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ANATOMICAL PATHOLOGY

A critical review of melanoma pathology reports for patients referred to the Western Australian Melanoma Advisory Service

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Summary

Aim: To assess concordance between the histopathological reports of referring pathologists and those of pathologists reviewing the cases for the Western Australia Melanoma Advisory Service.

Methods: A retrospective review of 721 pathology reports from 2000 to 2009 was conducted. Histological features including Breslow thickness, Clark level, tumour type and clinicopathological staging [American Joint Committee on Cancer (AJCC)] were compared. Further analysis was undertaken for 169 cases to compare mitotic rate, excision margins, regression, growth phase, vascular invasion, neurotropism, tumour infiltrating lymphocytes, microsatellites and predominant cell type.

Results: Referring pathologists consistently reported Breslow thickness, Clark level and excision margins. Reporting of other parameters including ulceration, mitotic rate and vascular invasion, however, was variable. There was almost perfect concordance (kappa = 0.81–1.00) for tumour thickness, ulceration, microsatellites and growth phase; substantial concordance ($\kappa = 0.61–0.80$) for Clark level, mitotic rate, completeness of excision and neurotropism; moderate concordance ($\kappa = 0.41–0.60$) for vascular invasion, regression, predominant cell type and histological type; and only slight concordance ($\kappa = 0–0.2$) for tumour infiltrating lymphocytes. There was a high level of agreement for diagnosis of lesions as melanoma versus benign (97.3%). Overall concordance for pathological tumour staging was substantial (81.9%, $\kappa = 0.79$). Lowest concordance was found for stage 1b (91.3%, $\kappa = 0.62$).

Conclusion: Overall concordance in clinicopathological stage was high due to consistency of reporting of tumour thickness and ulceration. Lower concordance was found for pathological substages due to discrepancies in Clark level, highlighting its limited reliability as a prognostic indicator and supporting the revision of its use in the latest AJCC melanoma staging protocol.

Key words: Interobserver agreement, kappa statistics, melanoma, Western Australia.

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INTRODUCTION

Cutaneous melanoma is the leading cause of skin cancer related deaths in Australia with 10 342 new cases and 1279 deaths in 2007.[1] Although rates are increasing nationally, in Western Australia (WA), recent figures show that there has been a significant decrease in the incidence of melanoma in males by 1.36% per year and a non-significant decrease of similar size in females (659 male cases, 423 female cases in 2008). Case numbers are expected to increase to 760 in men, despite the incidence rate falling from 42 to 41 per 100 000 per year. For females, rates are predicted to increase to 493 per year with no expected change in incidence rate by 2013.[2]

Microstaging of patients based on histopathological review plays a pivotal role in patient treatment and assessment of prognosis. As such, the importance of accurate diagnosis and histopathological reporting cannot be over-emphasised.

Current clinical practice guidelines for the management of melanoma in Australia and New Zealand highlight tumour thickness, ulceration, margins of excision, mitotic rate (per mm^2), and Clark level as essential components of a histopathological report and strong predictors of outcome.[3] Beyond these essential components, other histological features which may have prognostic value of lesser degree, or may be of use in studies of epidemiology or pathogenesis, include vascular invasion, microsatellites, lymphocytic infiltrate, regression, desmoplasia, neurotropism, associated benign melanocytic lesion, solar elastosis, predominant cell type, histological growth pattern and growth phase.[3]

Despite these guidelines, the histopathological reporting of melanoma in Australia is not standardised, with significant differences in report styles and in the histopathological features recorded. Levels of training and expertise amongst pathologists in the diagnosis of melanoma are also variable. Subjectivity in the analysis of lesions could lead to significant intra-observer and inter-observer variability.

There have been a number of studies comparing the consistency of reporting important histopathological variables. In general, tumour thickness and the presence of ulceration have been consistent[4–7] whilst agreement on other histopathological features has been poor.[4–10] Most of these studies have compared reporting between pathologists of similar background. Several authors have recommended referral to expert dermatopathologists for diagnostically difficult lesions.[4,9,11] This study compares reports between a wide range of pathologists who originally diagnosed the lesions and pathologists who reviewed the slides for patients referred to the Western Australian Melanoma Advisory Service (WAMAS).

