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Original Article

Five years, layer by layer: Mohs micrographic surgery insight from Indonesia Cancer Center, Dharmais Cancer Hospital

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Abstract

Background: Mohs micrographic surgery (MMS) is the gold standard for treating high-risk non-melanoma skin cancer (NMSC). However, epidemiological data on MMS in Indonesia remain limited. This study aims to evaluate MMS use, tumor characteristics, and surgical outcomes at a single center in Indonesia.
Methods: A retrospective review of 83 MMS cases at Dharmais Cancer Hospital (2020–2024) was conducted. Data on demographics, tumor characteristics, and surgical outcomes were analyzed. Tumor locations were classified into high-risk (H area), moderate-risk (M area), and low-risk (L area) anatomical zones.
Results: Most tumors were located in the H area (57.8%). Basal cell carcinoma (BCC) was the most common diagnosis (79.5%), with infiltrative BCC as the predominant subtype (41.0%). A surgical margin of ≥3 mm was significantly associated with achieving tumor clearance in a single stage (p = 0.018). Multiple-stage MMS was required in 15.0% of cases. Defect closure was primarily performed using grafts or flaps (69.9%), with dermatologists performing most reconstructions (83.1%).
Conclusion: MMS is effective for treating high-risk NMSC in Indonesia, with findings comparable to global data. The study highlights the importance of appropriate surgical margins and the need for further research, particularly in Asian countries. Establishing a national skin cancer registry would enhance future epidemiological studies.

Keywords: *Basal cell carcinoma, H area, Indonesia, Mohs micrographic surgery, surgical margin.*

Abstrak

Latar Belakang: *Mohs micrographic surgery* (MMS) merupakan baku emas dalam penatalaksanaan kanker kulit non-melanoma (NMSC) berisiko tinggi. Namun, data epidemiologi mengenai pelaksanaan MMS di Indonesia masih terbatas. Penelitian ini bertujuan untuk mengevaluasi penerapan MMS, karakteristik tumor, serta hasil pembedahan di satu pusat layanan kanker di Indonesia.
Metode: Tinjauan retrospektif dilakukan terhadap 83 kasus MMS di Rumah Sakit Kanker Dharmais selama periode 2020–2024. Data demografi pasien, karakteristik tumor, dan hasil pembedahan dianalisis. Lokasi tumor dikategorikan berdasarkan zona anatomi berisiko tinggi (area H), berisiko sedang (area M), dan berisiko rendah (area L).
Hasil: Sebagian besar tumor ditemukan pada area H (57,8%). *Basal cell carcinoma* (BCC) merupakan diagnosis tersering (79,5%), dengan subtipe infiltratif sebagai bentuk paling dominan (41,0%). Tepi bedah ≥3 mm secara signifikan berhubungan dengan keberhasilan pembersihan tumor dalam satu tahap (p = 0,018). Prosedur MMS dengan lebih dari satu tahap dibutuhkan pada 15,0% kasus. Defek pasca-bedah paling sering ditutup menggunakan cangkok atau flap (69,9%), dan sebagian besar rekonstruksi dilakukan oleh dokter spesialis kulit (83,1%).
Kesimpulan: MMS terbukti efektif untuk menangani NMSC berisiko tinggi di Indonesia, dengan hasil yang sebanding dengan data internasional. Penelitian ini menekankan pentingnya penentuan tepi bedah yang adekuat serta perlunya penelitian lanjutan, khususnya di negara-negara Asia. Pembentukan registri nasional kanker kulit akan sangat mendukung pengembangan penelitian epidemiologi di masa mendatang.

