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Medical Newsletter

May 2018 – Newsletter 1

Inside this Newsletter:

Introducing Liquid Biopsy:

The Revolutionary Aspect of Molecular Oncology

Aspect Liquid Biopsy

Dr Mirette Saad

Cancer, a leading cause of mortality, is associated with mutated genes. Analysis of tumour associated genetic alterations is increasingly used for diagnostic, prognostic and treatment purposes. Precision or personalised medicine harnesses genomic knowledge banks to tailor individualised treatments based on patients' or their tumours' genetic signatures.

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Somatic Mutations in Cancer

A high-quality genomic analysis is critical for personalised pharmacotherapy in patients with cancer. Identifying activated therapeutic gene targets (e.g., *BRAF* in melanoma, *EGFR* in lung cancer and *KRAS* in colorectal cancer) with established cancer associations, using focused panels for targeted cancer sequencing, allows for deeper coverage of those genes and higher sensitivity to confidently call rare variants (e.g., *PTEN* and *KIT*) in rare tumour subclones, including FFPE tissue. The advent of therapies targeting genomic alterations has improved the care of patients with certain types of cancer dramatically. Thus, elucidating the genetic profile of a given tumour is potentially useful in designing tailored treatment regimens that avoid unnecessary toxic therapy.

Liquid Biopsy

The genetic profile of solid tumours is currently obtained from surgical or biopsy specimens; however, performing biopsies, particularly in lung cancer, is not always possible in advanced disease stages and is associated with potential complications. Also, information acquired from a single biopsy provides a limited snap-shot of a tumour and might fail to reflect its true genetic and cellular heterogeneity.

While molecular targets were initially detected in nucleic acid samples extracted from tumour solid tissues, detection of circulating nucleic acids in blood has enabled the development of what has become known as “liquid biopsy”.

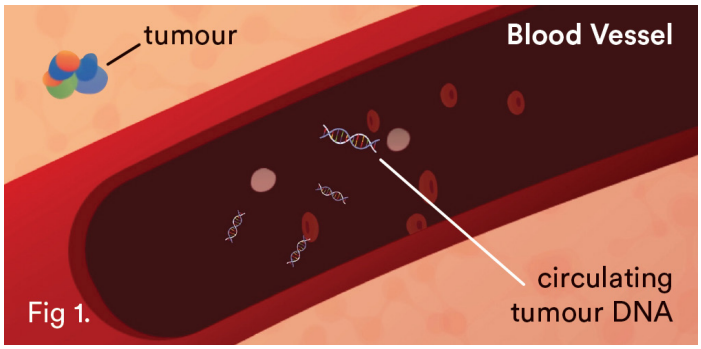

Fig 1.

Certain fragments of DNA, cell-free DNA (cfDNA), have been shown to be elevated in the plasma of patients with cancer. This increase is the result of the rapid turnover of cells within the tumour, releasing DNA into the circulation[1] (see Fig. 1). With new highly sensitive technologies, cell-free circulating DNA can now be isolated and analysed. cfDNA analysis can complement and in many instances correlate to solid tissue biopsies[3,4] for real-time molecular monitoring of treatment, detection of recurrence, and tracking resistance. Circulating tumour DNA (ctDNA) reflects the overall tumour information and is not biased by analysing only a small fraction of the tumour. It is always accessible, in contrast to the lung cancer tissue.

Various studies in breast, lung and colorectal cancers have demonstrated the potential application of ctDNA analysis at each stage of clinical management: early diagnosis[12,13], molecular profiling[14], prognostication[12,15,16], detection of residual disease[7,17], monitoring response and clonal evolution[18,19,20]. Lastly, there have been recent approvals by the Federal Drug Administration (FDA) and the European Medicines Agency (EMA) for detection of the tyrosine kinase resistant clone *EGFR* p.T790M mutation in plasma as a companion diagnostic for second-line treatment of metastatic *EGFR*-mutant non-small cell lung cancer (NSCLC)[21, 25].

Prospective research cohort studies are ongoing to explore the possible clinical applications of ctDNA in cancer. The inclusion of ctDNA analysis into multiple clinical trials (ClinicalTrials.gov), signals the recent integration of this form of biomarker into routine clinical oncology.