MATERIALS AND METHODS

WAMAS is a multidisciplinary service that provides advice on the management of patients with melanoma. It consists of a collaborative team of experts

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including four pathologists with a special interest in melanocytic lesions. Three of four WAMAS pathologists are full time dermatopathologists with a range of 3 to more than 20 years of full time dermatopathology experience. All slides and reports relating to patients referred to the service are reviewed by the WAMAS pathologists. In addition, where there is controversy or difficulty with diagnosis, those cases are reviewed by multiple WAMAS pathologists.

Referrals to WAMAS are clinician-based, with general practitioners contributing approximately 75% of all referrals. Referrals are mainly for more complex melanomas, e.g., melanoma with deep invasion (Breslow thickness >1.0 mm), metastases, or difficulty with diagnosis. In addition, there is an over-representation of referred cases with melanoma metastases of unknown primary. WAMAS reviews approximately 8% of new melanoma cases in WA.

Initial pathology reporting is performed by a broad range of pathologists, the majority being general anatomical pathologists and a smaller proportion of dermatopathologists. These pathologists are employed in both public and private laboratories providing a wide spectrum of the reporting from WA.

This study is a retrospective review of pathology reports on cases referred to WAMAS from 2000–2009, inclusive. For each case, comparison was made between the initial histopathology reports and subsequent WAMAS reviews to determine the concordance for each histological feature examined. Data for each case were retrieved from the electronic WAMAS database and included the following histopathological features from both WAMAS and non-WAMAS reports: anatomical site, mode of biopsy, melanoma type, Clark level and tumour thickness.

Further information from cases presenting in 2007 and 2008 was collected directly from patient files. This included mitotic rate (number of mitoses per mm^2), ulceration (present or absent), completeness of excision (complete or incomplete), tumour infiltrating lymphocytes (present or absent), predominant cell type (epithelioid, spindle, naevoid or mixed), microsatellites (present or absent), growth phase (radial or vertical), vascular invasion (present or absent), regression (present or absent) and neurotropism (present or absent).

For Breslow thickness (BT), cases were categorised according to the American Joint Committee on Cancer (AJCC) TNM staging classification as follows: T1 (BT ≤1 mm); T2 (BT >1 mm to ≤2 mm); T3 (BT >2 mm to ≤4 mm); T4 (BT >4 mm).

Clark level of invasion was analysed for thin melanomas, i.e., BT ≤1 mm.

For mitotic rate (MR), cases were included in which MR had been reported by the initial pathologist as the number of mitoses per mm^2. Results were categorised by MR as follows: 0, 1–5, 6–10, 11–20 and >20/mm^2. Where cases were reported using other methods, they were excluded from analysis.

TNM staging

Tumour thickness from WAMAS and non-WAMAS pathology reports and clinical data were used to classify patients into pathological and clinical AJCC TNM stages. The WAMAS electronic database only includes ulceration data from WAMAS reports, so this was not available for the reports from the original pathologists. Therefore, stage grouping used the ulceration status derived from the WAMAS analysis.

Statistical analysis

Histopathological features were directly compared between WAMAS and non-WAMAS groups to obtain the percentage of agreement. Cohen's kappa coefficient[12] was used to account for the possibility of chance agreement in results. The equation and interpretation of results were followed according to Landis and Koch[13] as shown below:

$$\kappa = \frac{\Pr(a) - \Pr(e)}{1 - \Pr(e)}$$

Pr(a) is the relative observed agreement among raters, and Pr(e) is the hypothetical probability of chance agreement.

K values were interpreted as follows: 0–0.20, slight agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, substantial agreement; and 0.81–1.00, almost perfect agreement.

Ethical approval for this study was obtained from St John of God Hospital Ethics Committee.

RESULTS

The study reviewed 721 lesions from 598 patients referred to WAMAS from 2000 to 2009. Cases were analysed to assess whether specific histopathological parameters had been reported, and whether there was concordance on what was reported. In calculating concordance, cases were excluded if data were missing from the WAMAS database or from the initial pathology report which accounts for the variance in case numbers for each histological feature examined.

