Original Research

Skin cancer discovery during total body skin examinations

Check for updates

Angela Jiang MD[a], Itisha S. Jefferson BS[b,*], S. Kayo Robinson MD[b], Dana Griffin MD[c],
William Adams PhD[d], Jodi Speiser MD[e], Laura Winterfield MD, MPH[f],
Anthony Peterson MD[g], Eleanor Tung-Hahn[h], Kristin Lee MD[g], David Surprenant MD[i],
Anne Coakley BS[b], Rebecca Tung MD[j], Murad Alam MD, MSCI, MBA[k]

[a] Department of Dermatology, Henry Ford Health System, Detroit, Michigan
[b] Stritch School of Medicine, Loyola University Chicago, Maywood, Illinois
[c] Dermatology, Advocate Aurora Health Care Medical Group Racine, Wisconsin
[d] Department of Public Health Sciences, Loyola University Chicago, Maywood, IL
[e] Department of Pathology, Loyola University Chicago, Maywood, Illinois
[f] Department of Dermatology, Medical University of South Carolina, Charleston, South Carolina
[g] Department of Dermatology, DuPage Medical Group, Naperville, Illinois
[h] Department of Public Health, University of South Florida, Tampa, Florida
[i] Dayton Skin Surgery Center, Dayton, Ohio
[j] Florida Dermatology and Skin Cancer Centers, Winter Haven, Florida
[k] Departments of Dermatology, Otolaryngology, and Surgery, Northwestern University, Chicago, Illinois

A R T I C L E   I N F O

A B S T R A C T

Background: Patients presenting with a site-specific skin complaint may receive a total body skin examination (TBSE) or a more focused examination. A TBSE may be time-consuming but can potentially detect unsuspected or early stage skin cancers. The purpose of this study was to assess the detection of skin cancers associated with dermatologist-initiated TBSE performed immediately after a focused skin examination on the same patients.

Methods: The dermatology records of patients with biopsy-proven melanoma, basal cell carcinoma (BCC), or squamous cell carcinoma (SCC) during a 2-year period were reviewed. Generalized linear mixed-effects models were used to estimate the odds of a lesion being identified by a dermatologist (rather than the patient or the patient's primary health care provider).

Results: A total 1563 biopsy-proven cutaneous malignancies were found on 1010 patients. Of these, 797 cancers (51%) were first identified by a dermatologist on TBSE and 764 (48.9%) by the patient or the referring provider. Among tumors first identified by dermatologists (n = 797), 553 (69%) were BCCs, 220 (28%) were SCCs, and 24 (3%) were melanomas. The mean Breslow depth was 0.53 mm (standard deviation: 0.31 mm) for melanomas found on TBSE versus 1.04 mm (standard deviation: 1.68 mm) if identified by patients or referring providers. BCCs were more likely to be identified by a dermatologist during a TBSE (n = 553 [56%] vs. n = 434 [44%]; odds ratio: 1.79; $p < .001$). Tumors ultimately diagnosed as SCCs were more often identified by patients or patients' primary care providers (n = 302 [58%]; odds ratio: 0.56; $p < .001$). However, 220 otherwise undetected SCCs were found during dermatologist-performed TBSE.

Conclusion: Dermatologist-performed TBSEs identified numerous cutaneous malignancies that might otherwise have remained undiagnosed. Early detection of melanoma or nonmelanoma skin cancer by TBSEs may spare patients significant morbidity and mortality.

Introduction

Skin cancer is the most common malignancy diagnosed in the United States. The exact numbers are uncertain because national cancer registries do not include basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), but 5.5 million nonmelanoma and malignant melanoma (MM) skin cancers are predicted to affect Americans in 2020 (American Cancer Society 2020a; 2020b). These numbers translate into a growing public health issue, with the United States spending approximately $8.1 billion to treat skin cancer yearly, including $4.8 billion for BCC and SCC and $3.3 billion

for MM (Guy et al., 2015). Along with primary prevention strategies, such as continued public education aimed at changing individual behaviors linked to the development of skin cancer, secondary prevention in the form of a dermatologist-provided, routine total body skin examination (TBSE) may detect early skin cancers and improve cure rates.

The value of a TBSE has been debated by professional organizations that provide health care recommendations. Many dermatologists consider TBSEs to be an important interventional tool to provide a timely diagnosis of skin cancer. Early diagnosis has been suggested to decrease skin cancer morbidity and mortality, but only limited data show the benefits of screening TBSEs, particularly in terms of unexpected new diagnoses of primary skin cancer (Breitbart et al. 2014; Rampen et al., 1995). The purpose of this study was to assess the detection of skin cancers associated with dermatologist-initiated TBSEs performed immediately after focused skin examinations on the same patients.