Implementation of Aspect Liquid Biopsy

Clinical Labs has analytically validated an integrated test process for a comprehensive mutation profiling assay for clinical oncology patients using circulating tumour derived DNA extracted from blood.

Our technology, including (NGS), MassArray Agena Biosciences ULTRASeek and Droplet Digital PCR (ddPCR), is able to identify clinically relevant variants at a sensitivity down to 0.5% or less.

Aspect Liquid Biopsy is Less Invasive

Surgical tissue biopsies have some inherent shortcomings and risks, and do not guarantee enough material will be collected for accurate analysis in clinical practice. Liquid biopsy provides a non-invasive alternative sample source, allowing the identification of genomic alterations that can be addressed by targeted therapy. This non-invasive type of liquid biopsy can be taken easily and repeatedly over the course of a patient’s treatment. ctDNA provides new insight into diagnosis, prognosis and patient follow-up compared to traditional tissue biopsy.

The Quality Choice for Cancer Treatment Response Monitoring

Early detection is the holy grail of cancer management. The biggest advantage of liquid biopsy is the ability to detect the cancer biomarkers in blood earlier than conventional methods[22,23]. While correlating with imaging scans, it has been demonstrated that monitoring for tumour-derived DNA in the plasma can identify relapse or drug resistance well before clinical signs and symptoms appear, enabling earlier intervention and better outcomes[22,23].

In the future, instead of extensive imaging and invasive tissue biopsies, employing ctDNA as liquid biopsies could be used to guide cancer treatment decisions and perhaps even screen for tumours that are not yet visible on imaging.

Over the past several years there have been multiple studies demonstrating the clinical utility of liquid biopsy ctDNA analysis following surgical resection of colorectal cancers (CRCs)[7]. Most studies demonstrate better outcomes when no tumour-derived DNA is found in patients following surgery, or chemotherapy in colorectal cancer patients[7], whereas those where tumour DNA

is still present do better with the addition of more aggressive targeted treatment or chemotherapy.

It is important to note that for melanoma patients who harbour a *BRAF* mutation, targeted therapy remains the first-line treatment, particularly in Australia[11]. Tracking of *BRAFv600* ctDNA levels as patients undergo targeted treatment can potentially help identify the period when resistance to targeted therapy emerges. Gray et al. and Lee et al.[22,24] showed that baseline ctDNA levels predict response to immunotherapy in melanoma patients, and low basal ctDNA levels were significantly associated with long-term clinical benefit. Nevertheless, prospective clinical studies of survival in a larger cohort of patients are underway to validate the predictive value of ctDNA in melanoma patients treated with immunotherapy.

Aspect Liquid Biopsy Can Guide Treatment Decisions

Liquid biopsy can offer valuable insights into how best to treat cancer. ctDNA can be used to monitor the effects of cancer treatment and give an early warning about possible recurrence. The detection of resistant clones can offer clues to the reasons for treatment resistance[5,6] (see Fig.2). Recently, a third-generation *EGFR* Tyrosine Kinase Inhibitor (*TKI*), which is effective in tumours harbouring the T790M *EGFR* mutation (~50-60% of lung cancer patients[5,6,10]), was approved in Australia for patients with NSCLC harbouring the *EGFR* T790M mutation following progression on an *EGFR TKI*[9].

Serial analysis of ctDNA from the time of diagnosis throughout treatment can provide a dynamic picture of molecular disease changes, providing evidence that this non-invasive approach could also be used to monitor the development of secondary resistance and identify heterogeneous sub-clonal populations of tumour cells developing during the course of treatment. NCCN guidelines[8] recommend the use of liquid biopsy for lung cancer patients as an alternative for tissue in initial T790M EGFR testing[2,6]. However, if the plasma is negative, then a tissue biopsy is recommended, if feasible.

