**Introduction:** Recent development of methods to measure $pO_2$ in the clinic has generated data confirming a prognostic relationship between tumor $pO_2$ and clinical outcome. These results provide a powerful stimulus for development of enhanced methods for monitoring tumor $pO_2$. We have been developing a method: *FREDOM* (Fluorine Relaxometry using Echo planar imaging for Dynamic Oxygen Mapping), which typically provides $pO_2$ measurements at > 50 individual locations in 8 minutes with a precision of 1-3 torr. We have now compared this approach with the new commercial OxyLite™ fiber-optic based oxygen monitoring system.

**Methods:** The relatively slow growing Dunning rat prostate adenocarcinoma R3327-HI (volume doubling time 10 days) was implanted in a skin pedicle on the foreback of Copenhagen rats (1). Once the tumor reached ~ 2 cm diameter, the rat was anesthetized with 1.5% isoflurane in air (1 dm³/min). Three optical fiber based probes (230 µm diameter) connected to a four channel OxyLite™ system (Oxford Optronix, UK) were inserted into the tumor. Sensors were moved until they were located at representative regions with high and low $pO_2$. Measurements were performed with respect to respiratory challenge using sequentially oxygen and carbogen. The following day the rat was re-anesthetized and 45 µl hexafluorobenzene were introduced directly into the tumor at both central and peripheral locations using a 32 G needle. $^1H$ PBSR-EPI relaxometry (2) with an enhanced acquisition protocol (3) was applied to generate maps of tumor oxygenation with respect to respiratory challenge.

**Results:** OxyLite™ indicated baseline $pO_2$ of 1.3, 17 and 1.5 torr at three respective locations with distinct stability over a period of 10 mins. Altering the inhaled gas to either oxygen or carbogen showed significant changes in all regions (p< 0.001; Fig. 1), which reversed upon reverting to air inhalation. $^1H$ EPI provided $pO_2$ values simultaneously from ~ 50 individual locations and dynamic changes are shown for a representative voxel (Fig. 2).

**Discussion:** Each approach shows similar results for the influence of respiratory challenge on dynamic changes in regional oxygenation in the well differentiated slow growing R3327-HI tumor. Strengths of the fiber optic approach are the ability to detect $pO_2$ almost instantly and move the probes to specific tumor regions, e.g., with high or low $pO_2$ as desired. The instrument is also relatively inexpensive. By contrast, the FREDOM approach provides an extensive map of regional tumor $pO_2$ with many more individual locations, providing a more comprehensive indication of tumor heterogeneity. Most significantly, the two approaches revealed similar patterns of oxygenation in this tumor line, providing further evidence for the robustness and validity of each approach.

![Fig. 1. $pO_2$ dynamics at 3 locations using OxyLite™](image1.png)

![Fig. 2. Dynamic variation of $pO_2$ in a single voxel by $^1H$ EPI respiratory challenge.](image2.png)

**References:**


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