MedicineToday 2011; 12(5): 27-32

PEER REVIEWED FEATURE
POINTS: 2 CPD/2 PDP

Vascular features to look for in the dermoscopy of cutaneous tumours

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Examining the skin using dermoscopy provides valuable information not seen with the naked eye. Vascular features relevant in the assessment of primary nonlymphoid cutaneous tumours are discussed.

Key points

- **Dermoscopy provides the clinician with immediate convenient magnification when examining the skin.**
- **Distinctive vascular features identified during dermoscopy facilitate the diagnosis of a range of both benign and malignant tumours.**
- **Benign tumours often have monomorphic vessels distributed in regular patterns over the tumour footprint.**
- **Malignant tumours characteristically display polymorphic vessels in irregular arrangements within a tumour.**
- **Acquiring skill in dermoscopy can reduce the number of excisions of benign tumours and improve the identification of malignant tumours.**

The use of dermoscopy – examination of the skin using a microscope with a usual magnification of 10 times – in primary care and specialist practice is increasing. Over the past two decades, understanding of the dermoscopic features of cutaneous tumours has grown considerably to provide a comprehensive and extensive pool of useful knowledge for clinical practice.

Considerable attention and effort have been applied in studying the morphology of various cutaneous features viewed by dermoscopy and how this morphology relates to the underlying histopathology. The magnification involved in dermoscopy provides the clinician with images of blood vessel features not seen with the naked eye. Some vascular features have been described in association with relevant histological entities, and these associations have become accepted by experienced dermoscopists.[1-6] However, the association of vascular features with specific histopathology has received minor attention in the dermoscopy literature when compared with the association of nonvascular features (such as pigmentation) and related histopathology.

The diagnostic application of vascular features seen in dermoscopy of primary nonlymphoid cutaneous tumours is reviewed in this article.

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TUMOUR VASCULARISATION

Extensive vascular perfusion is required for tumour survival if the tumour mass exceeds 1 to 2 mm diameter.[7] The expansion of tumour masses beyond 1 mm diameter depends on neovascularisation initiated at the capillary level.[8] Increased perfusion can be recognised in tumours as pink areas and blood-filled vessels with distinctive morphological features.[9] However, the identification of these features is limited by the visual acuity of the eye and the magnification of the optical instrument. Also, heavily pigmented tumours can mask vascular features, such that, generally, the lower the pigmentation in a tumour then the more apparent the vascular features.

INTERPRETING DERMOSCOPY IMAGES

The appearance of vascular structures seen during dermoscopy within the tumour usually contrasts with the background surrounding skin vascular features. The distinctive vascular features of important diagnostic entities contribute, to varying degrees, to clinching the diagnosis.

Vascular features seen with dermoscopy are not necessarily in intimate contact with the tumour cells. In squamous cell carcinoma (SCC) in situ, the associated characteristic glomerular-like coil vessels are actually located in the dermal papillae while the tumour cells are restricted to the epidermis. Branching vessels, with a common larger diameter than background vessels, are often identified with nodular basal cell carcinoma (BCC). Conventional histopathology and confocal microscopy have shown these nodular BCC vessels are in the mucinous stroma surrounding, but not within, the islands of basaloid tumour cells.[10,11] Lichenoid reactions associated with tumours may also contribute to the vessel features within a tumour 'footprint'.

The interpretation of vascular features in dermoscopy images is also limited by other factors, as discussed below.

Light penetration

As light penetrates deeper into the skin, the reflection, refraction, diffraction and absorption of light reduces the resolution of the appearance of deeper structures. Deeper vascular features of the reticular dermis are usually not visualised, particularly in thick skin. Papillary dermis vessels may be seen but not always in sharp focus. Tumour mass, even without significant pigment, is translucent rather than transparent.

Metaphorical terms

Vascular features are often described in metaphorical terms that can be subjective. The use of metaphorical terms in dermoscopy is now well established among experienced dermoscopists, and a range of useful vascular metaphors has been described and illustrated by several authors.[1-3] Considerable exposure to these terms is required to become fluent, confident and correct in their use in accurately predicting the actual diagnosis confirmed by histopathology.