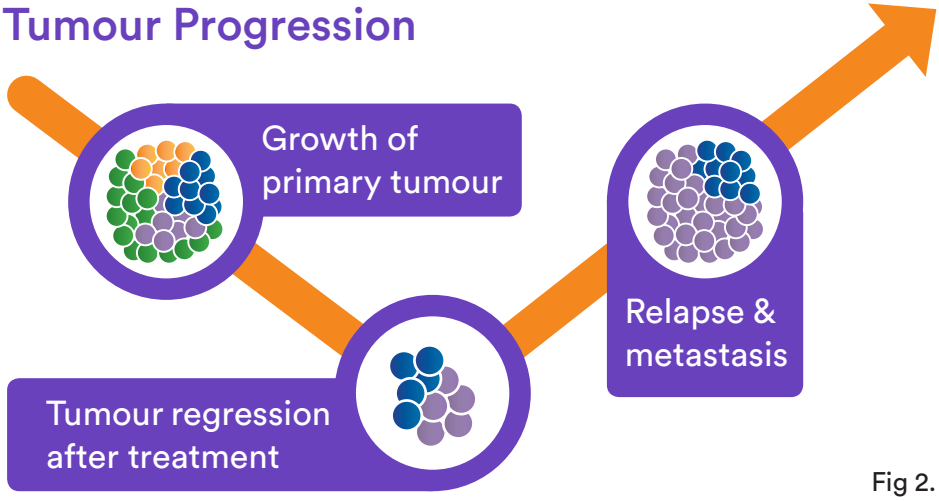

Fig 2.

How to Order?

Health Practitioners can order Aspect Liquid Biopsy for cancer patients using the Aspect request form. Some required information is listed on the form, including type of cancer and whether it is a new diagnosis and if the patient is on anti-tumour therapy (if known). Health Practitioners can download the Aspect Liquid Biopsy form on the Clinical Labs website at clinicallabs.com.au/aspect

What is the cost?

Out-of-pocket fee of $550. (No Medicare rebate available)

When will results be available?

Results will be available after 5-7 business days from the sample receipt date.

How is it collected?

This test requires two 10ml blood samples which can be taken at any of our collection centres.

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Precision Medicine, Cancer Genetics, Antenatal Screening, NIPT, Endocrine, Fertility Testing and Research & Medical Teaching

Dr Mirette Saad is a Consultant Chemical Pathologist and the National Clinical Director of Molecular Genetic Pathology at Australian Clinical Labs. At Clinical Labs, Dr Mirette Saad leads the Molecular Genetic testing for Non-Invasive Prenatal Testing (NIPT), carrier screening, personalised drug therapy and cancer. She is a member of the RCPA Chemical Pathology Advisory Committee and a Chair of precision medicine services at Australian Clinical Labs.

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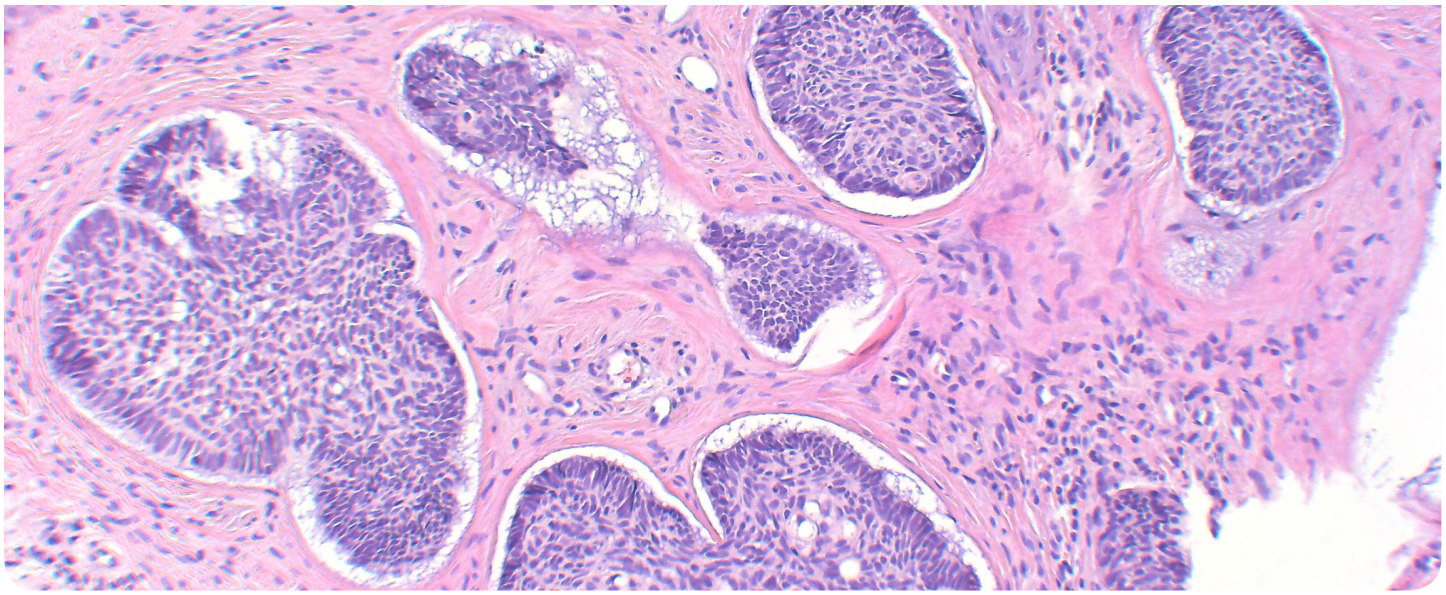
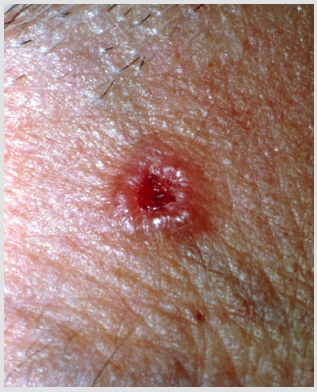
Skin Biopsy: Lesions and Inflammation

