1.6 cm	1, 1, 1	WLE	$1,210
OR 7	45	F	MIS	Right lower leg	2.8 cm	2, 2, 2	WLE	$9,198
OP 7	45	F	MIS	Left achilles/calf	3.5 × 2.8 cm	1, 1, 1	WLE	$571
OR 8	58	M	MIS	Right cheek	5 × 3.2 cm	IND	WLE	$8,769
OP 8	68	M	MIS	Right mid cheek	3.5 × 4 cm	2, 2, 2	MMS	$4,671
OR 9	48	F	MIS	Left chest	3 × 5 cm	1, 1, 1	WLE	$8,615
OP 9	55	M	MIS	Left upper chest	6 × 4 cm	1, 1, 1	WLE	$2,609
OR 10	79	M	Melanoma	Left temple	3 × 3 cm	2, 2, 2	WLE	$14,425
OP 10	92	F	Melanoma	Right upper forehead	4.5 × 4.5 cm	2, 2, 2	MMS	$2,378
OR 11	63	M	Melanoma	Right shoulder	3.2 cm	1, 2, 1	WLE	$6,757
OP 11	54	M	Melanoma	Left anterior shoulder	3.5 × 3.2 cm	2, 2, 2	WLE	$1,260
OR 12	59	M	Melanoma	Right shoulder	2.8 cm	IND	WLE	$8,038
OP 12	56	M	Melanoma	Left posterior shoulder	3 × 3 cm	2, 2, 3	WLE	$1,405
OR 13	89	M	Melanoma	Right upper chest	3 × 5 cm	4, 3, 4	WLE	$8,656
OP 13	71	M	Melanoma	Mid chest	4.5 × 4.4 cm	3, 2, 3	WLE	$1,233
OR 14	39	F	Melanoma	Upper back	2.3 cm	1, 2, 1	WLE	$11,589
OP 14	43	F	Melanoma	Upper back	2.7 × 2.7 cm	3, 3, 3	WLE	$836
OR 15	69	F	Melanoma	Right upper arm	2.5 × 2.5 cm	1, 1, 2	WLE	$11,923
OP 15	68	F	Melanoma	Left upper extremity	4.9 × 4 cm	2, 2, 2	MMS	$2,398
OR 16	26	F	Melanoma	Left upper back	3 cm	1, 2, 2	WLE	$13,523
OP 16	27	F	Melanoma	Right mid back	3 × 2.6 cm	3, 3, 2	WLE	$1,308
OR 17	58	F	Melanoma	Right upper back	3 × 5 cm	2, 2, 2	WLE	$8,266
OP 17	78	M	Melanoma	Right back	3.5 × 5.2 cm	2, 3, 3	MMS	$1,773
OR 18	76	F	Melanoma	Right mandibular	3.35 cm	2, 2, 2	WLE + SLNB	$23,090
OP 18	66	F	Melanoma	Left jawline	3 × 2.5 cm	1, 1, 1	MMS	$3,285
OR 19	79	F	Melanoma	Right abdomen	5 cm	3, 3, 3	WLE	$10,685
OP 19	65	M	Melanoma	Left mid abdomen	3.7 × 4.5 cm	2, 2, 2	WLE	$1,717

OR 3 was excluded from cost analysis given the excessively high charge.

OR 18 was included despite SLNB as melanoma depth was 0.53 mm.

ASA, American Society of Anesthesiologists; BCC, basal cell carcinoma; IND, indeterminate; MIS, melanoma in situ; MMS, Mohs micrographic surgery; OP, outpatient; OR, operating room; SCC, squamous cell carcinoma; SLNB, sentinel lymph node biopsy; WLE, wide local excision.

neck was 27% less expensive than ambulatory surgery center excision with frozen sections.[3,5]

Bialy and colleagues compared cost MMS by a dermatologic surgeon and surgical excision by an ear, nose, and throat surgeon. The costs were similar in the 2 groups unless frozen sections were used with surgical excision. When compared with surgical excision with frozen section, MMS was $443 less costly. Much of this difference was incurred from the ambulatory surgery center fee.[3,6]

Similar studies have been done in the Netherlands by Essers and colleagues When comparing MMS versus surgical excision for BCC of the face, they were able to calculate an incremental cost-effectiveness rate. This helped determine that the cost of avoiding a recurrence for primary BCC was $32,843 and for recurrent BCC $9,094. Overall, the study did not show that MMS was more cost-effective than surgical excision likely due to similar recurrence rates in the 2 groups and short follow-up period.[3,7]

Rogers and colleagues used relative value units to compare multiple treatment modalities. They found that MMS was more expensive at $1,263 average estimated cost compared with surgical excision at $1,006. However, it was determined to be cost-effective given its low recurrence rate of 1% compared with 10% for surgical excision. MMS was much less expensive than surgical excision with frozen section in an ambulatory surgical center ($2,334) or hospital operating Room ($3,085).[8]

Using a computer simulation of 98 consecutive patients, Seidler and colleagues factored in 5-year recurrence rates to determine quality-adjusted life years (QALYs). MMS was not only less costly than surgical excision by $292 but also more effective by a QALY of 0.056 (3 weeks of optimal quality of life).[9]

As a 10-year follow-up study by Cook and colleagues, Ravistskiy and colleagues compared actual cost of MMS versus calculated cost of surgical excision with permanent or frozen section in the office of an ambulatory surgical center. MMS was the least expensive surgical procedure at $805 per tumor. When factoring in initial exam, biopsy, follow-up, and inflation, MMS was actually less expensive in 2009 than in 1998.[10]

Rogers and colleagues also published skin cancer cost data from the Medicare population from 1996 to 2008. Skin cancer treatments increased by 53%, whereas MMS procedures increased by 248%. The authors felt that this seemingly dramatic increase was a natural transition to a more effective treatment option that was becoming more widely accepted. Skin cancer treatments average $294 per case, making the overall cost expensive from the number of cases being treated, not the individual treatment cost.[4]

Kauvar and colleagues recently reviewed these studies. The average cost of office-based surgery was $895.50, whereas the average cost in the operating room was $4,188.17.[11] The authors' study shows even more dramatic results with a median cost difference of $9,578.

This study is not without limitations. It is small, single center, and retrospective. Being set in one geographic location limits its generalizability, as operating room costs can vary depending on states and even hospitals. Surgeon preferences also often differ which affects cost. Most of the 18 pairs were melanomas and the genders of the cases were not perfectly matched. A larger, multicenter study with a greater variety of skin cancer types would not only have greater power but would allow one to generalize the findings more broadly. Despite these limitations, there are many strengths including statistically significantly matched age and health status of the cases. To the authors' knowledge, it is the first case-matched cost analysis of the treatment of skin cancer.

Conclusion

The outpatient setting is a cost-effective location to treat skin cancer compared with the operating room. This study provides real case data that support the high value of treating skin cancer in the office. Additional studies in other settings would be of value to generalize the authors' findings.

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