Mohs Micrographic Surgery: 10 year Experience in Puerto Rico

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Objective: The incidence of nonmelanoma skin cancer (NMSC) is increasing rapidly worldwide. As NMSC incidence increases, the modalities to treat this condition have become diverse. However, Mohs surgery remains the standard treatment for skin cancer in several particular locations such as the face. The objective of this study is to compare the changes, occurring over a 10-year period, in the characteristics of those cancers that were treated with Mohs micrographic surgery (MMS) at the dermatology clinics of the University of Puerto Rico as well as the modifications in the repair patterns used to close the surgical defects.

Methods: A retrospective chart review of patients treated with MMS at the dermatology of the University of Puerto Rico in the years 2000 and 2010. Variables analyzed include patient demographics, the anatomic site of each patient's lesion, pathology, the preoperative tumor size, the postoperative defect size, and the repair method.

Results: Thirty-eight (38) patients in the year 2000 and 55 patients in the year 2010 were treated with MMS, signifying a 44% increase in this kind of treatment over a 10-year period. The 2000 cohort was found to be slightly older (P = 0.22), with no gender predominance (P = 0.44). In both years, the majority of tumors were located on the head and neck region, being the nose the most frequent site of involvement (P = 0.06). Basal cell carcinoma (BCC) was the most common neoplasm (P = 0.65). No statistical difference was found in preoperative tumor sizes (P = 0.27). More stages were required to remove a given tumor completely in the year 2000 (P = 0.025). Postoperative defects were smaller in 2000 (P = 0.027) than they were in 2010. Flap repair was used more often in 2010 (P = 0.001) than in 2000.

Conclusion: This study shows a trend toward larger defects in a slightly younger population of patients in the 2010 cohort compared to the 2000 cohort. It also demonstrates a reduction in the number of stages required to excise the tumors, and a tendency to reconstruct the surgical defects with flaps. However, the tumor types, preoperative tumor sizes, and anatomic sites of the lesions were all similar in the 2 cohorts. [*P R Health Sci J 2014;33:22-26*]

Key words: Mohs micrographic surgery, Skin cancer, Basal cell carcinoma

Skin cancer is the most common cancer in the United States and Puerto Rico (PR). One in 6 Americans will develop skin cancer during his or her lifetime (1). The incidence of nonmelanoma skin cancer (NMSC) is increasing rapidly, with an estimated incidence of over 600,000 cases per year in the United States (2). The average annual increase of NMSC in white populations in Europe, the United States, Canada, and Australia has been 3% to 8% per year since 1960 (3). NMSC development is mainly attributed to chronic sun exposure, affecting most frequently those areas of the body exposed to sunlight such as the head, neck, and back of the hands. Furthermore, the incidence of NMSC in white populations increases proportionally with proximity to the equator, with the incidence of SCC doubling for each 8 to 10 degrees of decline in latitude (4). In 2010, De la Torre et al. reported that there was a 305% increase in the incidence of NMSC (41.5/100,000 vs. 167.5/100,000 inhabitants) in 1974 compared to 2005,in the Puerto Rican population (5).

As NMSC incidence increases, the modalities to treat this condition have become diverse (6). Excisional surgery is the most frequent approach; other methods such as electrodessication and curettage, cryosurgery, and topical chemotherapeutics can be used to treat superficial tumors. Although Mohs surgery has been frequently reserved for large, recurrent, or histologically aggressive lesions in high-risk anatomical locations (7), it remains the "gold-standard" treatment for the removal of NMSC on the head and neck. Mohs

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micrographic surgery (MMS) is a technique in which serial horizontal sections of tumor are removed, mapped, processed by frozen section, and analyzed microscopically. During this process, peripheral and deep margins are examined, and the excision of the residual tumor region is performed until the area is tumor free (6). MMS provides adequate control of peripheral and deep margins without sacrificing inappropriate amounts of normal tissue, while at the same time providing a high cure rate of 99% (8) and maximum tissue conservation (9-11).

This article reports our 10-year experience with MMS in Puerto Rico. We compare those patients treated with MMS at the dermatology clinics of the University of Puerto Rico School of Medicine in the year 2000 with those treated in 2010. We evaluate and discuss the changes over time in the characteristics of skin cancer identified and treated with Mohs micrographic surgery (MMS) at our clinics as well as the variations in surgical defects and in repair methods.