Dr Jenny Grew



Biopsies of the skin are generally used to diagnose skin pathologies, but occasionally are used in treatment. This information sheet serves to outline the techniques of biopsy, including: excision (elliptical, saucerisation/ shave, punch), incision, superficial shave, punch and wedge. The type of biopsy a clinician uses is dependent on the pathology of the individual patient.

Non-Pigmented Discrete Lesions



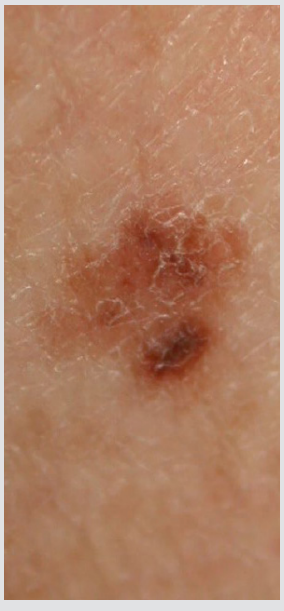
- A biopsy should be performed when a diagnosis is uncertain.
- Complete excision is recommended for suspected malignancy.
- Small and/or non-suspicious lesions can be removed using punch or shave biopsy.

Excision Biopsy: A well-differentiated squamous cell carcinoma or keratoacanthomas is diagnosed by excising the entire lesion. Partial biopsy often does not present enough information to make an accurate diagnosis.

For a patient with a broad lesion who is prone to keloid/ hypertrophic scar formation, saucerisation could aid in negating surgical and/or cosmetic difficulties, and can be used for the complete removal of in situ/thin lesions. The margins of these samples must remain intact and flat, enabling assessment of the entire sample (achieved by flattening the sample on a card). If atypical/pigmented areas are seen at the base following saucerisation, punch or elliptical excision of the base area may be required to remove further pathology.

Punch biopsy is preferable to shave biopsies, which are prone to sample errors. Many clinicians prefer to use a punch biopsy technique for thick, keratotic lesions. Large, deep lesions require an incisional or wedge biopsy, which includes tumor/fat margins, for accurate diagnosis.

Pigmented Lesions



Suspected melanoma:

- Excision margins 1-3 mm
- Small or superficial biopsies may not be representative - subsequent tumor staging may be difficult.

