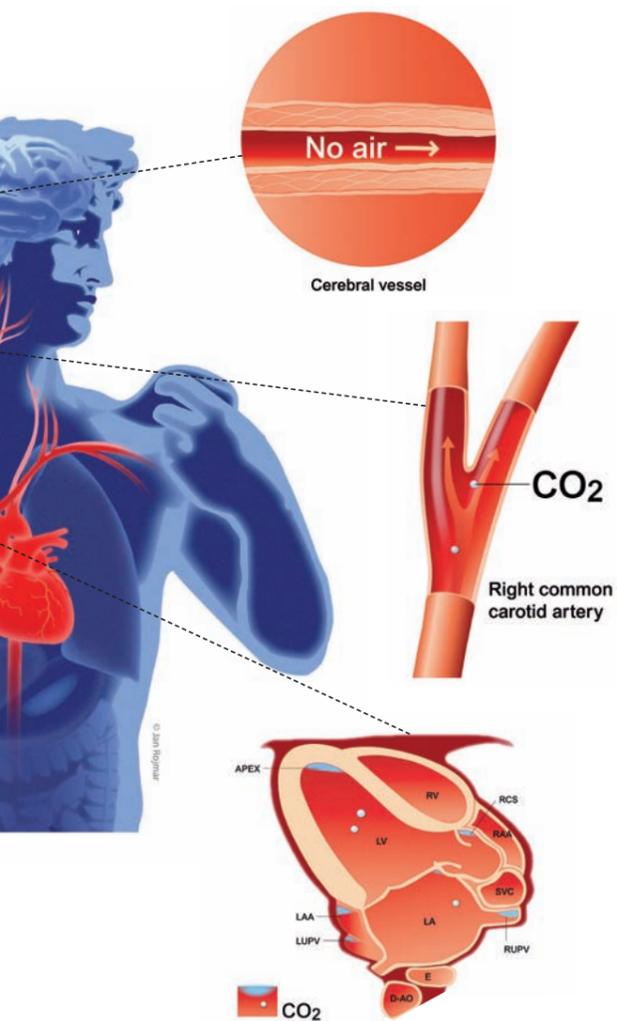


Preventing air embolism during open-heart surgery

Complete de-airing



**CarbonAid®
&
CarbonMini™**

References

1. Persson M, van der Linden J. Intraoperative CO₂ insufflation can decrease the risk of surgical site infection. *Medical Hypotheses*. 2008;71(1):8-13.
2. van der Linden J, Persson M, Svenarud P. Carbon dioxide insufflation on the number and behavior of air microemboli in open-heart surgery - Response. *Circulation*. 2004 Aug;110(5):E55-56.
3. Persson M, Svenarud P, van der Linden J. What is the optimal device for carbon dioxide de-airing of the cardiothoracic wound and how should it be positioned? *Journal of Cardiothoracic & Vascular Anesthesia*. 2004 Apr;18(2):180-4.
4. Svenarud P, Persson M, van der Linden J. Effect of CO₂ insufflation on the number and behavior of air microemboli in open-heart surgery. *Circulation*. 2004 Mar;109(9):1127-32.
5. Persson M, van der Linden J. Wound ventilation with carbon dioxide: a simple method to prevent direct airborne contamination during cardiac surgery? *Journal of Hospital Infection*. 2004 Feb; 56(2):131-6.
6. Svenarud P, van der Linden J. Carbon dioxide de-airing techniques. *Proceedings of the European Association for Cardio-thoracic Surgery*. 2004 Sep; 103-5.
7. Persson M, van der Linden J. De-airing of a cardiothoracic wound cavity model with carbon dioxide: theory and comparison of a gas diffuser with conventional tubes. *Journal of Cardiothoracic & Vascular Anesthesia*. 2003 Jun;17(3):329-35.
8. van der Linden J, Persson M. A gauze sponge cannot act as a gas diffuser in cardiac surgery when it gets wet. *Journal of Thoracic & Cardiovascular Surgery*. 2003 May;125(5):1178-9.
9. Helps SC, Parsons DW, Reilly PL et al. The effect of gas emboli on rabbit cerebral blood flow. *Stroke* 1990;21:94-99.
10. Persson M, Svenarud P, Flock J-I, van der Linden J. Carbon dioxide inhibits the growth rate of *Staphylococcus aureus* at body temperature. *Surgical Endoscopy*. 2005 Jan;19(1):91-4.
11. Persson M, van der Linden J. Wound ventilation with ultra-clean air for prevention of direct airborne contamination during surgery. *Infection Control & Hospital Epidemiology*. 2004 Apr;25(4):297-301.

cardia
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Address: Lillskogs v. 22, S-133 34 Saltsjöbaden, Sweden
E-mail: contact@cardiainnovation.com