Materials and Methods

The University of Puerto Rico Medical Sciences Campus Human Resources Protection Office approved this retrospective study. The medical records of all of the patients treated with MMS at the dermatology clinics of the University of Puerto Rico in the years 2000 and 2010 (Current Procedural Terminology codes 17311, 17312, and 17313) were evaluated. The variables examined include patient demographics (age and sex), the type of skin cancer, the anatomic site of each patient's tumor, the preoperative tumor size, the postoperative defect size, and the repair method used to close the defect after Mohs surgery.

Data were analyzed using SPSS version 17.0 (SPSS Inc., Chicago, Illinois). The t test, the x2 test, and contingency analysis were performed; p values less than 0.05 were considered significant.

Results

A total of 38 and 55 patients in 2000 and 2010, respectively, were treated with MMS at the University of Puerto Rico dermatology clinics, with the 2010 total representing a 44% increase in the number of procedures performed. The 2000 cohort was found to be older than the 2010 cohort (72±13 vs. 69±12; P = 0.22), although this was not statistically significant. No statistically significant difference was observed in sex distribution (19 [50%] males in 2000 and 32 [58%] males in 2010; P = 0.44).

Nearly all the neoplasms identified in our patients were located on the head and neck region (94.73% in 2000 and 90.90% in 2010), most commonly on the nose (52.63% in 2000 and 41.82% in 2010). There was no statistical difference in the anatomic sites of the tumors between the 2 cohorts (P = 0.06) (Table 1).

Table 1. Preoperative evaluation of skin tumor sites of MMS patients in the years 2000 and 2010.

Skin site	2000 (N) %	2010 (N) %	P = 0.06
Nose	(20) 52.63	(23) 41.82	
Eyelid	(1) 2.63	(12) 21.82	
Cheek	(5) 13.16	(6) 10.91	
Body	(2) 5.26	(5) 9.09	
Forehead	(0) 0.00	(4) 7.27	
Ear	(3) 7.89	(3) 5.45	
Temple	(3) 7.89	(1) 1.82	
Lip	(1) 2.63	(1) 1.82	
Scalp	(2) 5.26	(0) 0.00	
Chin	(1) 2.63	(0) 0.00	

P value of the difference between means Pearson's X^2 test

Basal cell carcinoma was the most common skin cancer treated with MMS (83.33% in 2000 and 67.27% in 2010), with SCC (11.11% in 2000 and 18.18% in 2010) and other skin tumors (2.78% in 2000 and 3.64% in 2010) being less frequent. There was no statistically significant difference in tumor type between the 2 cohorts (P = 0.65) (Table 2).

Table 2. Preoperative histopathological diagnosis of skin tumor types of MMS patients in the years 2000 and 2010

Diagnosis	2000 (N) %	2010 (N) %	P = 0.65
BCC	(30) 83.33	(37) 67.27	
SCC	(4) 11.11	(10) 18.18	
Persistent (both)	(3) 8.33	(6) 10.91	
Other tumors	(1) 2.78	(2) 3.64	

P value of the difference between means Pearson's X2 test; BCC = Basal cell carcinoma; SCC = Squamous cell carcinoma

There was no significant difference in preoperative tumor sizes between the 2 years (P = 0.27). The postoperative defects were significantly smaller in 2000 (mean defect size of 3.45 cm in the year 2000 versus 5.80 cm in the year 2010; P = 0.027) (Table 3). In 2000 most tumors were cleared in 2 stages (52.63%), in contrast to 2010 in which only 1 stage (67.27%) was required to clear the majority of the tumor (P = 0.001).

Table 3. Preoperative tumor sizes and postoperative defect sizes of patients treated with Mohs micrographic surgery in 2000 and 2010.

	2000	2010	
Tumor size, cm (mean±std dev)	2.31±3.20	1.67±1.76	P = 0.27
Defect size, cm (mean±std dev)	3.45±3.78	5.80±6.20	P = 0.027

P value of the difference between means Pearson's X2 test

Regarding repair methods of closure, an increase was observed in the use of surgical flaps (18.42% vs. 21.82%). A decrease was observed both in closures by secondary intention (2.63% vs. 0%) and in side-to-side closures (55.26% vs. 36.36%) (P = 0.025) (Table 4).

Table 4. Number of surgical stages required for tumor clearance and repair methods for closure in 2000 and 2010.