Magnification

Routine clinical dermoscopy uses 10 times magnification. The use of higher magnification will provide greater vascular detail resolution but at the cost of a smaller field of view.

Depth perception

Optimal depth perception is achieved when full stereopsis is used; this reaches full potential when viewing is binocular. Current dermoscopy practice is monocular and relies on a variety of clues to judge depth, such as the overlapping of features. Precise vascular depth estimation is not easy to quantify with routine dermoscopy but is readily measurable with accuracy using confocal microscopy.

Confocal microscopy is a recent technology that uses laser light to produce high-resolution horizontal images of the skin. These images provide detail approaching traditional histopathology. Video mode confocal microscopy can immediately identify blood vessels due to cellular movement within the lumen.

The three-dimensional orientation of vascular features is readily apparent at a measurable depth when video mode confocal microscopy is used. In nodular BCC, for example, blood vessels run horizontally between or over the clumps of basaloid cells, and in Bowen's disease, the vessels appear as vertical tufts in the centre of the dermal papillae.[12]

Histopathological correlations

The histopathological correlations with vascular features is less understood than the correlations with nonvascular structures seen in dermoscopy. Blood vessels of similar shapes and size may be found in different histological entities. Although arborising or branching vessels are usually associated with nodular BCC, these vessels are not unique to BCC and can be noted in diverse areas such as background sun-damaged skin, scars and a variety of both benign and malignant tumours.

There are subtle variations in the morphology of the branching vessels seen in different background sites on the body and in moderately mature surgical scars on the upper back, shoulders and upper anterior chest. Recognising vessel features of recurrent tumours when juxtaposed to scar vessels is clearly important. However, comparing branching vessel morphology variations between recurrent tumours and scar tissue has not been formally studied.

Polarised and nonpolarised light

The use of nonpolarised light or polarised light in dermoscopy influences the assessment of vascular structures. Polarised light dermatoscopes provide enhanced demonstration of red colours.[13] Polarised dermatoscopes also have reduced light penetration into the skin and thus the images are dimmer than images seen with nonpolarised dermatoscopes. Noncontact polarised dermoscopy eliminates vessel compression.

TABLE. VASCULAR FEATURES ON DERMOSCOPY AND ASSOCIATED DIAGNOSES

Vascular morphology (metaphorical term)	Morphological detail	Associated diagnoses
Dot vessels	Fine dots or points	Often in melanocytic tumours Regular: Spitz naevi, Clark naevi and dermatofibroma Irregular: thin melanoma
Comma vessels	Curvilinear shape, sometimes thickened at one end	Combined and dermal naevi
Hairpin vessels	Loop shape Usually elongated	Keratinocytic tumours: often with white halo Warts Regular: seborrhoeic keratosis Irregular: thick melanoma, keratoacanthoma and SCC
Glomerular vessels	Multiple tight coil shapes	Clustered and with dot vessels in SCC in situ Leg venous stasis
Arborising vessels (tree-like)	Larger diameter branching vessels	Nodular BCC and other thicker malignant tumours
Short fine telangiectasia	Fine diameter branching vessels	Superficial BCC
Crown vessels	Radial pattern with deeper pale lobules	Sebaceous hyperplasia
String of dots, string of pearls	Dots arranged in serpentine strings	Clear cell acanthoma
Strawberry pattern	Red areas with perifollicular pallor on the face	Actinic keratosis: often with fine wavy vessels around the follicle
Pink or red globules	Raised areas, darker pink or red	Thicker hypomelanotic or amelanotic melanoma Pyogenic granuloma
Corkscrew vessels	Linear vessels with a helix shape	Uncommon finding; distinctive for melanoma metastasis

ABBREVIATIONS: BCC = basal cell carcinoma; SCC = squamous cell carcinoma.

