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ORIGINAL RESEARCH

Melanoma diagnosis at a specialist dermatology practice without the use of photographic surveillance

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Abstract

Background/Objective: Photographic aides are increasingly used in melanoma surveillance. We report melanoma characteristics detected using traditional surveillance without photographic technologies.

Methods: Retrospective study of melanomas diagnosed by three dermatologists at a private dermatology practice over 7 years. Patients underwent full skin examinations with dermoscopy and suspect lesions were excised or biopsied. Total body photography (TBP) and serial digital dermoscopic imaging (SDDI) were not used. Patient demographics, melanoma subtype and thickness, location, biopsy technique and keratinocyte cancers diagnosed at the same visit were recorded. Ratio of in situ to invasive melanomas was calculated. Melanoma risk factors were recorded for 69 randomly-selected patients.

Results: 492 patients were diagnosed with 615 melanomas during 579 visits. 505 (82%) were in situ (in situ to invasive ratio of 4.6:1). Of the invasive melanomas, 85.5% had a Breslow thickness <0.8 mm, 10 (9.1%) 0.8–1 mm and 6 (5.5%) >1 mm. 43.3% of in situ melanomas were lentiginous or lentigo maligna and 41.6% were superficial spreading melanomas (SSM). Of invasive melanomas, 24.3% were lentigo maligna melanoma and 59.5% were SSM. 48.4% of melanomas were diagnosed by shave procedures. Where risk factors were known, 25% were very-high-risk and 43% had a history of melanoma. Keratinocyte carcinoma was diagnosed by biopsy at 26.1% of visits.

Studies using TBP and/or SDDI report in situ to invasive ratios of 0.59:1 to 2.17:1.

Conclusion: Tradiational melanoma surveillance with immediate biopsy of suspect lesions results in high in situ to invasive ratios. Studies using photographic surveillance show lower ratios of in situ to invasive disease.

KEYWORDS

cutaneous malignant, melanoma, photography, skin neoplasms, surveillance

INTRODUCTION

Early detection of melanoma aims to reduce morbidity, mortality and costs. Photographic aids including total body photography (TBP) and serial digital dermoscopic imaging (SDDI) are reported to improve melanoma detection and reduce benign excisions.[1–4] 3D imaging systems combining TBP and dermoscopic imaging have been developed.[5] Traditional surveillance involves a full skin examination using loupe magnification and dermoscopy and targeted biopsy of suspect lesions.

Multiple recent studies of TBP or SDDI have not used traditional surveillance as a control group to compare outcomes and none have demonstrated improved survival (Table 1). TBP and SDDI are recommended in melanoma guidelines[6] and studies are ongoing to determine their benefit.

Two recent systematic reviews of TBP for melanoma detection are published. Ji-Xiu et al.[7] concluded that "lack of controlled studies precludes our ability to estimate added benefits from TBP" beyond a "potential reduction" in the number needed to biopsy (NNB). Hornung et al.[8] concluded "TBP identified a higher proportion of in situ lesions and melanomas with a lower average Breslow thickness compared with the comparison groups". However, the comparison groups used were from national registry data[9] not an equivalent patient group undergoing traditional screening.

Excision of melanoma before it becomes invasive gives the highest chance of cure at the lowest cost and morbidity. Outcome measures in studies using photographic surveillance are the ratio of in situ to invasive lesions[10] and the proportion of high-risk melanomas (i.e. >1 mm thick). Studies using TBP and SDDI report an in situ to invasive ratio of 0.59:1 to 2.17:1 with up to 8.2% of melanomas >1 mm thick (Table 1).

We performed a study of melanoma diagnoses using traditional surveillance by specialist dermatologists aided by loupe magnification and dermoscopy with immediate biopsy of suspicious lesions without photographic monitoring. This is compared to published results where photographic surveillance was employed.

METHODS

A retrospective study of histopathological melanoma diagnoses by three dermatologists at a private practice in Queensland over 6 years between 1 January 2012 and 31 December 2018.

All patients underwent full skin examinations with loupe magnification and dermoscopy. Lesions considered suspicious were excised or biopsied at the same consultation or soon after. TBP and SDDI were not employed.

Histopathological diagnoses of melanoma were reviewed. Patient demographics, pathological subtype, melanoma thickness, body location, biopsy technique and any other skin cancer diagnosed by biopsy at the same appointment were recorded.

A random sample of 69 patients had melanoma risk factors and time since last skin examination recorded.

Statistical methods

Results are descriptive and presented as number (percent) for categorical variables, mean (standard deviation (SD)) for continuous variables that are approximately normally distributed and median (interquartile range (IQR)) for continuous variables that are not normally distributed.