	2000 (N) %	2010 (N) %	
Stages			**P = 0.025***
1	(14) 36.84	(37) 67.27	
2	(20) 52.63	(17) 30.91	
3	(3) 7.89	(1) 1.82	
Repair			**P = 0.001***
Flap	(7) 18.42	(12) 21.82	
Graft	(8) 21.05	(11) 20.00	
2nd-intention	(1) 2.63	(0) 0.00	
Side-to-side (linear) closure	(21) 55.26	(20) 36.36	
Repair by other specialties	(1) 2.63	(12) 21.82	

P value of the difference between means Pearson's X^2 test

Discussion

Surgical and non-surgical treatments such as curettage and electrodessication, surgical excision, cryotherapy, radiation therapy, photodynamic therapy, topical 5-fluorouracil, and topical imiquimod have been proven to be successful in the treatment of NMSC, especially for BCC (12-14). The treatment of choice is usually decided upon taking into account multiple variables, such as patient-based factors (age, sex, general health), tumor characteristics (size, location, histologic subtype), the treating physician's preferences, and available resources (12, 15). MMS is indicated for the treatment of NMSC, especially that which occurs in the facial area, where tissue preservation and complete tumor removal is essential to restore function and achieve acceptable aesthetic results. It is also helpful in tumors with clinically indistinct margins and neoplasms with the following histological subtypes: morpheaform, infiltrative, and micronodular (13). It is also a very sensitive technique for identifying perineural involvement of the tumor. Mohs micrographic surgery provides the combination of a high cure rate and tissue conservation, accounting for its increasing popularity. It has shown a cure rate of 99% for primary BCCs, 94.4% for recurrent BCCs(16), and 97% for primary SCCs (8).

In this study, a 44% increase in the number of MMS procedures performed between the year 2000 and 2010 was identified. Although the incidence of NMSC increases with age, the 2010 cohort was found to be slightly younger than the 2000 cohort (72±13 years vs. 69±12 years; P = 0.22); yet this age difference was not statistically significant (3). The fact that the 2010 cohort was larger could be explained by the fact that MMS is a new service not previously available to our patient population. At the beginning of this clinic, patients came from our general dermatology clinics, but as time passed, specialists, such as oculoplastic, ophthalmologic, and ear, nose, and throat (ENT) surgeons, started referring their patients.

In 2005, a total of 6,568 new skin cancer cases were reported in Puerto Rico, which number represented a 305% increase in incidence compared with the incidence report rates for 1974 (5). The rising incidence rate of nonmelanoma skin cancer is probably multifactorial, secondary to increased sun exposure, increased outdoor activities, increased longevity, and ozone depletion (1). Over 80% of NMSCs occur on areas of the body that are frequently exposed to sunlight, such as the head, neck, and back of the hands. In a large retrospective series of 13,457 patients with BCC at a dermatopathology referral center in France, 85% of the tumors were located on the head and neck (19). Analysis of the anatomic distribution in our series showed that there was a predominance of tumors in such sun-exposed areas as head and neck region, (94.73% in 2000 and 90.90% in 2010), being the nose the most common site of involvement (52.63% in 2000 and 41.82% in 2010). However, there was no statistically significant difference in the anatomic sites of the tumors between the 2 cohorts (P = 0.06) (Table 1).

Our results compare to those reported by Diepgen (3) in the Australian population, but with an increased number of eyelid lesions (nose: 41.82% in PR vs. 41.36% in Australia; eyelid: 21.82% in PR vs. 12.61 % in Australia; cheeks: 10.91% in PR vs. 9.27% in Australia). There has been a dramatic 19% increase of MMS for eyelid tumors, with the lower eyelid and the inner canthus being the most common locations of BCC (53% and 29%, respectively) (20, 21). Because of their complexity, periorbital tumors often require a team approach that utilizes both a Mohs and an oculoplastic surgeon. In fact, most NMSCs on the eyelids are treated through this multidisciplinary approach. Given the risk of invasion to the orbit, nasopharynx, and cranium, it is imperative to ensure complete margin control and tumor clearance with MMS.

BCC is the most common malignancy among white persons in the United States and Australia (13,22-24); the standardized ratio of BCC to SCC is roughly 4: 1 (2). When the rates of BCC, SCC, and melanoma were compared between Hispanic and non-Hispanic whites in New Mexico, the rates in non-Hispanic whites were 5 to 10 times higher than those in darker skinned Hispanic whites (25). Although BCC was the most common skin cancer treated with MMS in our study (83.33% in 2000 and 67.27% in 2010), with SCC (11.11% in 2000 and 18.18% in 2010) and other skin tumors (2.78% in 2000 and 3.64% in 2010) being less frequent, there was no statistically significant difference in tumor types between the 2000 and 2010 cohort (P = 0.65) (Table 2). Furthermore, although male predominance in the development of basal cell carcinoma has been reported

in other studies (19, 27, 28), no statistically significant gender predominance was observed in our cohorts (50% male in 2000 and 58% male in 2010; P = 0.44), which is most likely due to the small size of our cohort, which is itself most likely not representative of the entire population.