The application of gel between the skin surface and the glass plate of the dermatoscope minimises vessel compression when using nonpolarised dermoscopy.

Increased confidence in the diagnosis of BCC has been reported when using polarised compared with nonpolarised dermatoscopes, even in inexperienced dermoscopists.[14] Experienced dermoscopists become familiar with, and routinely choose, either polarised or nonpolarised dermoscopy, and the resultant diagnostic accuracy has not been shown to be influenced by this choice.

Milia cysts and blue colours are better visualised with nonpolarised dermoscopy. Polarised dermoscopy is required to view chrysalis structures found in melanoma and BCC. True amelanotic melanoma, a relatively rare variant of melanoma, has typical vascular features of irregularly distributed polymorphous vessels, including dot vessels; correctly recognising the significance of these vascular features enhances the chance of identifying this elusive tumour.

OPTIMAL TECHNIQUE TO ASSESS VESSEL FEATURES USING NONPOLARISED DERMOSCOPY

The surface of the skin scatters incident and internally returned light by reflection and refraction; this degrades the resolution of the optical image seen in dermoscopy. Image degradation can be vastly reduced by applying a transparent clear gel between the dermatoscope lens and the skin. Gel application reduces light scatter and thereby enhances light transmission into and out of the skin, providing higher resolution. As mentioned previously, gel application also removes the compressive load of the dermatoscope glass plate on blood vessels, allowing improved vessel identification by optimal filling.

DIAGNOSIS USING VASCULAR STRUCTURES

Vascular structures seen on dermoscopy can be used to predict the histological diagnosis.[3,5,6] Some vascular features and the associated diagnoses are listed in the Table.

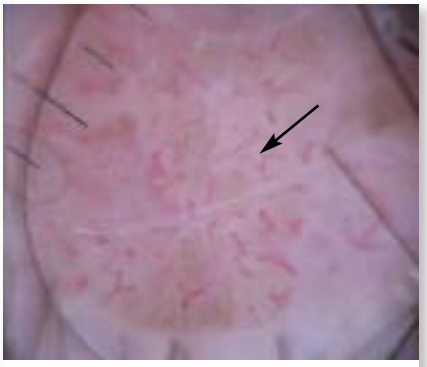


Figure 1. Comma vessels (curvilinear-shaped) in a dermal naevus on the scalp.

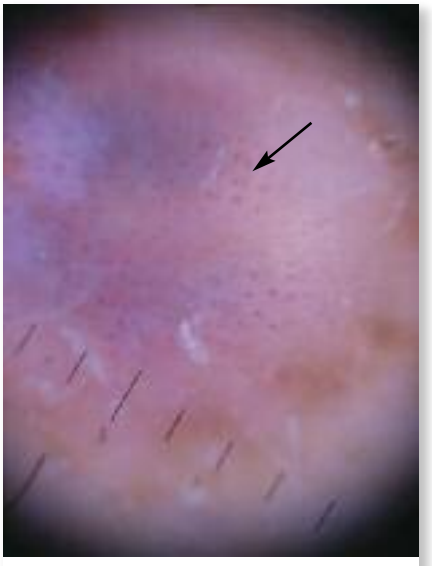


Figure 2. Monomorphic dot vessels (fine dots or points) in a dermatofibroma.

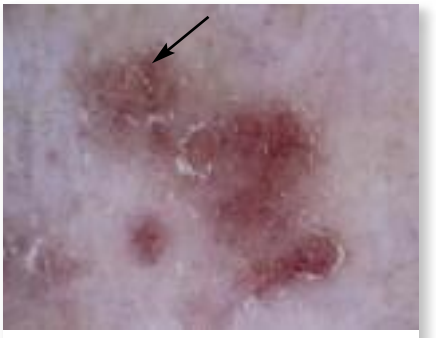


Figure 3. Clusters of glomerular vessels (coil-shaped) and dot vessels in Bowen's disease, an SCC in situ variant.

