

Hyperbaric Oxygen for Gas Gangrene

A referral guide for emergency and referring physicians in Canada.

Condition: **Gas Gangrene** Open-access studies: **14** Updated **June 2026** Reviewed **quarterly**

For referring and emergency physicians in Canada. Gas gangrene (clostridial myonecrosis) is one of the 14 conditions Health Canada recognises for hyperbaric oxygen therapy (HBOT), and it is treated as a surgical emergency at every Canadian hospital-based hyperbaric programme, fully covered by provincial health insurance. HBOT is adjunctive: it does not replace urgent surgical debridement and broad-spectrum intravenous antibiotics, which remain the primary determinants of survival. This guide summarises when to refer, how to assess 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, in parallel with surgical and antibiotic management, when a patient has confirmed or strongly suspected clostridial myonecrosis. Do not wait for hyperbaric assessment before debriding, and do not delay debridement to arrange transfer. The clinical picture that should prompt an emergency referral includes:

DIAGNOSTIC TRIGGERS: RECOGNIZING CLOSTRIDIAL MYONECROSIS

 SEVERE PAIN Disproportionate to visible findings; the classic early hallmark.	 RAPIDLY SPREADING NECROSIS Bronze or dusky discolouration, bullae, thin serosanguinous discharge.	 PALPABLE CREPITUS OR GAS Tracking through soft tissue and fascial planes.	 SYSTEMIC TOXICITY Tachycardia, hypotension, altered mentation, rapid deterioration.	 COMPATIBLE HISTORY Penetrating/crush trauma, contaminated surgical/obstetric wounds, or spontaneous in immunocompromised patients.
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Referral is driven by the clinical syndrome. Microbiological confirmation arrives too late to guide the first hours of care.

FIGURE

Recognising clostridial myonecrosis: severe pain out of proportion to visible findings is the classic early hallmark, followed by rapidly spreading necrosis with bronze discolouration, palpable crepitus or radiographic gas, and systemic toxicity. Refer on the clinical syndrome and a compatible exposure history, because microbiological confirmation arrives too late to guide the first hours of care.

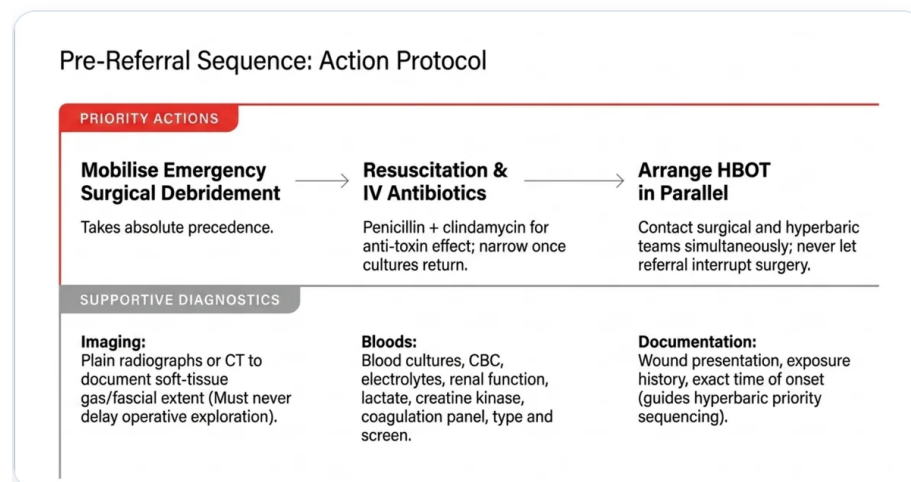
- **Severe pain disproportionate to visible findings**, the classic early hallmark, often preceding overt skin changes.
- **Rapidly spreading muscle necrosis** with bronze or dusky discolouration, bullae, and a thin serosanguinous discharge.

- **Palpable crepitus or radiographic gas** tracking through soft tissue and fascial planes.
- **Systemic toxicity** out of proportion to local findings: tachycardia, hypotension, altered mentation, and rapid clinical deterioration.
- **A compatible exposure history**, most often penetrating or crush trauma, contaminated surgical or obstetric wounds, or, less commonly, spontaneous (non-traumatic) myonecrosis in an immunocompromised or malignancy patient.