Reporting

WAMAS pathology reports include both a descriptive and synoptic report and had complete reporting for all histopathological features in almost all cases.

The referring (non-WAMAS) reports did not include ulceration in 42.5% and mitotic rate in 40.8% of tumours. BT and Clark level were almost always reported and excision margins were reported in 98% of cases.

In addition, non-WAMAS pathologists did not report the presence or absence of microsatellites in 79.1%, growth phase in 76.4%, neurotropism in 64.1%, predominant cell type in 58.2%, tumour infiltrating lymphocytes in 51%, regression in 49%, and vascular invasion in 37.9% of cases.

Concordance of reported values

Table 1 summarises the level of agreement for the key histopathological features that had been recorded.

Tumour type

There was concordance in reported histological type in 333 of 584 cases (57.0%, $\kappa = 0.40$). All major tumour types had at least a moderate level of agreement and almost perfect level of agreement was found for superficial spreading, naevoid, and desmoplastic/neurotropic types (Tables 1 and 2).

Diagnosis of lesions as melanoma versus non-melanoma

There was congruence in the diagnosis of melanoma in 567 of 583 cases (97.3%, $\kappa = 0.10$). WAMAS pathologists reported 570 cases (97.6%) as melanoma and 13 cases were reported as non-melanoma, including 12 naevi (3 dysplastic, 5 compound, and 4 Spitz) and one non-melanocytic lesion (squamous cell carcinoma). In contrast, non-WAMAS pathologists reported five cases as non-melanoma. In only one case did both groups agree that the lesion was not a melanoma. The majority of discrepant cases were reported as melanoma of unclassified type followed by superficial spreading type.

In situ versus invasive

Analysis of 551 cases showed agreement in 96.8% in the classification of lesions as *in situ* melanoma ($\kappa = 0.86$). Six cases initially reported as *in situ* melanoma by non-WAMAS pathologists were reported as invasive melanoma by WAMAS pathologists. Conversely, 12 cases initially reported as invasive melanoma were reclassified as *in situ* melanoma by WAMAS pathologists.

Tumour thickness

After exclusion of unsuitable cases (metastatic tumours, non-melanocytic lesions and unrecorded thickness), 585 cases were suitable for analysis of tumour thickness (BT).