Methods

The medical records of patients who received dermatologic care over a 2-year period were retrospectively reviewed with approval from the Loyola University Medical Center Institutional Review Board. Included patients were seen by one of three dermatologists (A.P., R.T., L.W.) at a suburban-based dermatology clinic affiliated with this academic medical center. Patients in the cohort were seen by the dermatologist for at least one of the following presenting reasons: 1) concern regarding a specific lesion, 2) noncancerous general dermatology problem, or 3) routine skin examination. Each biopsy-proven diagnosis of BCC, SCC, or melanoma emanating from a dermatology visit in this cohort was recorded.

Other collected data included chief complaint(s) or reason(s) for referral, age, smoking history, history of tanning device use, ZIP code, personal history of skin cancer, and family history of skin cancer. Two authors separately extracted data from the electronic medical records (A.J., R.T.). The full text of the dermatology visit notes was reviewed to ensure correct ascertainment of the history of the present illness and other fields. Lesions presented to the dermatologist were divided into two categories: (1) concerning lesions identified by a nondermatologist referring doctor or self-identified by the patient that were subsequently found to be consistent with cutaneous malignancy on biopsy and (2) lesions of concern identified only by the dermatologist on TBSE that were subsequently found to be consistent with cutaneous malignancy on biopsy. If there was no mention in the chart record of either patient or referring provider identifying a lesion as suspicious or concerning, but such a lesion was indeed identified during the examination performed by the dermatologist, the lesion was categorized as dermatologist-identified. All patient data were de-identified before statistical analysis.

In this study, patients could contribute multiple lesions to the analysis. Generalized linear mixed-effects models were used to estimate the odds of a lesion being identified by a dermatologist (rather than the patient or patient's primary care provider) as a function of the patients' race, smoking history, prior use of a tanning bed, family history of melanoma, and personal history of melanoma or nonmelanoma skin cancer. The odds of a lesion being identified by a dermatologist was also estimated as a function of its Breslow depth, as well as its positivity for BCC, SCC, melanoma in situ (MIS), and MM. For these models, a binomial distribution with logit link was specified for the outcome (i.e., identification by a dermatologist), and random intercepts were allowed for each participant to account for within-subject correlation. For each model, the denominator degrees of freedom were estimated using the Kenward and Roger method (Kenward and Roger, 2009). All analyses were conducted using SAS, version 9.4 (SAS Institute Inc, Cary, NC).

Results

A total of 1563 biopsies in 1010 patients were indicative of melanoma, MIS, BCC, or SCC. BCC was the most common malignancy identified (63.3%), followed by SCC (33.4%), melanoma skin cancer (2.0%), and MIS (1.3%). Of the 31 total invasive melanoma skin cancers diagnosed, 15 (48%) were suspected by the patient or referring physician, and an additional 16 (52%) were discovered during a comprehensive screening examination by the dermatologist (Table 1). Of the 21 MIS cancers, 13 (62%) were suspected by the patient or referring physician and 8 (38%) were discovered by a dermatologist on TBSE. Of the total 1563 biopsies, 797 tumors (51%) were first identified during a dermatologist-performed TBSE, 764 (48.9%) were identified by the patient or the patient's health care provider, and 2 (0.1%) were unattributable.

MM found only during a TBSE had a mean Breslow depth of 0.53 mm (standard deviation: 0.31 mm; range, 0–1.15 mm), whereas MM identified by either the patient or a referring provider had a mean Breslow depth of 1.04 mm (standard deviation: 1.68 mm; range, 0.20–6.90 mm; Table 1). Malignant lesions were more likely to be identified during a dermatologist-performed TBSE when patients presented with a family history of MM (odds ratio [OR]: 1.55; 95% confidence interval [CI] 1.05–2.28; $p = .03$), personal history of MM (OR: 2.42; 95% CI, 1.50–3.90; $p < .001$), personal history of BCC (OR: 1.87; 95% CI, 1.49–2.36; $p < .001$), or personal history of SCC (OR: 1.39; 95% CI, 1.07–1.79; $p = .01$; Table 2). Of the 987 BCCs, 553 (56%) were found during dermatologist-provided TBSE (OR: 1.79; 95% CI, 1.42–2.26; $p < .001$). Of the 522 biopsy-proven SCCs, patients or referring providers identified 302 lesions as suspicious for malignancy and 220 additional cancers (42%) were discovered during dermatologist-provided TBSEs (OR: 0.56; 95% CI, 0.43–0.71; $p < .001$; Table 1).