Kata Kunci: *Area H, Indonesia, karsinoma sel basal, Mohs micrographic surgery, tepi bedah.*

Background

Mohs micrographic surgery (MMS) is a specialized technique offering the highest cure rates for many types of skin cancer. MMS involves precise, visible tumor resection while minimizing the removal of healthy tissue.[1] Excision is followed by a complete histopathological analysis of the peripheral and deep surgical margins under microscope by the systematic use of frozen sections to ensure eradication of the neoplasm by mapping the tumor extension and margin clearance.[2,3] Following tumor clearance, the defect areas are repaired by primary closure or reconstruction.[4,1] Approximately 75% of skin cancer are basal cell carcinoma (BCC), whereas cutaneous squamous cell carcinoma (SCC) represent approximately 20%, and the remaining are melanomas (4%) and other rare tumors.[1] According to Global Cancer Observatory (GLOBOCAN) in 2022, it is estimated 1,234,533 cases of Non-melanoma skin cancers (NMSC) occur worldwide.[5] NMSC can cause significant morbidity from local compression and invasion.[6,7] MMS is preferred for high-risk tumors, particularly in cosmetically sensitive areas such as the H area, which includes the face, eyelids, periorbital region, nose, lips, and ears, and is the most common site of recurrence.[8] Study in Brazil on the use of MMS for BCC has shown 87.1% of BCC case were located in the H area.[9] According to guideline from National Comprehensive Cancer Network (NCCN), BCC is considered high risk for recurrence if any of major risk is present.[10] It is considered high risk when BCC is in the H area, larger than 2 cm, a recurrent rumor, has ill-defined borders, perineural invasion, or has aggressive histological subtype.[11] For high-risk lesions exceeding 2 cm, a 4–6 mm margin is advised to ensure complete tumor removal. However, research indicates that a 4 mm margin is often unfeasible on the face due to cosmetic and functional limitations. Some studies suggest that a 2 mm margin may be sufficient for small, well-defined BCCs in the head and neck, though a 3 mm margin is often recommended for more reliable results.[12] According to data from the national Spanish Mohs registry, MMS offers a 5-year cure rate of 98.7% for BCC and 95.5% for SCC.[13]. A retrospective review of patients who underwent MMS for BCC in Singapore from 2019 – 2024 showed 79.7% of BCC subtype was nodular followed by infiltrative subtype by 12.5%.[14] There is a paucity of data in Asia, with use of MMS reported in less than 20% of Asian countries.[14] Epidemiological studies on the incidence and use of MMS are limited in Indonesia. Therefore, this study aims to review the epidemiological features and identify significant correlations between various parameters of MMS cases and enhancing our understanding of skin cancer treatment. The newly established registry may also serve as a valuable resource for future MMS research, particularly in Asian countries.

Methods

We conducted a retrospective review of patients who underwent MMS in a single center in Indonesia, Dharmais Cancer Hospital from January 2020 to December 2024. Data were retrospectively collected for patients' demographics, tumor characteristics, and MMS aspects. Outcomes included need for multiple-stage of MMS and referral to other specialties for closure. Tumors were classified as being located on either areas H, M, or L: The H Area such as the mask area of the face, the M Area encompasses the cheeks, the forehead, the scalp, the neck, the jawline, and pretibial surfaces. Finally, the L Area includes the rest of the body (i.e., trunk and extremities).

All statistical analyses were conducted using the Statistical Package for the Social Sciences software (SPSS) version 25. Categorical variables were explored and summarized using frequency and percentage. Chi-square test was used to test association between MMS stages and surgical characteristics and Fisher's exact test was applied to ensure result accuracy. Variables with a p value less than 0.05 on bivariate analysis were used.

Results

A total number of 83 cases were reviewed.

Table 1. The patient demographics, tumor and surgical characteristics

Variable	N = 83
Age	66.05 (±11.8)
Sex, *n* (%)	
Female	44 (53%)
Male	38 (45.8%)
Diagnosis	
Basal cell carcinoma (BCC)	66 (79.5%)
Superficial	7 (8.4%)
Nodular	8 (9.6%)
Infiltrative	34 (41.0%)
Micronodular	8 (9.6%)
Morpheaphorm	1 (1.2%)
Basosquamous	1 (1.2%)
Squamous cell carcinoma (SCC)	5 (6.0%)
Bowen's Disease	9 (10.8%)
Dermatofibrosarcoma	2 (2.4%)
Protuberans	
Lentigo Maligna	1 (1.2%)
Tumor location, *n* (%)	
L Area	16 (19.3%)
M Area	19 (22.9%)
H Area	48 (57.8%)
Tumor Risk Group	
Low-Risk Group	5 (7.6%)
High-Risk Group	61 (92.4%)
Tumor size, cm^2	
Mean (SD)	2.2 (1.9)
Minimum	0.5
Maximum	15.0
MMS Stage, *n* (%)	
I	68 (81.9%)
Multiple Stages	15 (18.1%)
II	12 (14.5%)
III	3 (3.6%)
Surgical margin, *n* (%)	
< 3 mm	33 (39.8%)
≥ 3 mm	50 (60.2%)
Intervention, *n* (%)	
Primary closure	25 (30.1%)
Reconstruction	58 (69.9%)
Defect closure specialty, *n* (%)	
Dermatologist	69 (83.1%)
Plastic surgeon	14 (16.9%)

