Handheld single photon emission computed tomography (handheld SPECT) navigated video-assisted thoracoscopic surgery of computer tomography-guided radioactively marked pulmonary lesions

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OBJECTIVES
Radioactive marking can be a valuable extension to minimally invasive surgery. The technique has been clinically applied in procedures involving sentinel lymph nodes, parathyroidectomy as well as interventions in thoracic surgery. Improvements in equipment and techniques allow one to improve the limits. Pulmonary nodules are frequently surgically removed for diagnostic or therapeutic reasons; here video-assisted thoracoscopic surgery (VATS) is the preferred technique. VATS might be impossible with nodules that are small or located deep in the lung. In this study, we examined the clinical application and safety of employing the newly developed handheld single photon emission tomography (handheld SPECT) device in combination with CT-guided radioactive marking of pulmonary nodules.

METHOD
In this pilot study, 10 subjects requiring surgical resection of a pulmonary nodule were included. The technique involved CT-guided marking of the target nodule with a 20-G needle, with subsequent injection of 25-30 MBq (effective: 7-14 MBq) Tc-99m MAA (Macro Albumin Aggregate). Quality control was made with conventional SPECT-CT to confirm the correct localization and exclude possible complications related to the puncture procedure. VATS was subsequently carried out using the handheld SPECT to localize the radioactivity intraoperatively and therefore the target nodule. A 3D virtual image was superimposed on the intraoperative visual image for surgical guidance.

RESULTS
In 9 of the 10 subjects, the radioactive application was successfully placed directly in or in the immediate vicinity of the target nodule. The average size of the involved nodules was 9 mm (range 4-15). All successfully marked nodules were subsequently completely excised (R0) using VATS. The procedure was well tolerated. An asymptomatic clinically insignificant pneumothorax occurred
in 5 subjects. Two subjects were found to have non-significant discrete haemorrhage in the infiltration canal of the needle. In a single subject, the radioactive marking was unsuccessful because the radioactivity spread into the pleural space.

CONCLUSIONS
In our series of 10 patients, it was demonstrated that using handheld SPECT in conjunction with VATS to remove radioactively marked pulmonary nodules is feasible. The combination of proven surgical techniques with a novel localization device (handheld SPECT) allowed successful VATS excision of pulmonary nodules which, due to their localization and small size, would typically have required thoracotomy.

REGISTRATION
ClinicalTrials.gov, NCT02050724, Public 01/29/214, Joachim Müller.