Discussion

A dermatologist-performed TBSE for patients presenting for consideration of specific lesions may reveal numerous skin ma-

Table 1
Histologically confirmed skin cancers detected during a directed examination versus those detected after a dermatologist-initiated total body skin examination

Tumor type	Patient- or primary care provider-identified malignancy, n (%)*	Additional dermatologist-identified malignancy, n (%)*	p-value
Basal cell carcinoma	434 (44)	553 (56)	< .001
Squamous cell carcinoma	302 (58)	220 (42)	< .001
Melanoma in situ	13 (62)	8 (38)	.33
Malignant melanoma	15 (48)	16 (52)	.85
Mean Breslow depth (standard deviation), mm	1.04 (1.68)	0.53 (0.31)	.44

Two additional malignant lesions were detected (not listed).

* Percentage of total tumors of a given type.

Table 2

Demographic and patient history associations of biopsy-proven tumors detected during a directed examination versus those detected after a dermatologist-initiated total body skin examination

Association	Patient- or primary care provider-identified malignancy, n (%)*	Additional dermatologist-identified malignancy, n (%)*	*p*-value
Mean age, year (standard error)	67.10 (0.63)	68.14 (0.59)	
Caucasian	533 (50)	531 (50)	
Hispanic	20 (71)	8 (29)	.15
Other	7 (64)	4 (36)	
History of smoking	80 (52)	74 (48)	.45
Prior use of tanning bed	22 (40)	33 (60)	.15
Family history of malignant melanoma	63 (38)	105 (63)	.03
Personal history of malignant melanoma	36 (29)	90 (71)	< .001
Personal history of basal cell carcinoma	311 (41)	453 (59)	< .001
Personal history of squamous cell carcinoma	212 (43)	277 (57)	.01

* Percentage of total tumors with a given demographic association or associated with a particular patient history element.

lignancies that might otherwise remain undiagnosed. Although lesion-directed examinations may detect significant numbers of skin cancers, the unknown missed cancer rate is a significant limitation of this approach (Hoorens et al., 2016). Based on our data, approximately half of skin cancers are missed during focal, lesion-specific examinations.

Previous studies of skin cancers discovered by dermatologists found that 6.9% of patients referred for any reason and 15.3% of patients referred for suspicious lesions had a missed malignancy that was detected only during dermatologist-administered skin examinations (Kingsley-Loso et al., 2015). Our data suggest that these statistics may be significantly underestimated. Furthermore, this study confirms that physician-performed TBSEs increase the likelihood of detecting invasive melanoma at a more superficial Breslow thickness. Each such detection is a potentially life-enhancing or preserving event, with a concomitant diminished financial burden to the health care system if advanced melanoma is prevented (Goldberg et al., 2007; Guy et al., 2012). When BCC or SCC is detected early, patients may be spared significant morbidity and mortality. Sun safety education and counseling by a dermatologist also provide an opportunity to prevent future development of skin cancers. Therefore, organizations that fail to recommend skin cancer screening in appropriate patients may be overestimating the harms and underestimating the benefits of TBSEs.

Routine skin cancer screenings need not be costly. In addition to being rapid, safe, and accurate, TBSE is an inexpensive and effective screening method when performed by a board-certified dermatologist (Zalaudek et al., 2008). TBSE could also be prioritized in patients with high-risk features, as noted in prior work: age >65 years, sun-sensitive skin, personal or family history of skin cancer, immunosuppression, photosensitizing medication, indoor tanning, having ≥50 nevi or atypical nevi, specific complaints regarding a skin lesion, and detection of a worrisome lesion during a focused skin examination (Argenziano et al., 2012; Robinson and Jablonski, 2018). Nondermatologist providers and primary care physicians may not have time to determine a patient's risk for skin cancer, provide sun protection counseling, and perform a thorough TBSE (Robinson and Jablonski, 2018).

Although we did not assess the accuracy with which dermatologists or other providers made clinical diagnoses when confronted with suspicious lesions, other studies have confirmed that dermatologist-provided visual skin examinations are both highly sensitive and specific. When compared with skin biopsies performed by dermatologists, those by primary care providers are less sensitive for the detection of skin malignancy (Jones et al., 1996). Additionally, dermatologist-performed TBSEs are associated with a low false-negative rate, which may not hold for examinations performed by other types of providers (Koh et al., 1990; Rampen et al., 1995). That said, any type of skin examination by any willing provider should be encouraged as a first step in detecting skin cancer as a means to reduce morbidity and mortality; at-risk individuals may further benefit from TBSEs.