Vascular features of interest include individual vessel morphology, the number of vessels with different morphology, the spatial distribution of vessels within the tumour and the number of vessels per unit area or volume. Pink areas within a tumour often draw attention to the lesion.

The monomorphic, comma-shaped vessels of a dermal naevus are illustrated in Figure 1. Comma shapes are curvilinear and intermediate between the serpentine and loop forms and occur as a consistent pattern in dermal naevi.

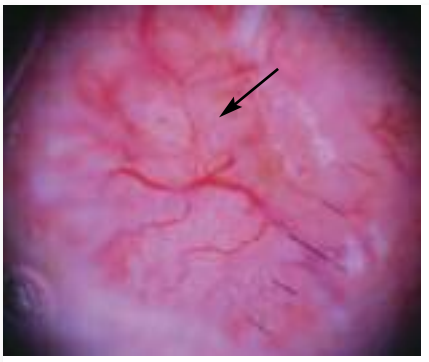
Generally, benign lesions tend to have reduced variation in vessel morphology. This is illustrated in the example of dermatofibroma in Figure 2, which shows a monomorphic dot vessel pattern.[15]

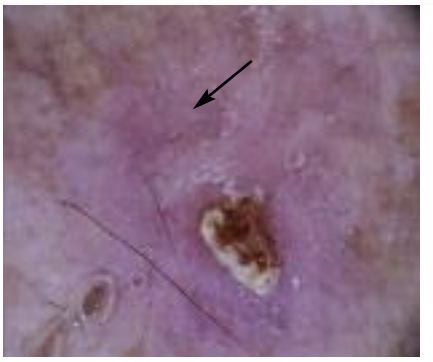
The glomerular (coil-shaped) vessels associated with the intraepithelial SCC variant known as Bowen's disease are illustrated in Figure 3. Note there are more vessels per unit area over the tumour, compared with the background. These coil and dot vessels are in spatial clusters. Topical therapy of SCC in situ may fail if tumour cells extend deep into follicles.

Branching vessels are a recognised distinctive feature of nodular BCC, where the term arborising vessels ('tree-like') is often used. Large diameter branching vessels may also be seen with thicker melanomas. Figures 4a to c illustrate how branching vessels may be associated with BCC and other diagnostic entities.

DO VASCULAR STRUCTURES INDICATE BIOLOGICAL BEHAVIOUR?

Histopathological studies of microvascular variation in melanocytic tumours have found that microvessel counts per unit area increase with tumour development – that is, on viewing of histopathology slides of dysplastic naevi through primary melanoma to melanoma metastasis.[16]





Figures 4a to c. Arborising vessels. a (left). Branching vessels in a nodular BCC. Large diameter branching vessels may also be seen in thicker melanomas. b (centre). Polymorphous vessels, including branching vessels, in a nodular BCC on the dorsum of the hand. c (right). Branching vessels in an epidermoid cyst.

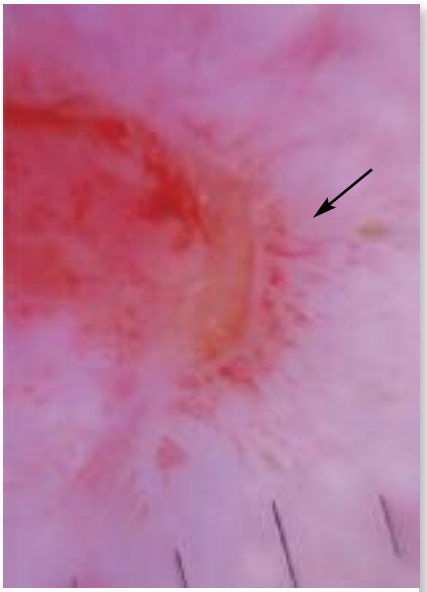


Figure 5. Hairpin vessels (loop-shaped) in an invasive SCC.

