

Hyperbaric Oxygen for Air or Gas Embolism

A referral guide for emergency and referring physicians in Canada.

Condition: **Air or Gas Embolism**

Open-access studies: **30**

Updated **June 2026**

Reviewed **quarterly**

For referring and emergency physicians in Canada. Air or gas embolism is one of the 14 conditions for which Canadian hospital-based hyperbaric programmes, working within Health Canada-aligned practice, provide hyperbaric oxygen therapy (HBOT) under provincial health insurance, and it is treated as a time-critical emergency at every such programme. Recompression is the definitive treatment, and the time to chamber is the strongest determinant of neurological recovery. This guide summarises when to refer, how to assess and stabilise the patient before referral, what the evidence supports, the Canadian referral pathway, and contraindications. It closes with the complete list of open-access research published since 2020, each linked to its free full text.

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When to refer

Refer immediately for recompression when a patient has a sudden focal neurological deficit, unexplained altered mental status, seizure, or cardiovascular collapse appearing within minutes of any event that could introduce gas into the circulation. Air or gas embolism is a clinical diagnosis, and you should not wait for imaging confirmation before contacting the hyperbaric team. Refer when any of the following applies:

Recognising the Embolic Event



New stroke-like deficits or collapse in close temporal relationship to these procedures = gas embolism until proven otherwise. Do not wait for imaging confirmation.

Plausible Exposures

Iatrogenic Sources

- Central venous catheter (CVC) insertion/removal
- Haemodialysis line disconnection
- Cardiopulmonary bypass
- Neurosurgery in sitting position
- Mechanical ventilation at high inspiratory pressures
- Percutaneous lung biopsy
- Endoscopy with insufflation
- Laparoscopic surgery

Diving / Barotrauma Sources

- Pulmonary barotrauma from a breath-hold or rapid scuba ascent.

Clinical Features

- **Sudden focal neurological deficit**
- **Unexplained altered mental status**
- **Seizure**
- **Cardiovascular collapse**

(Features typically appear within minutes of exposure)

FIGURE

Recognising air or gas embolism: new stroke-like deficits, unexplained altered mental status, seizure, or cardiovascular collapse in close temporal relationship to an iatrogenic procedure or a dive should be treated as gas embolism until proven otherwise. Do not wait for imaging confirmation.

- **An iatrogenic source is plausible.** In Canadian hospitals the leading sources are central venous catheter insertion or removal, haemodialysis line disconnection, cardiopulmonary bypass, neurosurgery in the sitting position, mechanical ventilation at high inspiratory pressures, percutaneous lung biopsy, endoscopy with

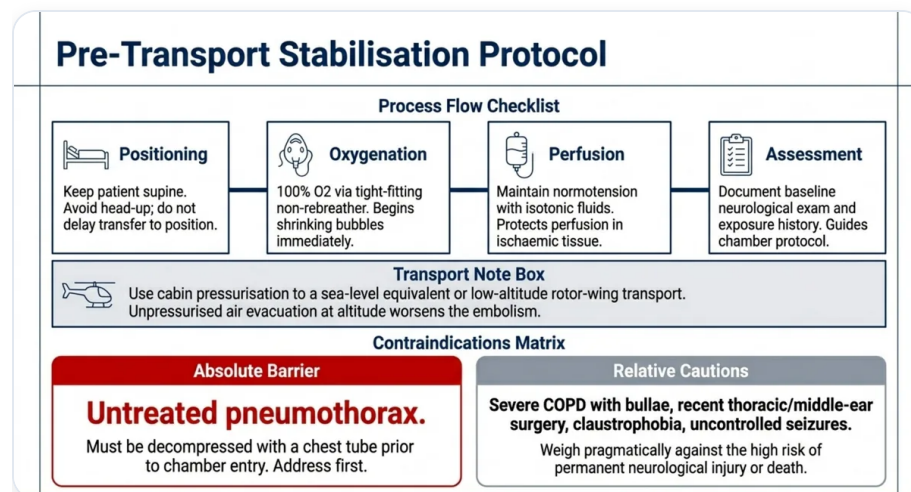
insufflation, and laparoscopic surgery. New stroke-like deficits or collapse in close temporal relationship to any of these should be treated as gas embolism until proven otherwise.

- **A diving or barotrauma source is present.** Pulmonary barotrauma from a breath-hold or rapid ascent during scuba diving can force gas into the arterial circulation; neurological symptoms after surfacing are an embolism until excluded.
- **Stroke-like or cardiovascular features.** Focal deficit, seizure, loss of consciousness, or sudden cardiovascular collapse arising within minutes of a plausible exposure are all indications for urgent recompression.