Table 1 Total level of agreement for all histopathological features

Variable	% Equal	κ value	95% CI
Breslow thickness ($n=585$)			
Total	90.8	0.86	0.83–0.90
BT ≤ 1	96.2	0.93	0.90–0.96
BT $>1 \leq 2$	89.2	0.79	0.73–0.85
BT $>2 \leq 4$	94.8	0.80	0.73–0.87
BT >4	89.0	0.90	0.84–0.96
Mitotic rate ($n=35$*)			
Total	80.0	0.69	0.45–0.92
0	91.4	0.77	0.52–1.01
1–5	85.7	0.72	0.50–0.94
6–10	91.1	0.62	0.2–1.0
11–20	94.3	0.47	−0.15–0.94
>20	97.1	0.65	0.41–0.90
Clark level ($n=271$)			
Total	76.0	0.68	0.61–0.75
I	92.4	0.86	0.79–0.93
II	81.0	0.63	0.52–0.74
III	69.8	0.58	0.47–0.69
IV	61.6	0.65	0.55–0.75
Tumour type ($n=584$)			
Total	57.02	0.40	0.36–0.44
SSM	78.8	0.73	0.65–0.81
NM	60.3	0.70	0.59–0.81
ALM†	71.4	0.83	0.60–1.06
LMM	55.5	0.70	0.50–0.90
Desmo/Neuro	90.9	0.95	0.85–1.05
Spitzoid†	100.0	1.00	
Naevoid†	50.0	0.66	0.22–1.10
Metastases	53.8	0.69	0.45–0.93
SSM mixed	21.4	0.33	0.04–0.62
Melanoma vs non-melanoma ($n=583$)	97.3	0.10	−0.10–0.3
Vascular invasion ($n=91$)			
Total	94.5	0.59	0.27–0.91
Absent	94.3		
Present	44.4		
Ulceration ($n=89$)			
Total	94.4	0.85	0.72–0.98
Absent	92.8		
Present	80.0		
Completeness of excision ($n=136$)			
Total	86.9	0.67	0.47–0.87
Complete	83.6		
Incomplete	60.9		
Regression ($n=75$)			
Total	76.3	0.49	0.29–0.69
Absent	68.4		
Present	69.2		
Neurotropism ($n=53$)			
Total	96.2	0.65	0.20–1.10
Absent	96.1		
Present	50.0		
Predominant cell type ($n=57$)			
Total	82.5	0.43	0.145
Epitheloid	82.4	0.41	0.149
Spindle	89.5	0.52	0.168
Naevoid	93.0	0.30	0.250
Tumour infiltrating lymphocytes ($n=74$)			
Total	51.4	0.12	0.06–0.30
Absent	33.3		
Present	35.7		
Growth phase ($n=43$)			
Total	97.7	0.95	0.86–1.04
Vertical	96.2		
Radial	94.4		
Microsatellites ($n=30$)			
Total	100	1.00	1.00
Absent	100		
Present	100		
TNM pathological stage			
Total	81.9	0.79	0.75–0.83
Tis (*in situ*)	96.7	0.86	0.80–0.92
1A	90.4	0.74	0.64–0.84
1B	91.3	0.62	0.52–0.72
2A	93.5	0.80	0.74–0.86
2B	99.1	0.84	0.72–0.96
3A	96.7	0.79	0.70–0.88
3B	98.0	0.82	0.72–0.92
4A	99.0	0.86	0.75–0.97
4B	99.1	0.93	0.87–0.99
TNM clinical stage			
Total	83.8	0.79	0.75–0.83
0	96.7	0.86	0.79–0.92
IA	90.4	0.738	0.67–0.80
IB	88.7	0.75	0.69–0.81
2A	95.8	0.80	0.72–0.88
2B	96.9	0.83	0.75–0.91
2C	99.1	0.927	0.87–0.99

* Cases reported as number of mitoses per mm^2.
† Less than 10 cases.
ALM, acral lentignious melanoma; Desmo/Neuro, desmotropic/neurotropic melanoma; LMM, lentigo maligna melanoma; NM, nodular melanoma; SSM, superficial spreading melanoma.

There was a tendency for cases to be reported with greater BT values by WAMAS compared with non-WAMAS pathologists (mean BT 1.75 versus 1.62 mm). Discrepancies in BT values were generally small with a mean difference of 0.18 mm greater in the WAMAS reports. In 394 cases (70.6%) differences were within 0.1 mm.

Comparison of BT staging groups showed a high level of agreement for all categories (90.8%, $\kappa = 0.86$; Table 1). The highest level of agreement corresponded to T1 (96.2%, $\kappa = 0.93$) and lowest agreement was for T3 lesions (94.8%, $\kappa = 0.79$).

BT discrepancies were further analysed according to the individual WAMAS pathologists, ulceration, location of lesion, pre-existing naevus and biopsy method. Higher levels of agreement were found for lesions obtained by excision and incision biopsy ($\kappa = 0.86$ and 0.88, respectively) compared with lesions obtained by punch or shave biopsy ($\kappa = 0.65$ and 0.70, respectively). Other variables did not significantly affect concordance.

Clark level (Tables 1, 3 and 4)

In 271 cases both pathology sources reported BT ≤ 1 mm, of which 206 reported the same Clark level (76.1%, $\kappa = 0.68$). The highest level of concordance was for Clark Level I (*in situ*) lesions ($\kappa = 0.86$). Concordance was lowest for Clark level III ($\kappa = 0.58$). Moderate levels of agreement were found for Clark levels II and IV ($\kappa = 0.63$ and 0.65, respectively).

In 49 of 65 cases (reported with BT ≤ 1.0 mm), WAMAS pathologists reported a higher Clark level. Thirty-six cases involved a change in the Clark level by one, most frequently involving Clark levels initially reported as II or III by non-WAMAS pathologists.

Further analysis of Clark level revealed a trend towards lower levels of agreement for Clark level III and IV lesions with the presence of ulceration (Table 4). Levels of agreement were also lower where lesions were obtained by punch biopsy, compared to excision biopsy. Level III lesions had low agreement for both biopsy methods.