Partial biopsies can be used:

- If melanoma is unlikely
- For benign, pigmented melanotic macules on the genitals
- Cosmetic concerns
- Broad lesions
- Surgically difficult sites

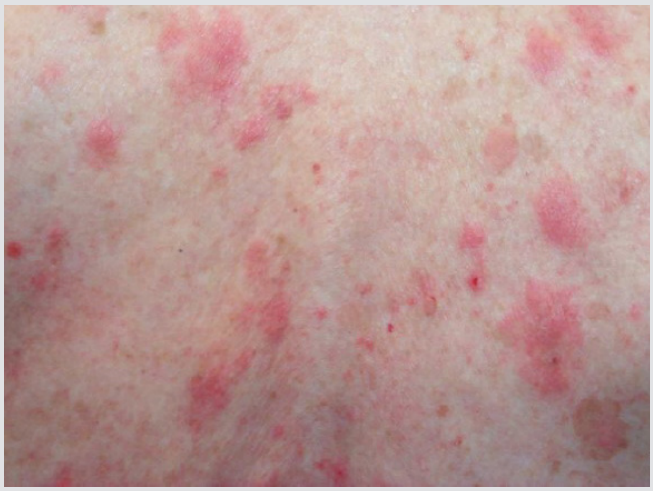
Saucerisation (including a 0.5-1.0 mm margin) can be performed for 'ugly duckling' dysplastic naevi.

If partial biopsy of suspected melanoma is unavoidable:

- The thickest area/s should be biopsied at greater depth.
- Multiple small shaves across different areas of lentigo-maligna-type lesions are recommended.

Small suspicious acral lesions can be removed using saucerisation which include a margin of healthy skin.

Rashes/Inflammatory Conditions



- 4 mm punch biopsy
- Incisional biopsy for larger, deeper lesions
- Saucerisation to remove entire blisters

Many rashes have similar histological patterns. A clinical description of the rash should accompany the biopsy sample and include: distribution, duration and course, other history (e.g. medication), clinical photographs (sent via email or text message) and clinical diagnosis to ensure accurate categorization of the sample.

Stating the biopsy type and reason for the biopsy will ensure that the sample is handled appropriately.

Lesions: A small rim of perilesional skin should be included in a biopsy of tissue that has not been excoriated or ulcerated. Frictional sites and lower limbs may have secondary features resulting in false negative results, and biopsy of these areas should be avoided. Multiple biopsies of the rash and a concurrent biopsy of normal skin may be helpful in disorders that are of polymorphous and pigmented appearance, respectively.

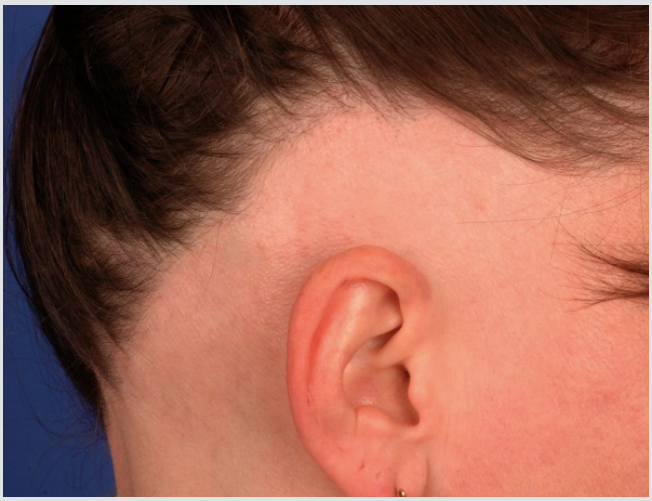
Blisters: Biopsies maintaining the attachment of the blister roof are important. A second biopsy of a non-blistered lesion or normal skin immediately adjacent to the lesion should be taken for direct immunofluorescence microscopy (DIF) and preserved in immunofluorescence transport medium or phosphate buffer saline.

Annular lesions (e.g. porokeratosis): Incisional biopsies should be taken from the center of the lesion in an outwards direction and include a 1 mm margin of normal skin.

Lupus erythematosus, dermatomyositis and vasculitis: The biopsy site is crucial. For lupus and dermatomyositis, biopsy an established lesion (>6 months old) that is active for routine histology and DIF. For vasculitis, biopsy an established, purpuric lesion (>72 hours old) for routine histology and an acute lesion (<24 hours old) for DIF.