Because the condition is rapidly fatal or disabling without recompression, the threshold to call the hyperbaric team should be low. When the clinical picture fits, refer first and complete the workup in parallel.

Assessing the patient before referral

While arranging recompression, the receiving department should stabilise the patient and begin treatment without delay:



FIGURE

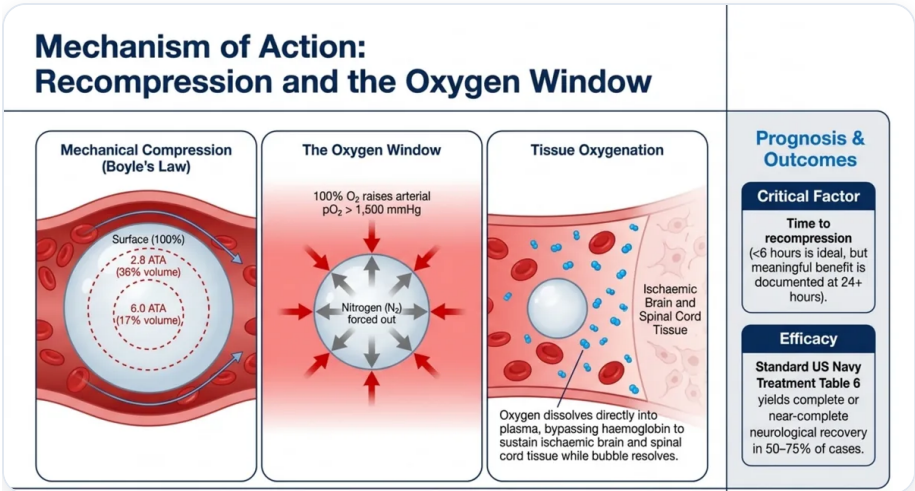
Pre-transport stabilisation: keep the patient supine on 100 percent oxygen, maintain normotension with isotonic fluids, and document a baseline neurological examination and exposure history. Drain any pneumothorax before chamber entry, and use cabin pressurisation if air transport is unavoidable.

- Keep the patient **supine**. Avoid head-up positioning, and do not delay transfer to position the patient.
- Place the patient on **100 percent oxygen by tight-fitting non-rebreather mask** immediately and continue it through transport. High-flow oxygen begins shrinking the gas bubbles and establishing the oxygen gradient before chamber entry.
- Maintain **normotension with isotonic fluids**; hypotension worsens cerebral and spinal perfusion in already-ischaemic tissue.
- **Decompress any pneumothorax** with a chest tube before chamber entry. An untreated pneumothorax is the one absolute barrier to recompression and must be addressed first.
- Document a **baseline neurological examination**. Serial neurological assessment guides both the chamber protocol and the decision on follow-up sessions, so an accurate reference point at presentation is essential.
- Record the **exposure history**: the procedure or dive involved, the time of symptom onset, and the interval since the suspected embolic event, since time to recompression is the factor that most directly predicts outcome.

A note on transport: air evacuation at altitude can worsen the embolism through bubble re-expansion. Cabin pressurisation to a sea-level equivalent or low-altitude rotor-wing transport is preferred when air transfer is unavoidable.

