

FURTHER DEVELOPMENTS

Augmented reality and minimal access surgical adjuncts

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The future of minimal access surgery will almost certainly feature more advanced applications of adjuncts to facilitate anatomical recognition and the localisation of pathology. These are becoming commonplace in both video-assisted and robotic-assisted procedures. Augmented reality

Augmented reality by definition comprises the fusion of projected computerised images with a real environment. In surgery, this involves the application of real-time imaging or other data overlaid via computer processing software onto the surgical field. Such technology may be particularly beneficial in minimal access surgery where the localisation of pathology and identification of anatomy may be more difficult than in open surgery because of the lack of digital palpation of the relevant structures. At an elementary level, examples include the use of indocyanine green for immunofluorescent localisation of tumours as well as vascular, bronchial or lymphatic structures. When bound to plasma proteins, indocyanine green emits light with near-infrared light. Through use of a specifically designed HD camera and software system with imposed pseudo-colour, areas of differential tissue density and vascular supply can be detected clearly without the need for digital palpation, thus facilitating complete resection and clear surgical margins. Its use is now well established in procedures such as minimal access liver, lung, renal and prostatic resections, and its role in other specialties such as colorectal surgery is also under investigation. The technology can be integrated into both video-assisted and robotic-assisted surgical procedures and is available within the da Vinci Xi and X robotic surgical systems as the Firefly mode, which can be turned on as required from the surgical console (Figure 10.7). - Another role for augmented reality in minimal access surgery is the overlay of imaging beside or directly onto the surgical field, 'navigating' the surgeon to the site of interest without the need to look away from the patient to review imaging. Such navigational techniques originated in image-guided diagnostics, enabling identification of pathology in areas more difficult to reach anatomically. Through increasing adoption of hybrid theatre complexes, these approaches may be utilised for both diagnosis and treatment in a single setting. An example is the use of navigational bronchoscopy to identify, diagnose and treat difficult to reach or small lung nodules. Preoperative planning CT scan is reconstructed by specialist software. The result is a 3D 'road map' of the bronchial tree and a side-by-side picture of real-time endobronchial images with those from the imaging system (Figure 10.8). The surgeon is then guided directly along the airway to the lesion of interest that can be

biopsied with on-site frozen section. Where the lesion is resectable but difficult to localise, a fiducial marker may be placed to enable localisation under fluoroscopy guidance in a second-stage procedure performed in a hybrid theatre (Figure 10.9). Where resection is not possible, ablation or other treatment may be offered in the same setting, both reducing surgical invasiveness and increasing the provision of curative surgery to patients who may not otherwise be candidates for resection. An area of interest is the application of head-mounted displays and eyeglasses to minimal access surgery . Although the majority of applications remain in the realm of simulation and training, the promise of real-time image guidance by means of multiplanar or imaging overlay of the surgeon's view is particularly attractive. Head-mounted displays may also provide data display or communication tools, reducing the need for the surgeon to look away from the operative field and allow real-time guidance by a trainer or professor. To date, clinical application is limited owing to time lag, the need for high-speed wireless Internet or Bluetooth connection and device weight and battery life; application to minimal access surgery remains under development.

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