Microvessel growth also increases in the surrounding host tissue of dysplastic naevi compared with primary melanoma, and of primary melanoma compared with metastatic melanoma.[17] Microvessel study of BCC and SCC has reported invasive growth correlating with an angiogenic response in the stroma, and metastatic potential correlating with microvessels being present in the tumour body of the SCC.[18]

Studies of the dermoscopy of melanocytic tumours have established there is diagnostic value in determining vascular structures, particularly in hypomelanotic melanoma.[1,2,19,20]

ESTIMATING TUMOUR DEPTH BY VESSEL MORPHOLOGY

The changes in blood vessel features as melanoma undergoes vertical growth have been described:[19]

- thin melanoma (Breslow thickness, less than 0.5 mm) tend to have regular dot vessels
- melanoma 0.5 to 2.0 mm in thickness often have regular point and hairpin vessels
- melanoma greater than 2 mm in thickness have more irregular twisted and splintered vessels
- melanoma generally thicker than 3 mm tend to have winding and branching vessels.

In keratinocytic tumours, flat thin lesions (e.g. actinic keratoses and SCC in situ) tend to have dot vessels whereas thicker tumours (e.g. keratoacanthoma and invasive SCC) develop hairpin-like longer loop vessels.[6] An example of hairpin vessels in an invasive SCC is seen in Figure 5.

Are hairpin vessels an indicator for rapid growth? (They are commonly seen in the rapidly growing low grade tumours known as keratoacanthoma.) Does the

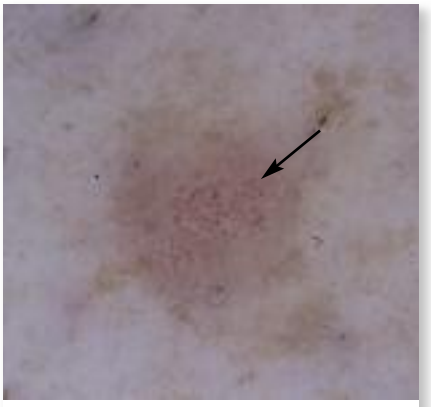


Figure 6. 'String of pearl' dot vessels (dots in serpentine lines) in a clear cell acanthoma.

direction of the loop indicate the direction of tumour expansion? What is the tumour thickness that correlates with loop vessels? These intriguing questions may direct future study.

Some vascular patterns are highly specific for certain diagnostic entities. Clear cell acanthomas are benign epidermal tumours of keratinocyte origin presenting as solitary papules or small nodules on the lower legs of middle-aged and elderly people. Clear cell acanthomas have a very distinct vascular pattern known as a 'string of pearls', as illustrated in Figure 6.

FUTURE RESEARCH

Many tumour types have significant histopathological variation within the tumour mass. Future study may improve and integrate knowledge on how the vessel features seen in dermoscopy relate with histology, using the techniques of confocal microscopy in vivo or traditional histopathology and genetic markers ex vivo. Nodular BCC vascular features have been described using confocal microscopy.[12]

Systematic analysis of the intensity and spatial relation of pink areas within tumours (areas of increased perfusion) may yield more information about diagnostic and histopathological correlation.[9]

CONCLUSION

Vascular features visualised on dermoscopy have been shown to facilitate diagnosis for a diverse range of tumours in the skin. These features are particularly important in thin tumours with little or no pigment. These dermoscopic vascular features can assist diagnosis and guide management decisions. MT