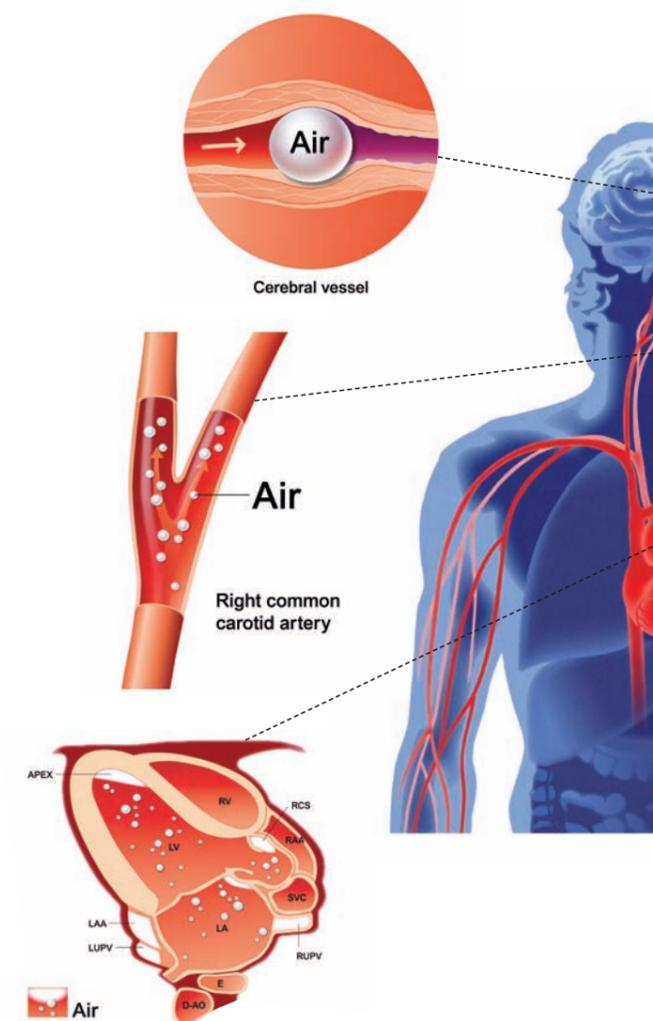
Phone/Fax: Int. +46 704 962 720
Web-site: www.cardiainnovation.com

Patents: US6494858, US6994685, EP1032322, EP1239915(DE,FR,GB), EP1494606(DE,FR,GB), EP1032322(DE,FR,GB), SE515473, JP4094810; further patents are pending.

