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Solitary pulmonary nodule imaging approaches and the role of optical fibre-based technologies

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ABSTRACT   Solitary pulmonary nodules (SPNs) are a clinical challenge, given there is no single clinical sign or radiological feature that definitively identifies a benign from a malignant SPN. The early detection of lung cancer has a huge impact on survival outcome. Consequently, there is great interest in the prompt diagnosis, and treatment of malignant SPNs. Current diagnostic pathways involve endobronchial/ transthoracic tissue biopsies or radiological surveillance, which can be associated with suboptimal diagnostic yield, healthcare costs and patient anxiety. Cutting-edge technologies are needed to disrupt and improve, existing care pathways. Optical fibre-based techniques, which can be delivered *via* the working channel of a bronchoscope or *via* transthoracic needle, may deliver advanced diagnostic capabilities in patients with SPNs. Optical endomicroscopy, an autofluorescence-based imaging technique, demonstrates abnormal alveolar structure in SPNs *in vivo*. Alternative optical fingerprinting approaches, such as time-resolved fluorescence spectroscopy and fluorescence-lifetime imaging microscopy, have shown promise in discriminating lung cancer from surrounding healthy tissue. Whilst fibre-based Raman spectroscopy has enabled real-time characterisation of SPNs *in vivo*. Fibre-based technologies have the potential to enable *in situ* characterisation and real-time microscopic imaging of SPNs, which could aid immediate treatment decisions in patients with SPNs. This review discusses advances in current imaging modalities for evaluating SPNs, including computed tomography (CT) and positron emission tomography-CT. It explores the emergence of optical fibre-based technologies, and discusses their potential role in patients with SPNs and suspected lung cancer.