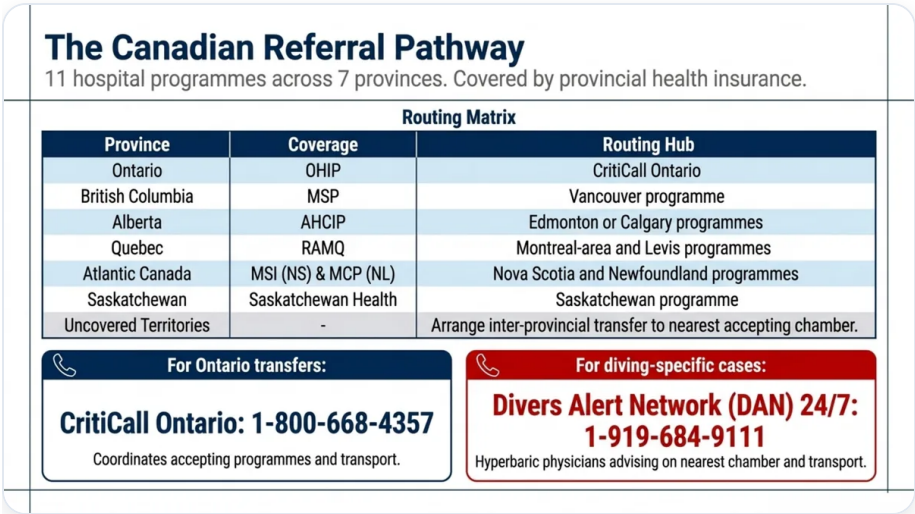
What the evidence supports

Recompression for arterial gas embolism is the established standard of care and is recognised as an accepted HBOT indication within Health Canada-aligned hospital practice. Because the condition cannot ethically be randomised, the supporting evidence comes from physiological rationale and consistent clinical experience rather than controlled trials. In published case series, the standard US Navy Treatment Table 6 has been associated with complete or near-complete neurological recovery in roughly 50 to 75 percent of treated cases, with the best results reported when treatment begins early.



The Canadian referral pathway

Air or gas embolism is treated as an emergency at Canadian hospital-based hyperbaric programmes and is covered by provincial health insurance. Eleven hospital programmes operate across seven provinces (Ontario, Quebec, British Columbia, Alberta, Nova Scotia, Newfoundland and Labrador, and Saskatchewan), with coverage under OHIP, RAMQ, MSP, AHCIP, MSI, MCP, and Saskatchewan Health respectively.



FIGURE

The Canadian referral pathway: eleven hospital-based programmes across seven provinces, covered by provincial health insurance. In Ontario, CritiCall Ontario (1-800-668-4357) coordinates accepting programmes and transport, and the Divers Alert Network line (1-919-684-9111) advises on diving-related cases.

- **Ontario:** call **CritiCall Ontario at 1-800-668-4357**, the provincial line that connects emergency departments to accepting hospital programmes and helps arrange transport when needed. CritiCall can also be a useful first call for general inter-facility coordination.
- **British Columbia:** route to the hospital hyperbaric programme in Vancouver; covered under MSP.
- **Alberta:** route to a hospital hyperbaric programme in Edmonton or Calgary; covered by AHCIP.
- **Quebec:** RAMQ covers the Montreal-area and Levis hospital hyperbaric programmes.
- **Atlantic Canada:** Nova Scotia (MSI) and Newfoundland and Labrador (MCP) operate hospital programmes; Saskatchewan Health covers the Saskatchewan programme.
- **Provinces and territories without a chamber:** arrange inter-provincial air or ground transfer to the nearest accepting hospital programme, with attention to cabin pressurisation if air transport is used.

For diving-related cases, the **Divers Alert Network 24/7 emergency line at 1-919-684-9111** is staffed by hyperbaric physicians and can help Canadian emergency departments locate the nearest accepting chamber and advise on transport.

Contraindications and cautions

The only absolute contraindication relevant in this setting is an **untreated pneumothorax**, which must be decompressed with a chest tube before chamber entry. Relative cautions include severe chronic obstructive pulmonary disease with bullae, recent thoracic or middle-ear surgery, claustrophobia, and uncontrolled seizures; these are weighed pragmatically against the high risk of death or permanent neurological injury, since suspected arterial gas embolism is rapidly fatal without recompression and has essentially no acceptable alternative treatment. As always, the gas embolism source should be identified and corrected (for example,

securing or removing the offending line) so that further embolisation does not continue during stabilisation and transfer.

How to use the research list below

The list contains every air or gas embolism study in the Canada Hyperbarics database that was published in 2020 or later **and** has a freely available full-text version, each linked directly to that full text. Paywalled and abstract-only studies are excluded, and retracted studies are removed. This is a reference list, not a set of summaries. Counts and the open-access set refresh each quarter.

You can review the broader clinical overview, including the full taxonomy of iatrogenic and diving-related sources, on the [air or gas embolism condition page](#).

Open-access research, 2020 to present

30 studies with a free full-text version, grouped by year, newest first. Each title links to the full text. Retracted and paywalled studies are excluded; the set refreshes quarterly.

2026

1. Obeidat M et al.. Blinded by the depths: A case of acute loss of vision in a scuba diver. *Medical journal, Armed Forces India*.
2. Fan Y et al.. Air embolism resulting from contrast agent injection during coronary computed tomography: a case report. *J Cardiothorac Surg*.
3. Wang J et al.. Gas in the Brain: A Case of Cerebral Arterial Gas Embolism. *J Emerg Med*.
4. Zhu Y et al.. From shadows to light: navigating the rare complication of cerebral air embolism from a case report. *Front Med (Lausanne)*.

