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Confocal Microscopy in Biomedical Research

Paul J. Rigby, Roy G. Goldie

Biomedical Confocal Microscopy Research Centre, Department of Pharmacology, University of Western Australia, Nedlands, Western Australia, Australia

Confocal microscopy has allowed a major advance in biological imaging, since it represents a rapid, cost effective means of examining thick tissue specimens. In most cases, this involves fluorescence imaging and it is increasingly being used as a basic tool in biomedical research. Confocal microscopy allows the collection of thin optical sections, without the need for physical sectioning of the tissue. Additionally, confocal microscopes can usually produce images with greater sensitivity, contrast and resolution than those produced with normal light microscopes. We attempt to explain how this technology might be better used as a routine research tool. Since high quality, in-focus optical sections of thick tissue preparations can be generated quickly, confocal microscopy, in combination with immunofluorescence histochemistry, can now be used to examine complex three-dimensional distributions of distinct structures within tissues such as nerves within airways. Additionally, ultraviolet confocal microscopy allows the assessment of both dynamic and static phenomena in living cells and tissues. Thus, in addition to the imaging of fluorescence associated with structural elements, confocal microscopes can be used to quantitatively evaluate the distribution and fluxes of intracellular ions like calcium. Rapid, line-scanning confocal microscopes can be used in the assessment of dynamic events. For example, the in vivo imaging of microvascular permeability in airways becomes possible for the first time. By providing examples of some of our uses for confocal microscopy, we might encourage others to explore this relatively new and important technology for examining events and structures in single cells, tissue samples and in intact animals.

Key words: bronchi; calcium; immunofluorescence microscopy; fluorescence microscopy; microscopy, confocal; muscle, smooth; substance P; trachea