TABLE 1 Comparison of in situ to invasive melanoma ratios in 11 studies of melanoma surveillance.

Study	Surveillance methods	Patient melanoma risk[a]	Total melanomas	Invasive melanomas	% >1 mm	Ratio of in situ to invasive melanoma
Maloney[1]	TBP/SDDI	Very high	61	29	8.2	1.10:1
Guitera[2]	TBP/SDDI	Very high	171	54	4.1	2.17:1
Banky[15]	TBP	High	17	10	0	0.89:1
Salerni[4]	TBP/SDDI	High	98	45	0	1.18:1
Goodson[17]	TBP/SDDI	High	12	5	0	1.40:1
Tromme[16]	SDDI	High	35	22	–	0.59:1
Haenssle[30]	SDDI	High	53	25	0	1.12:1
Truong[29]	TBP	High	93	47	–	0.98:1
Drugge[31]	TBP/SDDI	Mixed	81	31	–	1.61:1
Green[9]	Traditional	Mixed	497	128	1.6	2.88:1
Jimenez Balcells[8]	Traditional	Mixed	637	214	–	1.98:1

[a]Very high refers to patients meeting the criteria used by Maloney and Guitera (see Table 5). High refers to patients with at least one risk factor for melanoma. Mixed refers to patients with variable or no risk factors for melanoma.

RESULTS

492 patients were diagnosed with 615 melanomas during 579 visits.

Patient characteristics

Patient characteristics are shown in Table 2. Mean age at first visit was 63 (SD 13) and just over half were male (55.7%). Most had one melanoma in the study period (83.7%), 12.2% had two and 4% had three or more. At least one invasive melanoma was identified in 98 patients (19.9%).

Patient characteristics between those with one or multiple melanomas in the study period were similar (data not shown).

Lesion characteristics

615 melanomas were diagnosed with an in situ to invasive ratio of 4.59:1.505 (82.0%) were in-situ and 110 (18.0%) invasive.

Of the in situ melanomas (n = 505), 219 (43.4%) were lentigo maligna (LM) or lentiginous type and 210 (41.6%) were superficial spreading melanoma (SSM). Of the invasive melanomas (n = 110), 66 (59.5%) were SSM and 27 (24.3%) lentigo maligna melanoma (LMM) with 3 (2.7%) nodular melanomas and 2 (1.8%) desmoplastic melanomas (Table 3).

Of the 110 invasive melanomas, 94 (85.5%) had a Breslow thickness of <0.8 mm, 10 (9.1%) were 0.8–1 mm thick and 6 (5.5%) were >1 mm. Melanomas >1 mm thick comprised 0.98% of all melanomas (n = 615). Of those >1 mm in depth two were desmoplastic melanomas, two SSM and two LMM (Table 4).

TABLE 2 Characteristics of 492 adults diagnosed with at least one in situ or invasive melanoma between 1 January 2012 and 31 December 2018.

	***N* = 492**
Age at first visit (years, mean (SD))	63 (13)
Age group at first visit	
26–39 years	32 (6.5%)
40–59 years	152(30.9%)
60–79 years	255 (51.8%)
80 years or older	53 (10.8%)
Sex	
Male	274 (55.7%)
Female	218 (44.3%)
Total number of melanomas in study period (includes both in-situ & invasive)	
1	412 (83.7%)
2	60 (12.2%)
3	9 (1.8%)
4 or more	11 (2.2%)
Total number of invasive melanomas in study period	
0	394 (80.1%)
1	88 (17.9%)
2	8 (1.6%)
3	2 (0.4%)

TABLE 3 Characteristics of 615 in situ or invasive melanomas in 492 adults diagnosed between 1 January 2012 and 31 December 2018.

	Melanoma in situ ***N* = 505**	**Invasive melanoma** ***N* = 110**
Melanoma in situ sub-type		
Lentigo maligna melanoma or Lentiginous type	219 (43.4%)	
Not classified/other types	64 (12.7%)	
Mixed type (LMM and SSM mixed)	12 (2.4%)	
SSM	210 (41.6%)	
Invasive melanoma sub-type		
Superficial spreading melanoma (SSM)		66 (60.0%)
Nodular melanoma		3 (2.7%)
Lentigo maligna melanoma (LMM)		27 (24.5%)
Spindle cell or desmoplastic		2 (1.8%)
Not classified/other		3 (2.7%)
Mixed		9 (8.2%)
Location of melanoma		
Ear	9 (1.8%)	2 (1.8%)
Face	35 (6.9%)	3 (2.7%)
Scalp	11 (2.2%)	5 (4.5%)
Neck	24 (4.8%)	3 (2.7%)
Trunk	207 (41.0%)	52 (47.3%)
Upper limb/shoulder	135 (26.7%)	25 (22.7%)
Lower limb/hip	84 (16.6%)	20 (18.2%)
Specimen type		
Ellipse excision	264 (52.3%)	51 (46.4%)
Shave excision	239 (47.3%)	58 (52.7%)
Punch biopsy	1 (0.2%)	1 (0.9%)
Other	1 (0.2%)	0 (0.0%)
Breslow depth		
<0.8 mm		94 (85.5%)
0.8-1 mm		10 (9.1%)
>1 mm		6 (5.5%)

