Melanoma imaging and diagnosis: What does the future hold?

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Background
In Australia, artificial intelligence (AI) is increasingly being used in the field of melanoma diagnosis. Early diagnosis is arguably the most important prognostic factor for melanoma survival. The use of digital monitoring of naevi, especially dysplastic naevi, might reduce the number of biopsies needed in managing patients at risk of melanoma, especially in patients with high naevi counts.

Objective
This article discusses advances in imaging and early diagnosis including the use of AI in this process.

Discussion
The benefits of performing biopsies must be balanced with the potential to cause harm. Whole-body imaging can assist with more accurate detection of changing lesions and enable clinicians to focus on lesions where change is detected.

IN AUSTRALIA, artificial intelligence (AI) is increasingly being used in the field of melanoma diagnosis. Early diagnosis is arguably the most important prognostic factor for melanoma survival.[1] A common clinical challenge is identifying changing or unstable pigmented lesions, especially in patients with high naevi counts.[2] The benefits of performing biopsies for suspicious pigmented lesions must be balanced with the potential to cause harm.[3] AI, in the form of 3D total body imaging with dermoscopy, has been used in research settings in Australia for many years and is now starting to be implemented into clinical settings to assist clinicians in the diagnosis of melanoma.[4]

3D total body imaging with dermoscopy creates an Avatar of the patient's skin and body map of naevi.[5] These machines have in-built AI that have developed AI mechanisms to: (i) determine whether a lesion has reached the threshold for a diagnostic biopsy; and (ii) identify dermatoscopic changes by comparing serial photographs sequentially.[4] It has been demonstrated that these AI technologies are able to diagnose a pigmented lesion with an accuracy comparable to a dermatologist.[6] Sequential photographs have been shown to increase the sensitivity and specificity of diagnosing melanomas.[7] The main challenges with this technology are difficult-to-image areas (eg acral surfaces, groin, skin folds) and the reliance on melanographers for performing dermoscopy.

A study conducted by an Austrian–Australian research team showed that AI phone applications for categorising pigmented lesions as benign or malignant, matched the diagnostic accuracy of experts and outperformed less-experienced physicians.[8] In this study, the AI applications more commonly recommended removal of benign lesions, indicating that clinician judgement remains essential for treatment planning to avoid excessive false-positive findings and overtreatment.

Future applications

The future of AI in the diagnosis and treatment of melanoma is expected to bring significant advancements and improvements.

Screening

AI algorithms for differentiating between benign and malignant pigmented lesions are expected to become more sophisticated, allowing for even greater accuracy in diagnosing melanoma. These advancements will likely come from improved machine learning models that can analyse a wider range of data and incorporate information on patient history and even genetics.

This technology will likely also become available for the interpretation of lesions imaged with reflectance confocal microscopy (RCM), which is a non-invasive technique enabling visualisation of the epidermis and papillary dermis. Although the resolution is almost comparable to conventional histology, the use of RCM is limited to thin lesions.

As currently used in mammography, AI can exclude normal lesions and reduce the number of lesions needing diagnosis by clinicians. This could greatly reduce the workload of melanoma screening programs and allow clinicians to concentrate on challenging lesions. High-quality imaging also facilitates obtaining second opinions for more difficult lesions.

Early detection

Wearable devices equipped with sensors and AI capabilities aim to detect abnormal biometric markers in enzymes, antibodies, cell receptors or organelles for early detection of diseases such as cancer. Use of wearable biosensors could continuously monitor skin health, alerting users to any changes that might warrant professional evaluation. This would be particularly beneficial for individuals at high risk of melanoma.

Personalised treatment plans

AI might be used to develop more personalised treatment plans for melanoma patients. By using algorithms, AI might help identify the most effective diagnostic tests and treatments for a case. This might incorporate tumour information (histopathology, molecular and genetic factors), as well as patient characteristics (ie age, sex, comorbidities, medication use).

Early diagnosis of recurrence

AI in the form of wearable biosensors, might also be increasingly used for early detection of recurrence before visible symptoms appear and/or are detectable with imaging. Algorithms could also analyse historical data and identify patterns or risk factors that predispose individuals to recurrence, leading to closer monitoring and earlier interventions.

Automation in pathology

AI might automate certain aspects of pathology, such as the initial screening and diagnosis of biopsy specimens. More advanced models might assist with diagnosing borderline pigmented lesions with higher accuracy. This might reduce time delay from biopsy to diagnosis and increase the sensitivity and specificity of melanoma diagnosis.

Telemedicine and remote diagnostics

With the advancement of AI, remote diagnosis of melanoma might become achievable, where melanoma screening is reliably performed via 3D body imaging or AI smartphone applications. Patients in remote areas could receive timely diagnoses without needing to travel to specialised centres.[9]

Conclusion

AI in Australia is increasingly utilised for the diagnosis of melanoma. The most effective use of AI in melanoma diagnosis and treatment now, and in the near future, involves a collaborative approach, where AI supplements the skills and knowledge of healthcare professionals, rather than replacing them.[10] As AI becomes more integrated into healthcare, there will be an increased focus on the regulation of AI tools and ethical considerations, such as patient privacy and the decision-making process in AI-driven technology.[4]

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