

HYPOXIA IN BRAIN TUMORS: CHARACTERIZATION AND MODIFICATION.

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It is well recognized that hypoxia is associated with tumor progression and a reduced sensitivity of tumors to radiation and some forms of chemotherapy. The major pathophysiological mechanisms leading to tumor hypoxia are structural and functional abnormalities in the tumor microvasculature, an increase in O₂ diffusion distances, and tumor- or therapy-induced anemia resulting in a reduced O₂ capacity of the blood.

In human gliomas there is clear indication that the oxygenation status is compromised as compared to normal brain tissue. Whereas in normal human brain the median oxygen tension (pO₂) is 24 – 27 mmHg, in gliomas the median pO₂ values are usually distinctly lower (see Table).

Table: Oxygenation status of primary brain tumors vs. normal brain

	median pO ₂ [mmHg]	f (0 – 5 mmHg) [%]	References
low-grade gliomas	17 15		Collingridge et al. 1999 Lally et al. 2004
high-grade gliomas	6 13 3 22	28 25	Collingridge et al. 1999 Clavo et al. 2002 Lally et al. 2004 Evans et al. 2004
glioblastomas	7 9	46	Rampling et al. 1994 Beppu et al. 2002
normal brain	24 27 24	2 8 2	Rampling et al. 1994 Clavo et al. 2002 Vaupel 1994, 2002, Vaupel et al. 2003

pO₂ values in brain tumors varied widely among patients (and among observers using the same technology). The extent of hypoxia was independent of clinical tumor size and of the magnitude of perfusion.

In the clinical setting, increases in brain tumor pO₂ levels were observed upon hyperbaric oxygen exposures, hyperoxic hypercapnic gas mixtures, and cervical spinal cord stimulation.