TABLE 4 Characteristics of melanomas >1 mm in depth in six adults diagnosed between 1 January 2012 and 31 December 2018.

Patient age	Breslow depth (mm)	Melanoma type	Time since last appointment (months)	Biopsy technique	History of previous melanoma	Meets very high-risk criteria[a]
62	2.8	Desmoplastic	32	Ellipse	Y	N
84	4.8	Desmoplastic	3	Shave	Unknown	Unknown
79	1.2	SSM	7	Shave	Y	y
85	1.6	LMM	15	Shave	Y	y
74	1.2	SSM	6	Shave	N	N
58	1.5	LMM	5	Ellipse	Y	Y

[a]Very high refers to patients meeting the criteria used by Maloney and Guitera (see Table 5).

TABLE 5 Criteria for high-risk of developing melanoma.[1,2]

Group 1: Personal history of at least 1 invasive melanoma and dysplastic nevus syndrome (DNS). Dysplastic nevus syndrome was defined as at least 100 nevi, at least 6 of which showed atypical dermoscopic features consistent with dysplastic nevus as previously described,[14(pp79–128)] and at least 1 of which was at least 8 mm in greatest dimension
Group 2: Personal history of at least one invasive melanoma and a family history of at least three first-degree or second-degree relatives with a confirmed history of malignant melanoma
Group 3: Personal history of at least two primary invasive melanomas, with at least one occurring in the 10 years prior to recruitment for patients with only two melanomas
Group 4: Confirmed *CDKN2A* (OMIM 600160) or *CDK4* (OMIM 123829) gene mutation (the highest-penetrance susceptibility gene mutations for melanoma)

Diagnostic procedures were divided between elliptical excision and shave excision or partial biopsy. Just over half of the in situ melanomas were diagnosed by elliptical excision (264 of 505, 52.3%). For invasive melanomas just over half were diagnosed by shave procedure (58 of 110, 52.7%).

Depth of invasion was revised upwards for two of 615 melanomas (0.3%). Both diagnosed by shave biopsy. One desmoplastic melanoma was upstaged from Stage I to Stage II disease and one amelanotic melanoma from stage 0 to stage I (data not shown).

Melanomas occurred most frequently on the trunk, upper limb and shoulder (Table 3).

Characteristics of patient visits

Of the 579 patient visits where one or more melanoma was diagnosed, a single biopsy was performed in 250 (43.2%) cases. Two biopsies were performed at 163 (28.2%) visits, three at 109 (18.8%) and four or more at 57 (9.8%).

Another skin malignancy was diagnosed by biopsy at 180 (31.1%) visits with one or more keratinocyte carcinoma diagnosed at 141 (24.4%), a second melanoma at 30 (5.2%) and both a keratinocyte carcinoma and second melanoma at 9 (1.6%) visits.

Skin malignancies diagnosed clinically without histopathological confirmation were not included.

Patient risk factors and time since last skin examination

Risk factors for melanoma were determined by randomly selected chart review for 69 of the 492 patients (14.0%).

23% of these patients (17 of 69) met the high-risk criteria used in previous studies.[2] Amongst these high-risk patients, there were 27 in situ melanomas and three invasive melanomas giving an in situ to invasive ratio of 9.0:1. 43% (29 of 69) had a previous history of melanoma.

The median time since last skin check in this group was 8 months (IQR, 6–12 months) excluding eight patients (12%) for whom this was their first skin examination at this clinic.

DISCUSSION

Melanoma surveillance aims to reduce melanoma mortality and morbidity. Ideally, all studies of melanoma surveillance would measure survival outcomes. This requires data collection over long periods and is rarely achieved. Multiple recent studies of TBP and SDDI record the total number of melanomas found and in situ to invasive ratios as measures of efficacy. In situ melanomas present negligible risk to patient mortality. Thin invasive melanomas are low-risk but still have metastatic potential. A study of 681 invasive melanomas <0.76 mm thick reported 4.8% with metastatic disease after a mean follow-up of 3.6 years.[11] Whiteman et al showed that more melanoma deaths in Queensland were attributable to thin melanomas (<1 mm, 23% of deaths; 68% of all melanomas) than

thick (>4 mm, 14% of deaths; 3% of all melanomas)[12] highlighting the importance of early diagnosis.