TNM Staging (Tables 1, 5 and 6)

Overall agreement for AJCC pathological tumour staging was high (81.9%, $\kappa = 0.79$). Lowest agreement was found for stage 1b (91.3%, $\kappa = 0.62$). Reduced agreement was due to discrepancies in Clark levels with WAMAS tending to report higher Clark levels in thin melanomas.

Table 2 Concordance of tumour type between WAMAS and non-WAMAS

Type WAMAS Groups 1-11	Type non-WAMAS Groups 1–11												Total
	1 Metastasis	2 ALM	3 Desmo/ Neuro	4 LMM	6 Naevoid	7 NM	8 Spitzoid	9 SSM	10 Unclass	11 SSM mixed	12 Other	13 Non-melanoma	
1 Metastasis	7	0	0	0	0	2	0	1	0	0	0	0	10
2 ALM	0	5	0	0	0	0	0	0	0	0	0	0	5
3 Desmo/Neuro	0	0	10	0	0	0	0	0	0	0	0	0	10
4 LMM	1	0	1	10	0	1	0	2	11	2	0	0	28
6 Naevoid	0	0	0	0	2	0	0	0	1	0	0	0	3
7 NM	2	0	0	0	0	38	0	0	14	0	0	0	54
8 Spitzoid	0	0	0	0	0	0	2	0	0	0	0	0	2
9 SSM	0	2	0	0	2	15	0	130	97	6	0	2	254
10 Unclass	1	0	1	3	1	29	2	24	124	0	2	2	189
11 SSM mixed	0	0	0	0	0	2	0	1	1	3	0	0	7
12 Other	0	0	0	1	0	3	0	1	2	0	1	0	8
13 Non-melanoma	0	0	0	0	0	0	0	3	10	0	0	1	14
Total	11	7	12	14	5	90	4	162	260	11	3	5	584

ALM, acral lentignious melanoma; Desmo/Neuro, desmotropic/neurotropic melanoma; LMM, lentigo maligna melanoma; NM, nodular melanoma; SSM, superficial spreading melanoma.

Table 3 Comparison of Clark levels between WAMAS and non-WAMAS (thin melanomas)

	Level non-WAMAS				
	1	2	3	4	Total
Level WAMAS					
1	62	3	2	0	67
2	6	47	4	2	59
3	1	13	46	5	65
4	3	9	17	51	80
Total	72	72	69	58	271

Analysis of other histological features

Further analysis was undertaken for 169 cases from 2007–2009 to compare mitotic rate, excision margins, regression, growth phase, vascular invasion, neurotropism, tumour infiltrating lymphocytes, microsatellites and predominant cell type. Approximately 9% (16 cases) were excluded as their initial histopathology review was also performed by a WAMAS pathologist. These cases had almost perfect agreement for all histopathological features examined.

There was almost perfect agreement ($\kappa = 0.81–1.00$) in reporting of microsatellites, growth phase and ulceration. There was less agreement in reporting the presence of ulceration (80.0% of cases) compared to reporting on the absence of ulceration (92.7% of cases). Substantial agreement ($\kappa = 0.61–0.80$) was found for mitotic rate, completeness of excision and neurotropism (Table 1). However, there was much lower agreement in reporting the presence of neurotropism (50.0% of cases) compared to absence of neurotropism (96.0% of cases).

Only one-quarter (42/169, 24.9%) of non-WAMAS cases reported mitotic rate using the recommended method of number of mitoses/mm^2. Analysis of these cases found agreement to be 80% ($\kappa = 0.69$).

Moderate agreement ($\kappa = 0.41–0.60$) was found for vascular invasion, regression and predominant cell type. There was concordance in reporting an absence of vascular invasion in 82 of 87 cases (94.3%). However, where vascular invasion was reported as being present, only four of nine cases were in agreement (44.4%). Five cases with discrepancies involved WAMAS reporting the presence of vascular invasion which had not been previously identified.

There was only slight agreement in concordance for reporting of tumour infiltrating lymphocytes (52.4%, $\kappa = 0.12$).