2025

1. Wang Z et al.. Severe cerebral air embolism after CT-guided hook-wire localization - complete recovery and delayed lung resection: A case report. *Medicine (Baltimore)*.
2. Fakkert R et al.. Functional outcome and quality of life after iatrogenic cerebral air embolism treated with hyperbaric oxygen: a prospective cohort study. *Diving Hyperb Med*.
3. Mann P et al.. Bubble Trouble: Portal Venous Gas Embolism Following Hydrogen Peroxide Enema. *ACG Case Rep J*.
4. Reyhanoglu G et al.. Cerebral and Portal Venous Air Embolism: A Complication of PICC Line Placement. *Case Rep Radiol*.
5. Fang T et al.. Cerebral Air Embolism After Percutaneous Kyphoplasty: A Case Report and Systematic Review of Mechanisms and Management. *World Neurosurg*.
6. Vallélian M et al.. Two cases of highly concentrated hydrogen peroxide poisoning with portal venous gas treated using hyperbaric oxygen therapy. *BMJ Case Rep*.

2024

1. Li J et al.. Systemic air embolism associated with endoscopic retrograde cholangiopancreatography: A case report. *World J Gastrointest Endosc*.
2. Bousbaa A et al.. Cerebral air embolism following a hemodialysis session successfully treated with hyperbaric oxygen: a case report. *Ther Adv Neurol Disord*.
3. Kondo N et al.. Preventive Hyperbaric Oxygen Therapy for Asymptomatic Left Ventricular Air During CT-Guided Lung Needle Biopsy. *Cureus*.
4. Htay A et al.. Lateral ST-elevation myocardial infarction from systemic air embolism after CT guided lung biopsy. *Diving Hyperb Med*.
5. Zhu G et al.. Veno-arterial extracorporeal membrane oxygenation for the treatment of obstructive shock caused by venous air embolism: A case report. *World J Clin Cases*.
6. Franco MA et al.. The Influence of Advanced Hyperbaric Medical Training on Arterial Gas Embolism Treatment. *Military medicine*.

2023

1. Dinis-Ferreira S et al.. Pneumocephalus Secondary to Cerebral Air Embolism After Acute Bleeding in an Emphysema Bulla. *Cureus*.
2. Hjelte C et al.. Risk assessment of SWEN21 a suggested new dive table for the Swedish armed forces: bubble grades by ultrasonography. *Diving and hyperbaric medicine*.
3. Seong S et al.. Cerebral Air Embolism After Air-Powder Abrasive Dental Treatment: A Case Report. *Brain Neurorehabil*.

2022

1. Rosén A et al.. Protein tau concentration in blood increases after SCUBA diving: an observational study. *European journal of applied physiology*.

2. Chevasutho P et al.. Descriptive study of decompression illness in a hyperbaric medicine centre in Bangkok, Thailand from 2015 to 2021. *Diving Hyperb Med*.
3. Xing H et al.. Case report: Cerebral artery air embolism during CT-guided lung nodule resection in hybrid theater. *Front Surg*.
4. Pietersen P et al.. Systemic air embolism following computed-tomography-guided transthoracic needle biopsy of lung lesion - a systematic search of case reports and case series. *Acta Radiol Open*.
5. Kassir EV et al.. Portal and Mesenteric Vein Thrombosis Associated with Decompression Sickness in a 48-Year-Old Deep Sea Self-Contained Underwater Breathing Apparatus (SCUBA) Diver. *The American journal of case reports*.
6. Savioli G et al.. Dysbarism: An Overview of an Unusual Medical Emergency. *Medicina (Kaunas)*.

2021

1. Oka Y et al.. Postoperative cerebral air embolism with delayed abnormal brain MRI findings. *eNeurologicalSci*.
2. Lee J et al.. Massive cerebral air embolism following percutaneous transhepatic biliary drainage: A case report. *Medicine (Baltimore)*.
3. He Y et al.. Cerebral arterial air embolism after endobronchial electrocautery: a case report and review of the literature. *BMC Pulm Med*.
4. Hadjadj S et al.. To Take One's Breath Away: Echocardiography-Guided Aspiration of an Air Embolism During a MitraClip Procedure. *CJC open*.

2020

1. Tan T et al.. A diver's dilemma - a case report on bronchopulmonary sequestration. *BMC Pulm Med*.

Canada Hyperbarics, canadahyperbarics.ca. Reviewed each quarter. For clinicians; does not replace individual clinical judgement.