**Diagnosis of borderline ovarian tumours by rapid evaporative ionisation mass spectrometry (REIMS) using the surgical intelligent knife (iKnife)**

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**Introduction**

Borderline ovarian tumours (BOT) are often diagnosed in women of childbearing age, when it is reasonable to perform unilateral oophorectomy, for low stage disease, to retain fertility. Sensitivity for frozen section diagnosis of BOT ranges from 25-87%, therefore reliable diagnosis can only be made with full histopathology after hysterectomy and bilateral salpingo-oophorectomy. The surgical intelligent knife combines electrosurgical diathermy with rapid evaporative ionisation mass spectrometry to detect phospholipid signatures in tissue, allowing real-time diagnosis intra-operatively.

**Methods**

Fresh frozen samples of tissue were thawed, then cut with the REIMS iKnife. The surgical smoke was processed in a mass spectrometer. Samples had confirmatory histopathological diagnosis post-sampling and these diagnoses were matched with corresponding spectra in a reference library. Principal component (PCA) and linear discriminant analysis (LDA) with leave-one-out cross-validation were used to interrogate the dataset.

**Results**

285 spectra were obtained from 75 samples of BOT, ovarian cancer (OC) and normal ovary. There was clear clustering of the three groups in PCA/LDA analysis. BOT separated distinctly from normal ovary with 95.6% diagnostic accuracy. BOT and OC also separated well with 88% correct tissue classification in the cross-validation analysis.

**Conclusion**

BOT, OC and normal ovary have unique phospholipid signatures. These results suggest, that with optimisation of these models, it is feasible to provide accurate intra-operative tissue diagnosis in seconds with the new and exciting REIMS iKnife technology. There is potential to reduce the number of radical surgeries for suspected OC, which results in the loss of fertility, by providing real-time tissue diagnosis intra-operatively.