This study has limitations. The dermatology outpatient clinic where the study was conducted was community-based, with a relatively high percentage of patients with government-issued health insurance (Medicaid) compared with similar private practice clinics. Of the 1010 patients included in this study, 14 were identified as spending more than half the year out of state (Utah, Wisconsin, Florida, Michigan, Mexico).

Conclusion

A high percentage of malignant skin tumors are discovered only during dermatologist-provided TBSE. To improve diagnostic accuracy and decrease the number of unnecessary procedures, if a patient or primary care provider identifies a lesion of concern, the patient should be sent to dermatology for confirmation and a TBSE. During TBSEs, dermatologists may also educate patients regarding safe sun practices, thus helping to prevent future skin cancer–related morbidity and mortality.

Acknowledgements

Conflicts of interest

None.

Funding

Study approval

The author(s) confirm that any aspect of the work covered in this manuscript that has involved human patients has been conducted with the ethical approval of all relevant bodies.

References

American Cancer Society. Cancer facts and figures 2020 [Internet]. 2020a [cited 2020 November 15]. Available from: https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2020/cancer-facts-and-figures-2020.pdf

American Cancer Society. What are basal and squamous cell skin cancers? [Internet]. 2020b [cited 2020 November 15]. Available from: https://www.cancer.org/cancer/basal-and-squamous-cell-skin-cancer/about/key-statistics.html

Argenziano G, Zalaudek I, Hofmann-Wellenhof R, Bakos RM, Bergman W, Blum A, et al. Total body skin examination for skin cancer screening in patients with focused symptoms. J Am Acad Dermatol 2012;66(2):212–19.

Breitbart EW, Choudhury K, Anders MP, Volkmer B, Greinert R, Katalinic A, et al. Benefits and risks of skin cancer screening. Oncol Res Treat 2014;37:38–47.

Goldberg MS, Doucette JT, Lim HW, Spencer J, Carucci JA, Rigel DS. Risk factors for presumptive melanoma in skin cancer screening: American Academy of Dermatology National Melanoma/Skin Cancer Screening Program experience 2001–2005. J Am Acad Dermatol 2007;57(1):60–6.

Guy GP, Ekwueme DU, Tangka FK, Richardson LC. Melanoma treatment costs: A systematic review of the literature, 1990–2011. Am J Prev Med 2012;43:537–45.

Guy GP, Machlin SR, Ekwueme DU, Yabroff KR. Prevalence and costs of skin cancer treatment in the U.S., 2002–2006 and 2007–2011. Am J Prev Med 2015;48(2):183–7.

Hoorens I, Vossaert K, Pil L, Boone B, De Schepper S, Ongenae K, et al. Total–body examination vs lesion-directed skin cancer screening. JAMA Dermatol 2016;152:27–34.

Jones TP, Boiko PE, Piepkorn MW. Skin biopsy indications in primary care practice: A population-based study. J Am Board Fam Pract 1996;9(6):397–404.

Kenward MG, Roger JH. An improved approximation to the precision of fixed effects from restricted maximum likelihood. Comput Stat Data Anal 2009;53(7):2583–95.

Kingsley-Loso JL, Grey KR, Hanson JL, Raju SI, Parks PR, Bershow AL, et al. Incidental lesions found in veterans referred to dermatology: The value of a dermatologic examination. J Am Acad Dermatol 2015;72(4):651 –5.e1.

Koh HK, Caruso A, Gage I, Geller AC, Prout MN, White H, et al. Evaluation of melanoma/skin cancer screening in Massachusetts. Preliminary results. Cancer 1990;65(2):375–9.

Rampen FHJ, Casparie-van Velsen IJAMG, van Huystee BEWL, Kiemeney LALM, Schouten LJ. False-negative findings in skin cancer and melanoma screening. J Am Acad Dermatol 1995;33(1):59–63.

Robinson JK, Jablonski NG. Sun protection and skin self-examination and the U.S. preventive services task force recommendation on behavioral counseling for skin cancer prevention. JAMA 2018;319:1101–2.

Zalaudek I, Kittler H, Marghoob AA, Balato A, Blum A, Dalle S, et al. Time required for a complete skin examination with and without dermoscopy: A prospective, randomized multicenter study. Arch Dermatol 2008;144(4):509–513.