DISCUSSION

There have been a number of studies highlighting interobserver discrepancy in the reporting of melanoma; however, most studies do not consider the pathologist's level of training or experience in the evaluation of cutaneous melanoma. In this study, we have assessed the completeness of reports and level of concordance in reported values between the initial pathologists with those of the reviewing WAMAS pathologists. The latter have a special interest in melanoma and were specifically reanalysing cases selected for multidisciplinary review, rather than reporting them in routine practice. The training and background of the referring pathologists is highly varied, so no specific conclusions can be drawn regarding the pathologist's level of training and experience and their

Table 4 Clark levels by ulceration and biopsy type

Clark Level	1	2	3	4
Original κ value (95% CI)	0.86 (0.79–0.93)	0.63 (0.52–0.74)	0.58 (0.47–0.69)	0.65 (0.55–0.75)
κ value according to ulceration state				
Present	–	–	0.33 (−0.02–0.68)	0.30 (−0.03–0.63)
Absent	0.87 (0.81–0.93)	0.65 (0.55–0.75)	0.60 (0.5–0.70)	0.82 (0.77–0.87)
κ value according to biopsy type				
Excision	0.91 (0.85–0.97)	0.66 (0.55–0.77)	0.58 (0.46–0.69)	0.81 (0.75–0.87)
Incision	1.0	–	1.0	1.0
Punch	0.45 (0.08–0.82)	0.53 (0.26–0.80)	0.58 (0.34–0.8)	0.76 (0.6–0.92)
Shave	1.0	1.0	0.82 (0.48–1.2)	0.87 (0.63–1.11)

reporting characteristics. As the WAMAS pathologists were not blinded to the original reports when they reviewed the cases, it is possible that their opinion could have been biased by these original reports. A further potential source of bias is that the WAMAS pathologists generally have more detailed clinical information, history and follow-up data available than the original pathologists.

Reporting

There was a lack of standardised pathology reporting of melanoma in the initial pathology reports. Reports were varied in regards to style and the histological features listed. A significant proportion of cases reported by non-WAMAS pathologists did not report on some histopathological variables including ulceration, mitotic rate and vascular invasion which are regarded as essential components. Synoptic reports had a greater tendency to include essential histopathological criteria compared to reports written only in a descriptive format.

Compliance with guidelines for reporting of melanoma was recently studied in a Queensland audit of melanoma reports.[14] This study revealed similar findings, with low levels of reporting of mitotic rate per mm^2, predominant cell type, microsatellites, growth phase and desmoplasia.[14]

The advantage of using a synoptic pathology report format for cutaneous melanoma has been validated by several studies which have shown that synoptic pathology reports are more complete than non-synoptic forms.[15,16]

Pathology reports should provide all of the essential diagnostic information and other histological features which may be of prognostic value. Although not all details may be pertinent to individual patients, inclusion of additional information may be useful for further research. However, variations in reporting and interpretation between different pathologists are likely to make some of this information of limited reliability.

Concordance of reported values

There was a high level of reproducibility for tumour thickness and ulceration, but lower reproducibility for Clark level, in accordance with previous observations.[4–7] Most discrepancies involved Clark level III, probably due to difficulty in identifying the papillary and reticular dermal interface. Overall, there was agreement in Clark level in 84.3% of cases, slightly higher than the agreement reported in other studies of 60–80%.[4–7]

There was moderate concordance for the crucial distinction of a lesion as melanoma. The majority of discrepancies involved non-WAMAS pathologists reporting cases as melanoma (unclassified type) which were reclassified by WAMAS as non-melanoma. This included both benign melanocytic lesions (mostly compound, dysplastic and Spitz naevi) and a squamous cell carcinoma. A study by van Dijk *et al*. analysed data from 1887 lesions submitted for consultation to one of several expert pathologists to compare diagnosis of cutaneous melanoma with benign lesions. This study had similar findings with the most difficult lesions being spitzoid and dysplastic naevi. In addition, problematic lesions also included those with regression, a heavy lymphocytic infiltrate, nuclear atypia and deep mitoses.[17]

Other studies, which have not included pathology reports from different groups of pathologists, have reported higher levels of agreement for the diagnosis of melanoma with κ results generally between 0.40 and 0.75.[4,9,18] The lower levels of agreement found in our study may be a reflection of the more

