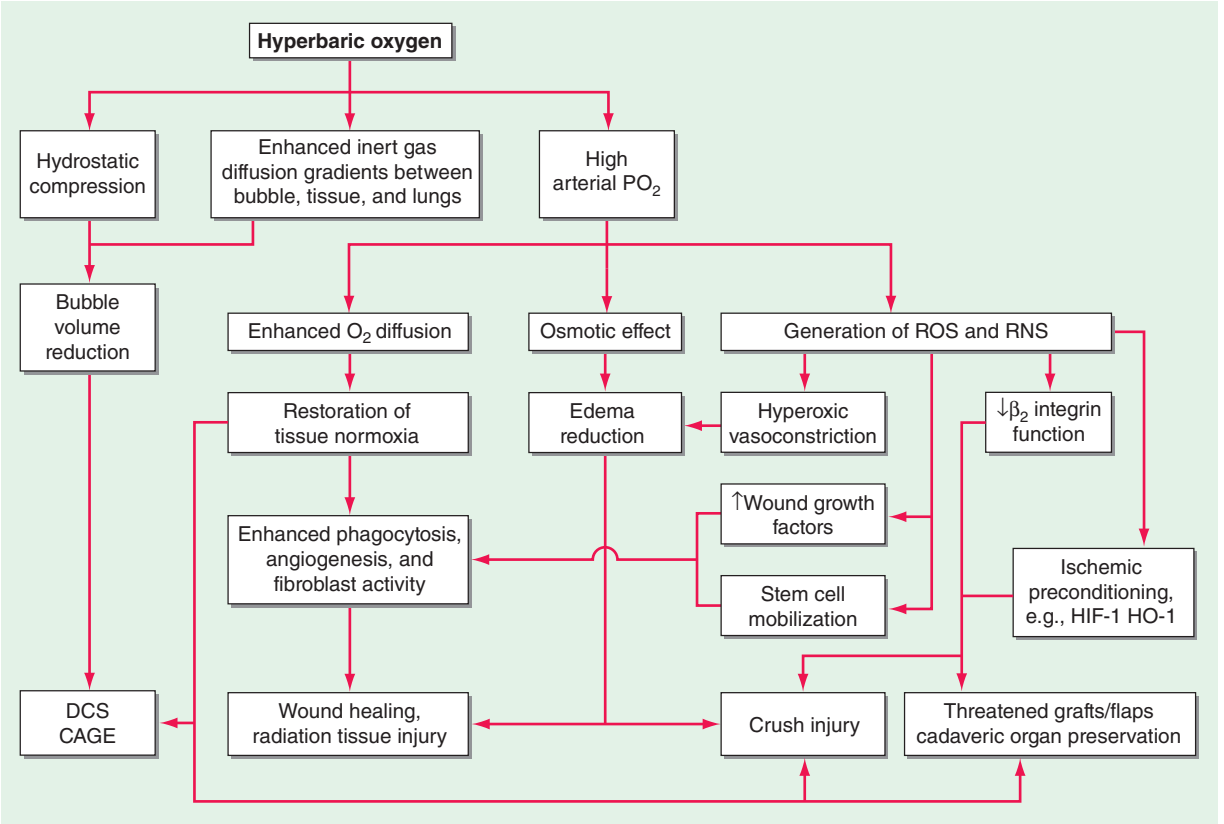

FIGURE 477e-3 Mechanisms of action of hyperbaric oxygen. There are many consequences of compression and oxygen breathing. The cell-signaling effects of HBO_2T are the least understood but potentially most important. Examples of indications for use are shown in the shaded boxes. CAGE, cerebral arterial gas embolism; DCS, decompression sickness; HIF-1, hypoxia inducible factor-1; HO-1, hemoxygenase 1; RNS, reactive nitrogen species; ROS, reactive oxygen species.

ADVERSE EFFECTS OF THERAPY

HBO_2T is generally well tolerated and safe in clinical practice. Adverse effects are associated with both alterations in pressure (barotrauma) and the administration of oxygen.

BAROTRAUMA

Barotrauma occurs when any noncompliant gas-filled space within the body does not equalize with environmental pressure during compression or decompression. About 10% of patients complain of some difficulty equalizing middle-ear pressure early in compression, and although most of these problems are minor and can be overcome with training, 2–5% of conscious patients require middle-ear ventilation tubes or formal grommets across the tympanic membrane. Unconscious patients cannot equalize and should have middle-ear ventilation tubes placed prior to compression if possible. Other less common sites for barotrauma of compression include the respiratory sinuses and dental caries. The lungs are potentially vulnerable to barotrauma of decompression as described below in the section on diving medicine, but the decompression following HBO_2T is so slow that pulmonary gas trapping is extremely rare in the absence of an undrained pneumothorax or lesions such as bullae.

OXYGEN TOXICITY

The practical limit to the dose of oxygen, either in a single treatment session or in a series of daily sessions, is oxygen toxicity. The most common acute manifestation is a seizure, often preceded by anxiety and agitation, during which time a switch from oxygen to air breathing may avoid the convulsion. Hyperoxic seizures are typically generalized tonic-clonic seizures followed by a variable postictal period. The cause is an overwhelming of the antioxidant defense systems within the brain. Although clearly dose-dependent, onset is very variable both between individuals and within the same individual on different days. In routine clinical hyperbaric practice, the incidence is about 1:1500 to 1:2000 compressions.

Chronic oxygen poisoning most commonly manifests as myopic shift. This is due to alterations in the refractive index of the lens following oxidative damage that reduces the solubility of lenticular proteins in a process similar to that associated with senescent cataract formation. Up to 75% of patients show deterioration in visual acuity after a course of 30 treatments at 202.6 kPa (2 ATA). Although most return to pretreatment values 6–12 weeks after cessation of treatment, a small proportion do not recover. A more rapid maturation of preexisting cataracts has occasionally been associated with HBO_2T. Although a theoretical problem, the development of pulmonary oxygen toxicity over time does not seem to be problematic in practice—probably due to the intermittent nature of the exposure.

CONTRAINDICATIONS TO HYPERBARIC OXYGEN

There are few absolute contraindications to HBO_2T. The most commonly encountered is an untreated pneumothorax. A pneumothorax may expand rapidly on decompression and come under tension. Prior to any compression, patients with a pneumothorax should have a patent chest drain in place. The presence of other obvious risk factors for pulmonary gas trapping such as bullae should trigger a very cautious analysis of the risks of treatment versus benefit. Prior bleomycin treatment deserves special mention because of its association with a partially dose-dependent pneumonitis in about 20% of people. These individuals appear to be at particular risk for rapid deterioration of ventilatory function following exposure to high oxygen tensions. The relationship between distant bleomycin exposure and subsequent risk of pulmonary oxygen toxicity is uncertain, however late pulmonary fibrosis is a potential complication of bleomycin, and any patient with a history of receiving this drug should be carefully counseled prior to exposure to HBO_2T. For those recently exposed to doses above 300,000 IU (200 mg) and whose course was complicated by a respiratory reaction to bleomycin, compression should be avoided except in a life-threatening situation.