Time to surgical debridement is the strongest single predictor of survival, and mortality rises sharply when debridement is delayed beyond 12 to 24 hours. The referral decision is therefore driven by the clinical syndrome, not by microbiological confirmation, which arrives too late to guide the first hours of care.

Assessing the patient before referral

While arranging surgical management and hyperbaric assessment, the receiving team should:



FIGURE

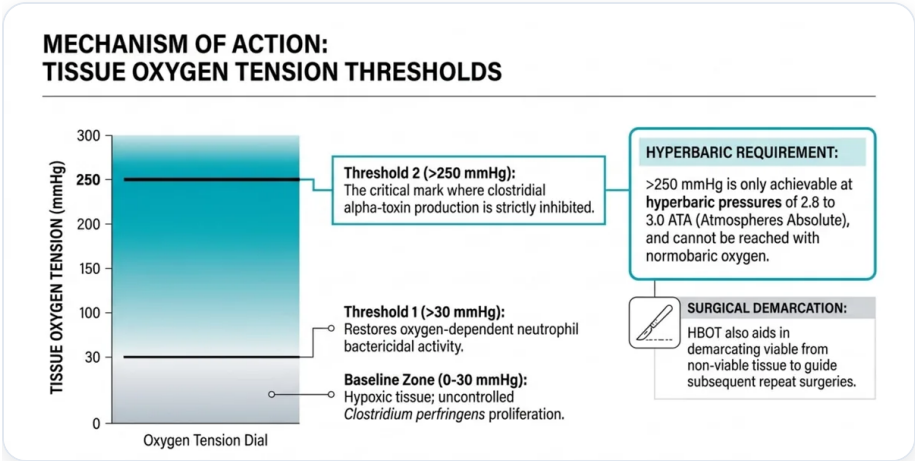
The pre-referral sequence is debride first, antibiotics second, hyperbaric oxygen third. Mobilise emergency surgical debridement, start resuscitation and broad-spectrum antibiotics (typically penicillin plus clindamycin for its anti-toxin effect), and contact the surgical and hyperbaric teams in parallel. Imaging and bloods support the workup but must never delay operative exploration.

- Begin **resuscitation and broad-spectrum intravenous antibiotics** without delay, using a regimen with clostridial coverage (typically a penicillin plus clindamycin for its anti-toxin effect), narrowed once cultures return.
- Mobilise **emergency surgical debridement**, which takes precedence over every other step. The treatment sequence is debride first, antibiotics second, HBOT third.
- Obtain **plain radiographs or CT** of the affected region to document soft-tissue gas and the extent of fascial involvement, recognising that imaging supports but never delays operative exploration.
- Draw **blood cultures, a complete blood count, electrolytes, renal function, lactate, creatine kinase, and a coagulation panel**, and type and screen for likely operative blood loss.
- Document the **wound, the exposure history, and the time of onset**, so the hyperbaric team can prioritise the first session relative to the index debridement.

What the evidence supports

The clostridial alpha-toxin produced by *Clostridium perfringens* drives the fulminant tissue destruction characteristic of this infection. The mechanistic rationale for HBOT is well established: alpha-toxin production is inhibited once tissue oxygen tension exceeds roughly 250 mmHg, a threshold reached only at hyperbaric pressures of about 2.8 to 3.0 ATA and not achievable with normobaric oxygen. At these pressures the chamber also restores oxygen-dependent neutrophil

bactericidal activity, which requires a tissue oxygen tension above roughly 30 mmHg, and supports clearer demarcation of viable from non-viable tissue to guide subsequent surgical debridement. The Undersea and Hyperbaric Medical Society classifies gas gangrene as an accepted indication.



FIGURE

How hyperbaric oxygen contributes: raising tissue oxygen tension above roughly 250 mmHg, a level reached only at about 2.8 to 3.0 ATA, inhibits clostridial alpha-toxin production, while a tension above roughly 30 mmHg restores oxygen-dependent neutrophil activity and helps demarcate viable tissue. Even with optimal modern care, mortality ranges from 25 to 50 percent, so hyperbaric oxygen is one part of a combined surgical, antibiotic, and critical-care response.