The preoperative tumor sizes were not significantly different between the 2 years (P = 0.27). However, the postoperative defects were significantly smaller in 2000 (mean defect size of 3.45 cm in the year 2000 versus 5.80 cm in the year 2010, P = 0.027) (Table 3).

Regarding the number of stages needed to excise the tumor (Table 4), 2 stages were more commonly required in the year 2000 (52.63%) while 1 stage was more commonly required in the year 2010 (67.27%) (P = 0.025). The reduction in the number of stages from 2000 to 2010 may be attributed to the earlier referral of primary tumors. On the other hand, the increase in postoperative defect size for patients in 2010 is most likely due to complicated cases that were referred by other surgical specialties and that required a multidisciplinary approach. Similarly, as the postoperative defect increases, more advanced repair techniques are required to close the defect, as evidenced by the increase in surgical flaps for the 2010 cohort.

There are some limitations to this study. First, as a single-center experience, it may not accurately reflect practice trends in private settings or on a national level. Furthermore, all the interventions reported in this study were performed by a single Mohs surgeon. Since all study participants were drawn from a single academic dermatology practice, our study may have been statistically underpowered for the purpose of detecting a true effect or subtle variations in some of the variables explored. We believe that a multicenter prospective study would be able to better determine the changing patterns in MMS referrals, the characteristics of skin tumors, and surgical preoperative and postoperative parameters. A prospective study would allow for more accurate preoperative and postoperative measurements of initial lesions and surgical defects. Furthermore, an evaluation of referral criteria by community physicians would allow for a better understanding of recorded referral patterns within the last years.

In conclusion, this is the first study of NMSC managed by MMS in our academic center in Puerto Rico. It compares the changes, occurring over a 10-year period, in the characteristics of those cancers that were treated with MMS, as well as the modifications in the repair patterns used to close the surgical defects. It is characterized by its high percentage of head and neck cases, predominantly identified as primary BCCs, which not only correlates with the findings of other studies but also with our population's UV exposure. The increase in MMS cases can be attributed not only to the cost-effectiveness of the surgical procedure but also to an increased acceptance between referring physicians because of its high cure rate, aesthetics, and tissue-sparing properties.

Resumen

Objetivo: La incidencia de cáncer de piel no melanocítico (CPNM) está aumentando rápidamente. A medida que este aumenta, las modalidades para su tratamiento se han ido diversificando. Sin embargo, la cirugía de Mohs se ha mantenido como el tratamiento de elección para lesiones particulares, localizadas en áreas de difícil manejo, como la cara. El objetivo de este manuscrito es comparar los cambios, a través de un periodo de 10 años, en las características de los cánceres de piel tratados con cirugía micrográfica de Mohs (CMM) en las Clínicas de Dermatología de la Universidad de Puerto Rico, así como las modificaciones en las reparaciones de defectos quirúrgicos. Métodos: Un estudio retrospectivo en pacientes tratados con CMM en las Clínicas de Dermatología de la Universidad de Puerto Rico en los años 2000 y 2010. Las variables analizadas incluyen factores demográficos, lugar anatómico de la lesión, patología, tamaño tumoral preoperatorio, tamaño del defecto postoperatorio, y el método de reparación. Resultados: Treintaiocho (38) pacientes (2000) y 55 pacientes (2010) fueron tratados con CMM, mostrando un incremento de 44% en el número de procedimientos. El cohorte del año 2000 era de mayor edad (P = 0.22), sin predominio de género (P = 0.44). Casi todos los tumores en ambos periodos estaban localizados en la cabeza y el cuello, en especial en la nariz (P = 0.06). El carcinoma basocelular (CBC) fue el neoplasma más predominante (P = 0. 65). No se encontró diferencia estadísticamente significativa entre los tamaños tumorales (P = 0.27). Los estadíos operatorios durante el año 2000 fueron mayores (P = 0.025). Los defectos post-operatorios fueron de menor tamaño en el año 2000 (P = 0.027). Igualmente se observó un aumento en la reparación mediante colgajos en el año 2010 (P = 0.001). Conclusión: Este estudio muestra una tendencia a defectos más grandes, en una población de pacientes ligeramente más joven en la cohorte de 2010 en comparación con la cohorte de 2000. También demuestra una reducción en el número de etapas requeridas para remover los tumores, y una tendencia a reconstruir los defectos quirúrgicos mediante colgajos. Por otro lado, no hubo variación en el tipo y tamaño de tumor y la localización anatómica de las lesiones.

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