A chi-square test was conducted to assess the association between intraoperative surgical margin size and the number of Mohs surgery stages required for tumor clearance. The results revealed a significant association between margin size and the number of stages (p = 0.018) Patients with intraoperative margins larger than 3 mm were more likely to achieve tumor clearance in a single stage of MMS (88.0%), whereas patients with margins smaller than 3 mm were more likely to require multiple stages for complete tumor removal (33.3%). Fisher's Exact Test confirmed the significance of this association (p = 0.026). Additionally, a linear-by-linear association test showed a significant linear trend (p = 0.020), indicating that smaller intra-operative margins were progressively associated with a higher likelihood of requiring additional stages (Table 2.)

Table 2. Bivariate analysis comparing surgical margin to MMS stages.

Surgical Margin	MMS		Total	*p* value
	Stage I	Multiple Stages		
< 3 mm	22 (66.7%)	11 (33.3%)	33	0.018
≥ 3 mm	44 (88.0%)	6 (12.0%)	50	

Discussion

Mohs micrographic surgery (MMS) remains the gold standard for treating non-melanoma skin cancer (NMSC). This study evaluated MMS use in a single center in Indonesia, reviewing 83 cases retrospectively. Findings revealed that females were more likely to undergo MMS (53%), which contrasts with previous literature where males are more commonly treated with MMS. The average tumor size in this study was 2.2 cm^2, aligning with findings from a Brazilian study that reported an average tumor diameter exceeding 2 cm^2. Most tumors were located H area (57.8%), followed by the M area (22.9%) and the L area (19.3%). Other studies have reported a higher percentage of tumors in the H area (87%). Regarding tumor diagnosis, basal cell carcinoma (BCC) was the most common, accounting for 66 cases (79.5%), reflecting global NMSC incidence patterns. Histopathological confir-mation identified BCC subtypes in 57 cases, with infiltrative BCC being the most prevalent (41%), followed by nodular BCC (8.4%). This differs from a retrospective study in Singapore, where nodular BCC was the most common (79.7%), with infiltrative BCC accounting for only 12.5%. NCCN guidelines on BCC recurrence risk factors, most BCC cases in this study (92.4%) were classified as high risk. Multiple MMS stages were required in 15% of cases, a slightly higher percentage than the 11% reported by Fantini et al. for BCC. The mean surgical margin used was 2.63 mm, with most cases (60.2%) utilizing a margin of ≥3 mm. Defect closure was primarily performed using grafts or flaps (69.9%), with dermatologists performing of these procedures (83.1%). A surgical margin of ≥3 mm was more likely

to achieve tumor clearance in a single-stage MMS. This finding aligns with a global guidelines review, which recommends a 3 mm margin for complete tumor excision in 85% of cases. Using this margin may also help reduce the risk of tumor recurrence, particularly in H area.

Conclusion

This study highlights the importance of MMS in treating NMSC, particularly BCC, which was the most common diagnosis. Using a safe and recommended surgical margin is crucial, as it can reduce the need for multiple MMS stages and may help lower the risk of tumor recurrence. A limitation of this study is the small sample size, which may not be representative of Indonesia's population. Additionally, the absence of a national skin cancer registry and the limited availability of MMS in Indonesia hinder nationwide comparisons with our center. Therefore, our study may serve as a foundation for future research and as a registry for MMS cases. Further studies, particularly those focusing on 5-year follow-up data on MMS recurrence risk and cure rates are needed to expand our understanding of MMS outcomes especially in Asian countries like Indonesia.

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