Randomised controlled trials are not ethically feasible in a rapidly fatal condition where withholding an established adjunct would be untenable, so the human evidence is observational. Retrospective cohort and case-control studies suggest that adjunctive HBOT is associated with reduced mortality and a reduced extent of definitive amputation, although these designs cannot establish causation and are subject to confounding by indication and centre-level differences in surgical care. Mortality remains in the range of 25 to 50 percent even with optimal modern care, which underscores that HBOT is one component of an aggressive combined surgical, antimicrobial, and critical-care response rather than a treatment that stands on its own.

◆ **Clinical translation**

Refer early, and never let the referral interrupt surgery. The benefit signal depends on starting hyperbaric treatment as soon as possible after the index debridement, while definitive surgical source control and antibiotics proceed. The first session does not substitute for repeat operative debridement, which is often required as the infection declares its margins. When clostridial myonecrosis is suspected, contact both the surgical team and the hyperbaric team at the same time.

The Canadian referral pathway

Gas gangrene is treated as an emergency at all 11 Canadian hospital-based hyperbaric programmes and is covered by every provincial plan without prior authorisation. Because the priority is rapid surgical source control, the receiving centre should arrange definitive surgery locally where possible and coordinate hyperbaric treatment in parallel.

The Canadian Referral Pathway Directory

Universal Protocol: Gas gangrene is an emergency at all 11 hospital-based programmes. Covered by provincial plans with no prior authorisation required. Arrange definitive surgery locally where possible, coordinate HBOT in parallel.

Ontario	Call CritiCall at 1-800-668-4357 (Routes to Toronto General UHN, Hamilton, Ottawa; arranges Ornge transport).
British Columbia	Route to Vancouver General Hospital (MSP covered).
Alberta	Route to Misericordia (Edmonton) or Foothills (Calgary) (Alberta Health covered).
Quebec	Route to Hopital du Sacre-Coeur de Montreal or Hotel-Dieu de Levis (RAMQ covered).
Chamberless Provinces & Territories	(MB, NB, PEI, YK, NWT, NU): Manage surgical control locally, then arrange inter-provincial air-ambulance to the nearest programme.



Emergency Fail-Safe: Divers Alert Network (DAN) 24/7 Emergency Line: 1-919-684-9111
(Assists in locating the nearest accepting chamber when local pathways fail).

FIGURE

The Canadian referral pathway: gas gangrene is a covered emergency at every Canadian hospital-based programme, with no prior authorisation. In Ontario, CritiCall Ontario (1-800-668-4357) connects emergency departments to the Toronto, Hamilton, and Ottawa programmes and arranges Ornge transport; other provinces route to Vancouver General, Misericordia or Foothills, and the Montreal or Levis programmes. Arrange definitive surgery locally where possible and coordinate hyperbaric treatment in parallel.

- **Ontario:** call **CritiCall Ontario at 1-800-668-4357**, the single coordination line that connects emergency departments to the Toronto General (UHN), Hamilton General, and The Ottawa Hospital programmes and arranges Ornge transport when needed.
- **British Columbia:** route to Vancouver General Hospital (Leon Judah Blackmore Pavilion), the only hospital chamber in the province; covered under MSP.
- **Alberta:** route to Misericordia Community Hospital (Edmonton) or Foothills Medical Centre / Arthur J.E. Child Comprehensive Cancer Centre (Calgary); covered by Alberta Health.
- **Quebec:** RAMQ covers Hopital du Sacre-Coeur de Montreal and Hotel-Dieu de Levis.
- **Provinces and territories without a chamber** (Manitoba, New Brunswick, PEI, Yukon, NWT, Nunavut): manage surgical source control locally and arrange inter-provincial air-ambulance referral to the nearest chamber, most commonly Misericordia Edmonton or the Ontario programmes.

The **Divers Alert Network 24/7 emergency line at 1-919-684-9111** can also help Canadian emergency departments locate the nearest accepting chamber when local pathways fail. Detailed clinical background is available on the [gas gangrene condition page](#).