Table 5 Comparison of pathological TNM staging between WAMAS and non-WAMAS

	TNM non-WAMAS									
	T1a	T1b	T2a	T2b	T3a	T3b	T4a	T4b	Tis	Total
TNM WAMAS										
T1a	107	9	4	0	0	0	0	0	8	128
T1b	23	48	7	0	0	1	0	0	3	82
T2a	4	4	100	0	3	0	0	0	1	112
T2b	0	0	0	14	0	2	0	0	0	16
T3a	0	0	11	0	38	0	3	0	0	52
T3b	0	0	0	3	0	27	0	1	0	31
T4a	0	0	2	0	1	0	20	0	0	23
T4b	0	0	0	0	0	4	0	34	0	38
Tis	5	1	0	0	0	0	0	0	63	69
Total	139	62	124	17	42	34	23	35	75	551

Table 6 Comparison of clinical TNM staging between WAMAS and non-WAMAS

	TNM non-WAMAS						
	0	IA	IB	IIA	IIB	IIC	Total
TNM WAMAS							
0	63	5	1	0	0	0	69
IA	8	107	13	0	0	0	128
IB	4	27	159	3	1	0	194
IIA	0	0	11	52	5	0	68
IIB	0	0	2	4	47	1	54
IIC	0	0	0	0	4	34	38
Total	75	139	186	59	57	35	551

difficult cases in this highly selected group of patients requiring referral to a specialist centre.

It is widely recommended that where there is uncertainty in the interpretation of a melanocytic lesion, referral for expert opinion should be made, as the diagnosis of melanoma rather than a benign lesion carries profound prognostic and therapeutic implications.

Substantial agreement for other prognostic variables was found for mitotic rate, vascular invasion, completeness of excision and neurotropism ($\kappa = 0.61–0.80$). Higher levels of concordance were found in this study than previously reported for predominant cell type and regression.[4,11,19,20] Although overall agreement was high in these cases, features possibly influencing prognosis had slightly lower levels of agreement [i.e., the presence of ulceration, vascular invasion and neurotropism (Table 1)].

Overall agreement was high for mitotic rate with greatest concordance corresponding to the presence or absence of any mitoses ($\kappa = 0.77$). This is significantly better than the concordance for Clark level III or IV ($\kappa = 0.58, 0.65$, respectively) suggesting that patients may be more consistently staged through the use of mitotic activity rather than Clark level in thin melanomas.

This study found high levels of overall concordance for pathological tumour staging with agreement in 81.9% of cases ($\kappa = 0.79$). This indicates a lesser level of agreement than seen in a recent study by Murali *et al*. which found overall concordance in pathological stage of 96.2%.[21] TNM staging showed most variability in substage T1B due to discrepancy in reporting of Clark levels II and III. Murali *et al*. also found the lowest agreement in substages TIB and TIIB.[21] Apart from the difficulty in discriminating between papillary and reticular interface, other factors such as ulceration and biopsy method may compound staging difficulties.

In summary, referring pathologists consistently reported Breslow thickness, Clark level and excision margins, but reporting of other parameters including ulceration and mitotic rate was poor.

Overall, there was a high level of concordance for most histopathological features between referring pathologists and reviewing WAMAS pathologists. Greatest concordance was found for Breslow thickness and ulceration, two key features for staging patients with melanoma. Concordance in Breslow thickness was less in shave and punch biopsies compared to excisional or incisional samples. Lower concordance was found for pathological substages due to discrepancies in Clark level, highlighting the lower reliability of this feature as a prognostic indicator. The higher concordance for the reporting of mitotic rate suggests that moving to the presence of mitoses rather than Clark level of invasion may improve staging accuracy of thin melanomas in the future.

Since the majority of melanomas are diagnosed by pathologists in non-specialist centres, it is encouraging to find high levels of concordance for assessment of the key prognostic features. The use of synoptic reports may improve adherence to recommended reporting guidelines, but the authors suggest that synoptic reports should be used in addition to a descriptive report which provides the rationale for the histological diagnosis of melanoma, the most important component of any report.[3]

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