REFERENCES

1. Kreusch JF. Vascular patterns in skin tumours. Clin Dermatol 2002; 20: 248-254.
2. Argenziano G, Zalaudek I, Corona R, et al. Vascular structures in skin tumours: a dermoscopy study. Arch Dermatol 2004; 140: 1485-1489.
3. Malvehy J, Puig S, Braun RP, Marghoob AA, Kopf AW. Handbook of dermoscopy. 1st ed. London and New York: Taylor and Francis; 2006.
4. Giacomel J, Zalaudek I. Dermoscopy of superficial basal cell carcinoma. Dermatol Surg 2005; 31: 1710-1713.
5. Zalaudek I, Kreusch J, Giacomel J, Ferrara G, Catricalà C, Argenziano G. How to diagnose nonpigmented skin tumours: a review of vascular structures seen with dermoscopy. Part 1. Melanocytic skin tumors. J Am Acad Dermatol 2010; 63: 361-374.
6. Zalaudek I, Kreusch J, Giacomel J, Ferrara G, Catricalà C, Argenziano G. How to diagnose non-pigmented skin tumours: a review of vascular structures seen with dermoscopy. Part 2. Nonmelanocytic skin tumours. J Am Acad Dermatol 2010; 63: 377-386.
7. Fidler I. The biology of skin cancer invasion and metastasis. In: Rigel D, Friedman R, Dzubow LM, Reintgen D, Marks R, Bystryn J-C. Cancer of the skin. London: Elsevier; 2004.
8. Folkman J. How is blood vessel growth regulated in normal and neoplastic tissue? G.H.A. Clowes Memorial Award Lecture. Cancer Res 1986; 46: 467-473.
9. Menzies SW, Kreusch J, Byth K, et al. Dermoscopic evaluation of amelanotic and hypomelanotic melanoma. Arch Dermatol 2008; 144: 1120-1127.
10. Weedon D. Skin pathology. New York: Elsevier; 2005. pp.766-768.
11. Agero ALC, Cuevas J, Jaen P, Margoob AA, Gill M, Gonzalez S. Basal cell carcinoma. In: Gonzalez SG, Gill M, Halpern AC, eds. Reflectance confocal microscopy of cutaneous tumours – an atlas with clinical, dermoscopic and histological correlations. London: Informa Healthcare; 2008. pp. 60-75.
12. Ahlgrimm-Siess V, Cao T, Oliviero M, Hofmann-Wellenhof R, Rabinovitz HS, Scope A. The vasculature of nonmelanocytic skin tumours in reflectance confocal microscopy: vasculature features of basal cell carcinoma. Arch Dermatol 2010; 146: 353-354.
13. Benvenuto-Andrade C, Dusza SW, Agero ALC, et al. Differences between polarized light dermoscopy and immersion contact dermoscopy for the evaluation of skin lesions. Arch Dermatol 2007; 143: 329-338.
14. Wang SQ, Dusza SW, Scope A, Braun RP, Kopf AW, Marghoob AA. Differences in dermoscopic images from nonpolarized dermoscope and polarized dermoscope influence the diagnostic accuracy and confidence level: a pilot study. Dermatol Surg 2008; 34: 1389-1395.
15. Ferrari A, Piccolo D, Fargnoli MC, Biamonte AS, Peris K. Cutaneous amelanotic melanoma metastasis and dermatofibromas showing a dotted vascular pattern. Acta Derm Venereol 2004; 84: 164-165.
16. Barnhill RL, Fandrey K, Levy MR, Mihm MC Jr, Hyman B. Angiogenesis and tumour progression of melanoma: quantification of vascularity in melanocytic nevi and cutaneous malignant melanoma. Lab Invest 1992; 67: 331-337.
17. Smolle J, Soyer HP, Hofmann-Wellenhof R, et al. Smolle-Juettner FM, Kerl H. Vascular architecture of melanocytic skin tumours. A quantitative immunohistochemical study using automated image analysis. Pathol Res Practice 1989; 185; 740-745.
18. Chin CW, Foss AJ, Stevens A, Lowe J. Differences in the vascular patterns of basal and squamous cell skin cancers explain their differences in clinical behaviour. J Pathol 2003; 200: 308-313.
19. Kreusch, J. Amelanotic melanoma. In: Soyer HP, Argenziano G, Hofmann-Wellenhof R, John RH. Color atlas of melanocytic lesions of the skin. Berlin, Heidelberg: Springer-Verlag; 2007. pp. 208-211.
20. Pizzichetta MA, Talamini R, Stanganelli I, et al. Amelanotic/hypomelanotic melanoma: clinical and dermoscopic features. Br J Dermatol 2004; 150: 1117-1124.

COMPETING INTERESTS: None.