Panniculitis: A deep or incisional biopsy, including subcutaneous fat, is recommended. If necrosis is present, a sample should be sent for culture.

Alopecia



- Two punch biopsies
- 4 mm diameter
- Parallel to the direction of hair growth/emergence.

Alopecia: Two biopsies should include the entire follicular unit, subcutaneous fat and be at least 5-6 mm in depth (no hairs emerging from the deep aspect). Such biopsies will allow the pathological examination of both vertical and horizontal sections of the biopsy. Clinical information including area of scalp involved, race, duration and clinical differential diagnosis are important.

Biopsy site

- **Non-cicatricial alopecia:** Most prominent area of hair loss.
- **Cicatricial alopecia:** Area of hair loss but not completely bald (active area where at least 6 months duration). Dermoscopy help identify suitable biopsy sites, e.g. areas of scaling or abnormal pigmentation. A second biopsy from the same area can be sent for DIF.

- Dr Jenny Grew

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Thank you

Updates From The Lab

In the past three months we have been very fortunate to welcome five excellent Victoria-based pathologists to our organisation. They are working from Ballarat, Bendigo, Geelong and Clayton and will provide great expertise for our medical community.

Dr Showan Balta — Anatomical Pathology, Ballarat

M.B.Ch.B., FRCPA

Dr Showan Balta obtained his M. B. Ch. B. from the University of Baghdad in Iraq. He finished his medical internship in Iraq and worked for a year as a rural general practitioner. He then moved with his family to Australia and was certified by the Australian Medical Council in 2010. Dr Balta completed his anatomical pathology training in Ballarat and St Vincent Hospital. He obtained his fellowship in Anatomical Pathology in 2017 and commenced working with Australian Clinical Labs at St John of God Hospital in Ballarat. His special interests include genitourinary, gastrointestinal, lung pathology and dermatopathology.

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Dr Frances Lee — Anatomical Pathology & Cytopathology, Geelong

B. Sci (Hons) MBBS, FRCPA

Dr Frances Lee obtained her MBBS from Flinders University in Adelaide and her Fellowship of the Royal College of Pathologists of Australasia in 2017. After completing two years as a junior doctor at University Hospital in Geelong, she undertook Anatomical Pathology training at the Royal Hobart Hospital and Hobart Pathology before completing her training with Australian Clinical Labs in Ballarat, Victoria.

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Dr Gabriel Scripcaru — Anatomical Pathology & Cytopathology, Clayton

FRCPA, MD

Dr Gabriel Scripcaru studied medicine at the Gr.T.Popa University of Medicine and Pharmacy in Iasi, Romania. Gabriel's clinical experience prior to anatomical pathology also included working in neurosurgery, emergency medicine and intensive care in both Australia and Scotland. His training in anatomical pathology comprised rotations at the the Royal Melbourne Hospital, and the Royal Women's and Royal Children's Hospitals in Melbourne. His main interests include dermatopathology, head and neck and soft tissue pathology.

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Dr Kate Stewart — Anatomical Pathology & Cytopathology, Clayton

B.Sc.B.Med.FRCPA

Dr. Kate Stewart obtained a Bachelor of Science with a pathology major at the University of Melbourne and then a Bachelor of Medicine from the University of Newcastle (NSW), qualifying in 1998. She began Anatomical Pathology training in 2000 at Austin Health (VIC). After rotations at the Royal Women's and Children's Hospitals and the Alfred Hospital, she obtained Fellowship of the RCPA in 2005. As a consultant, she has gained experience in a number of subspecialty areas in both the public and private sector in Melbourne.

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Dr Sagarika Tripathy — Anatomical Pathology, Bendigo

MBBS, FRCPA

Dr Tripathy holds a Bachelor of Medicine / Bachelor of Surgery from MKCG Medical College in India and a Doctor of Medicine (Pathology) from B.J. Medical College in India, graduating in 2008. She completed her Anatomical Pathology training in India and was employed as a Consultant Pathologist at the B.J. Medical College and Civil Hospital before relocating to Australia in 2013. Dr Tripathy then undertook further Anatomical Pathology training at Monash Health and the Peter MacCallum Cancer Centre. She obtained her Fellowship of the Royal College of Pathologists of Australasia in 2017.

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