Comparison to other studies

Direct comparison between studies is problematic due to variable patient and clinician characteristics. For a new surveillance system to replace existing approaches it should demonstrate a survival benefit or at least outperform current practice.

Studies using TBP and SDDI report in situ to invasive ratios between 0.59:1 and 2.17:1 with up to 8.2% of melanomas >1 mm thick (Table 1). We report a much higher ratio of in situ to invasive melanomas of 4.59:1 and <1% >1 mm thick using traditional surveillance and immediate surgery.

Relative performance of traditional surveillance versus systems reliant on TBP and SDDI would have been readily determined if studies employing TBP and SDDI had employed the standard measure of a control group.

Comparison to studies of high-risk patients

Guitera et al.[2] used TBP and SDDI in 593 Australian high-risk melanoma patients. Our study was conducted in a region with a high incidence of melanoma where most melanomas are managed by general practitioners. As patients were seen on a referral basis only it was expected that high-risk patients would be common.

A chart review of 69 randomly selected patients from our cohort of 492 determined their melanoma risk according to the criteria for high-risk patients in Guitera et al (Table 5).[2] One quarter (17 of 69, 24.6%) met their criteria. Amongst these patients, there were 27 in situ melanomas and three invasive melanomas giving an in situ to invasive ratio of 9.0:1. Guitera et al. reported an in situ to invasive ratio (after initial screening) of 2.17:1.

The proportion of melanomas >1 mm (6 of 615, 0.98%) in our cohort is low. Two of these were identified in patients who had not been seen in over 12 months (range 3–32 months). Within their high-risk patient group, Guitera reported seven melanomas >1 mm out of 171 melanomas (4.10%)[2] with all patients seen and imaged in the previous 6 months (up to 189 days).

The thickest melanoma in Guitera (12 mm, desmoplastic)[2] was diagnosed in a patient seen 8 days earlier and the thickest melanoma in our study (4.8 mm, desmoplastic) was diagnosed in a patient seen 3 months earlier, highlighting the difficulty in diagnosing desmoplastic melanoma.

Guitera et al. diagnosed more melanoma in years 2–4 of monitoring compared to years 0–2. The authors noted that because the protocol relied heavily on photographic change they were "shifting the diagnosis to later time points".[2]

Photography for monitoring pigmented lesions

TBP and SDDI allow the detection of new or changed lesions from baseline. They are particularly used for patients with multiple naevi. Melanomas may not demonstrate significant change over time[13] and benign lesions may have suspect features which continue to change well into adulthood.[14] Argenziano et al.[13] reported melanomas monitored by SDDI for a mean of 20 months without significant change. Of the 103 melanomas eventually excised 52.4% were already invasive and 3 were more than 1 mm thick. The thickest was 2.38 mm.

Monitoring rather than excising suspect lesions may result in melanoma progression and delayed melanoma treatment. Xiong et al.[15] examined the effect of delayed definitive treatment of melanoma. They defined time to treatment as the time from biopsy to definitive treatment by surgical excision. They demonstrated significant increases in adjusted melanoma-specific mortality with treatment delays of 3 months or greater. A period of monitoring before initial biopsy risks exceeding this time span. Whether this might lead to poorer outcomes in melanomas excised after prolonged monitoring can only be determined by a controlled trial.

Patient compliance is crucial to SDDI. Reported rates of patients failing to return for monitoring range from 12.5% to 75.9%.[16–18] Non-compliance is a feature of all surveillance programmes but is more dangerous when suspect lesions are imaged for surveillance rather than removed.

The health, psychological impact and medicolegal implications of diagnosing and treating melanoma after prolonged monitoring may be significant and should be addressed in any study of this modality.

Number needed to biopsy

TBP and SDDI aim to reduce benign excisions. Benign melanocytic lesions can have suspect and changing features thus TBP and SDDI still results in excision of more benign than malignant lesions.[19,20]

Savings from reduced benign lesion excisions are readily overwhelmed by the morbidity and cost associated with delayed melanoma diagnosis especially if metastasis occurs.[21,22] A lower number needed to biopsy (NNB) risks decreasing sensitivity.[23]

Our NNB is unknown as the study was retrospective and data could only be collected for patients with a

confirmed rather than suspected melanoma diagnosis. If studies of TBP and SDDI had included a control arm of usual surveillance the question of relative NNB and it is importance would have been answered.