Contraindications and cautions

The only absolute contraindication relevant in the emergency setting is an **untreated pneumothorax**, which must be managed with emergency tube thoracostomy before chamber entry. Several relative contraindications are weighed pragmatically against the risk of a rapidly fatal infection: **severe haemodynamic instability** requiring continuous high-dose vasopressor support, which can complicate transfer and monitoring in the chamber; **concurrent bleomycin or disulfiram**; an **uncontrolled seizure disorder**, given the small risk of oxygen-induced seizures at treatment pressure; and **severe chronic obstructive pulmonary disease with bullae**. None of these should delay surgical debridement, and in the acute setting the hyperbaric team weighs each against the likelihood of permanent disability or death.

Chamber Entry: Contraindications & Cautions Matrix

ALERT-RED Absolute Contraindication	NEUTRAL-AMBER Relative Cautions
Untreated Pneumothorax Must be managed with emergency tube thoracostomy before chamber entry.	These must be weighed pragmatically against the high risk of a rapidly fatal infection or permanent disability. None should delay surgical debridement. Severe haemodynamic instability: Requiring continuous high-dose vasopressor support (complicates transfer/monitoring). Concurrent medications: Bleomycin or disulfiram. Neurological: Uncontrolled seizure disorder (small risk of oxygen-induced seizures). Respiratory: Severe COPD with bullae.

FIGURE

Contraindications and cautions for chamber entry. An untreated pneumothorax is the only absolute contraindication and must be managed with tube thoracostomy first. Relative cautions, weighed pragmatically against a rapidly fatal infection, include severe haemodynamic instability on high-dose vasopressors, concurrent bleomycin or disulfiram, an uncontrolled seizure disorder, and severe COPD with bullae. None should delay surgical debridement.

How to use the research list below

The list contains every gas gangrene 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.

Open-access research, 2020 to present

14 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. Patel A et al.. Hyperbaric oxygen therapy and Fournier's gangrene: a systematic review and meta-analysis. *Medical gas research*.

2025

1. Azmi YA et al.. The impact of sodium-glucose cotransporter-2 inhibitors on the incidence, therapy, and outcomes of fournier gangrene: insights from a systematic review of case reports. *Systematic reviews*.
2. Takeno K et al.. Polymicrobial infection presenting as non-clostridial gas gangrene in a patient with an open pelvic ring fracture accompanied by abdominal evisceration: a case report. *AME Case Rep*.

2024

1. Alhumam T et al.. Relationship Between Symmetrical Peripheral Gangrene Patients and Using Vasopressors in the Intensive Care Unit. *Cureus*.
2. Hussain H et al.. Clostridial Myonecrosis: A Comprehensive Review of Toxin Pathophysiology and Management Strategies. *Microorganisms*.

2023

1. Muroya D et al.. Effects of Hyperbaric Oxygen Therapy for Clostridioides difficile-associated Colitis: A Retrospective Study. *J Anus Rectum Colon*.
2. Wójcik B et al.. Advances in Management of Fournier's Gangrene by Coupling Intensive Hospital Treatment With Innovative Post-discharge Hyperbaric Oxygen Therapy Rehabilitation: A Case Report. *Cureus*.

2022

1. Tutino R et al.. Which Role for Hyperbaric Oxygen Therapy in the Treatment of Fournier's Gangrene? A Retrospective Study. *Front Surg*.
2. Raizandha MA et al.. The role of hyperbaric oxygen therapy in Fournier's Gangrene: A systematic review and meta-analysis of observational studies. *International braz j urol : official journal of the Brazilian Society of Urology*.

2021

1. Schneidewind L et al.. Hyperbaric Oxygenation in the Treatment of Fournier's Gangrene: A Systematic Review. *Urol Int*.
2. Trama F et al.. Multimodal approach in a patient with Fournier's gangrene during the coronavirus pandemic. *Urol Case Rep*.
3. Creta M et al.. Fournier's Gangrene in Patients with Oncohematological Diseases: A Systematic Review of Published Cases. *Healthcare (Basel)*.
4. Feres O et al.. Hyperbaric oxygen therapy decreases mortality due to Fournier's gangrene: a retrospective comparative study. *Medical gas research*.

2020

1. Chu YT et al.. Acute chorioamnionitis complicated with symmetrical peripheral gangrene. *Taiwanese journal of obstetrics & gynecology*.

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