Just under half (47.7%) of in situ melanomas and just over half (52.7%) of invasive melanomas were diagnosed by shave procedures in our study. Our rate of deep margin transection was 4.3% (27 of 615). Some would have been intentional partial samples due to lesion size and location. As 4% of all melanomas are unsuspected by clinicians[24] this may result in partial biopsy. Only 2 of 615 (0.3%) melanomas were upstaged on wide excision.

Shave procedures pose minimal cost and morbidity for patients.[25] Shaves are a quick, same-day procedure removing any risk of non-compliance. We suspect shave procedures result in a lower biopsy threshold leading to a more favourable in situ to invasive ratio. It may also result in a higher NNB. The effect of a higher in situ to invasive ratio and a higher NNB on overall patient outcomes is best addressed by controlled trials.

Melanoma type

We had a higher proportion of lentiginous melanoma in situ, lentigo maligna and lentigo maligna melanoma than in previous studies.[26] LMM and LM are more common in chronically sun-damaged skin likely explaining our higher incidence. The higher proportion of SSM to LMM for invasive melanoma supports that LM is less likely to become invasive than SSM as found in other studies.[8]

Future steps

Our results show a lower ratio of in situ to invasive melanomas than those found in multiple recent studies utilising TBP and SDDI. Direct comparisons are impossible due to differences in patient and clinician characteristics. This disparity must however raise the concern that monitoring rather than removing lesions suspicious for melanoma risks patient safety. The paper by Xiong et al.[15] would support this concern. Whether this is a significant risk and whether patient outcomes would be better under traditional surveillance or TBP and/or SDDI is unknown. This concern should be addressed by prospective, controlled studies comparing traditional surveillance with immediate surgery to photographic surveillance.

A lower NNB is a desirable aim which should be tempered against the risk of delayed diagnosis.

When dermoscopy was first introduced it is utility was demonstrated in studies comparing it with naked-eye examination. It is unclear why this same rigour was not applied in studies of TBP and SDDI. It may be that standard surveillance is inferior, equal or even superior to photographic surveillance. As demonstrated in Argenziano and Guitera et al surveillance can result in imaging and observation of melanomas that on eventual excision prove to be invasive or indeed high risk. What proportion of these lesions would have been diagnosed earlier in their evolution using traditional approaches?

Properly controlled trials should be conducted to evaluate the relative effectiveness and safety of TBP and/or SDDI and current practice.

Limitations

Melanoma risk factors and the frequency of melanoma screening are only known for 69 (14%). Based on this sample approximately 25% of our patients were high risk limiting comparison to studies where all patients were high risk.

An NNB was unable to be determined. NNB of 7.5 for dermatologists[27] and four for Australian dermatologists[24] are documented.

Some melanomas identified may have been excised by other practitioners and thus not included in this audit.

Results from a single pathology company were obtained for this audit. Occasionally specimens were sent to other laboratories and are not included.

The histopathological diagnosis of melanoma varies between pathologists.[28] The higher rate of melanoma in situ in our study may reflect different pathological interpretations.

A progressive model of evolution from melanoma in situ to invasive melanoma has not been proven but is widely accepted. The superiority of surveillance programmes that remove a higher proportion of melanoma in situ to invasive melanoma has not been shown to improve long-term survival. We employed this metric to allow comparison with recent studies of TBP and SDDI. Change in melanoma morbidity and mortality is not assessed in this study.

Differing clinician and patient factors hamper comparison between studies. Our high in situ to invasive melanoma ratio may be affected by confounding factors including patient history of sun exposure, public education and access to healthcare.

CONCLUSION

Our data raises, the possibility that traditional surveillance using full skin examination and targeted removal or biopsy of suspect lesions results in higher ratios of in situ to invasive melanomas and a lower incidence of thick

invasive melanomas than TBP and/or SDDI. Delayed excision, inherent to photographic monitoring, carries at least some risk of melanoma progressing from a lower to a higher risk category. Whether TBP or SDDI is a safer and more effective intervention than traditional surveillance can only be addressed by the standard method of a prospective, randomised and controlled trial. Parameters measured should include effects on patient welfare, mortality and cost effectiveness.

The absence of control groups and any attempt to measure the effect on mortality are major shortcomings in the literature supporting the use of TBP and SDDI. Until these studies are done, guidelines recommending TBP and SDDI in melanoma surveillance should make it clear that there is no proven survival benefit.

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