 0123, 510 (K), number K052125, K112975

Prevent air embolism during open-heart surgery

Incomplete de-airing

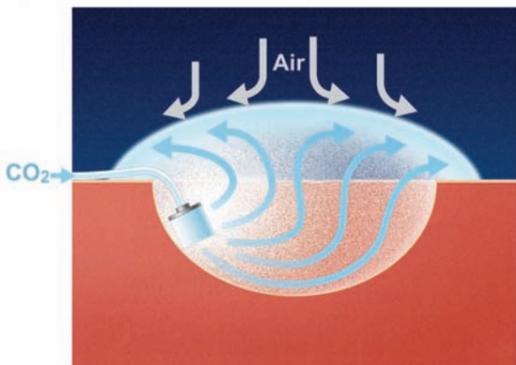


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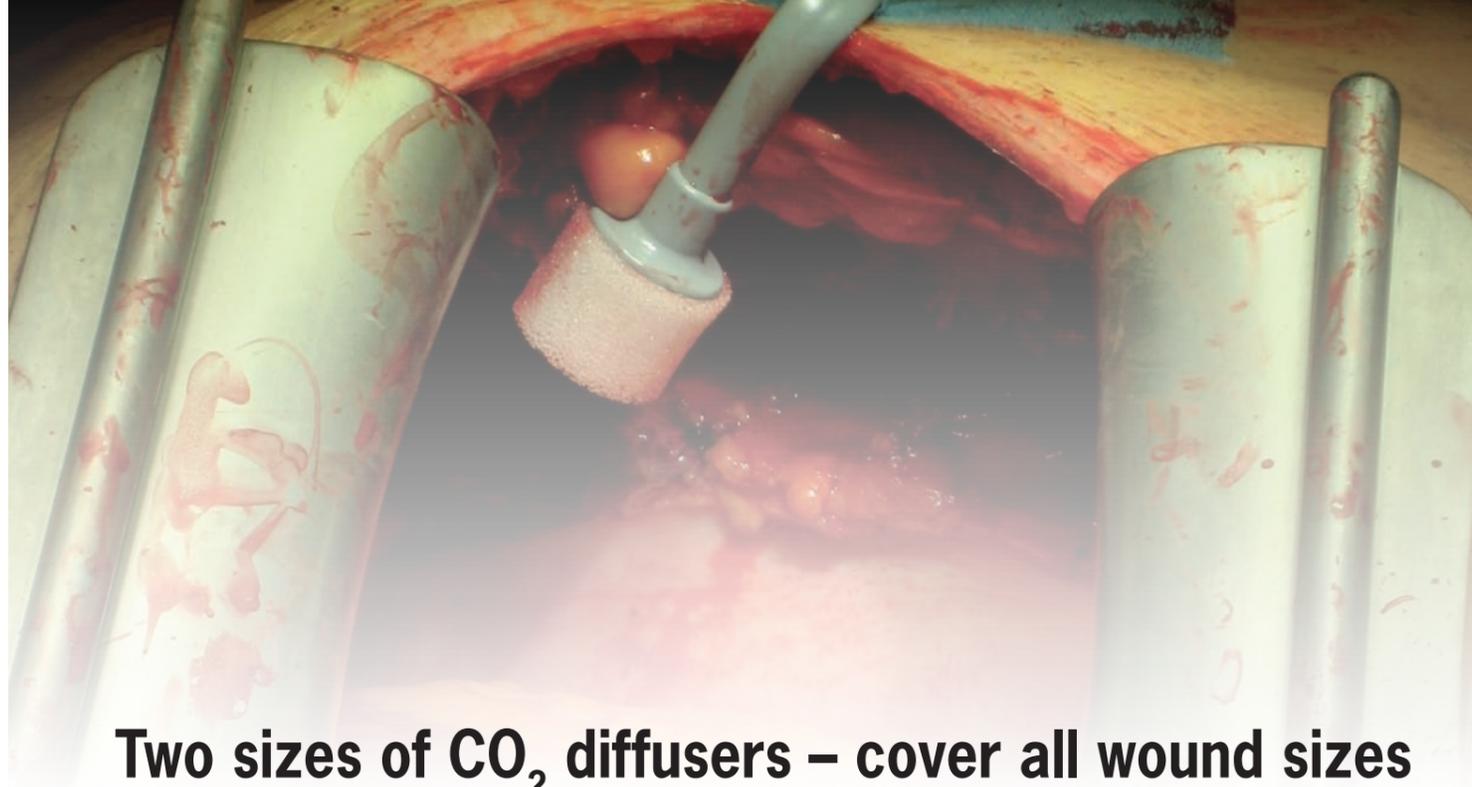
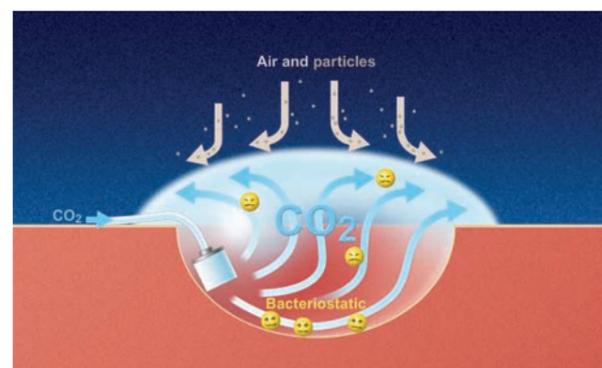
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The superiority of the Cardia Innovation CO₂ diffuser technology

The **CarbonAid®** and **CarbonMini™** can deliver a high CO₂ gas flow without any turbulence^{2,3,6,7} and as a result of this create a 100% CO₂ atmosphere inside the thoracic wound area. This prevents air embolism from occurring.



- When CO₂ is insufflated with a laminar flow a protective cushion is built up^{1,5}.
- The continuous overflow of CO₂ will repel and transport away small particles, this decreases the rate of airborne contamination^{1,5}.
- A bacteriostatic effect of CO₂¹.



Two sizes of CO₂ diffusers – cover all wound sizes

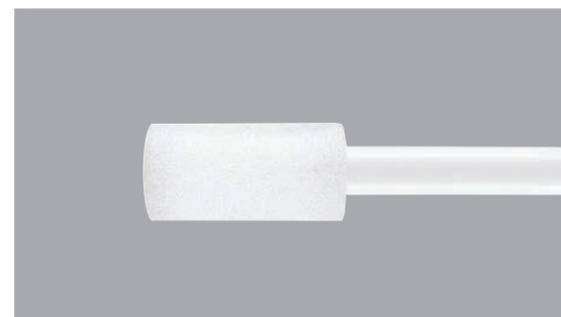
During open-heart surgery through a full sternotomy, a CO₂ flow of 10 l/min from the **CarbonAid®** is needed to generate continuous effective de-airing despite hand movements and use of suctioning devices. For smaller sized wounds a CO₂ flow of 3 l/min is, with the smaller **CarbonMini™**, sufficient for efficient de-airing. Both products give a laminar flow which is essential to avoid turbulence and admixture of ambient air. This is valid also when the foam tip is wet^{3,8}.

The distal part of the products consists of malleable tubing so that the diffuser tip can easily be positioned inside the wound cavity. Each product also contains a highly efficient bacterial filter and a long tubing for connection to a CO₂ flow meter.

CarbonAid® Diffuser tip

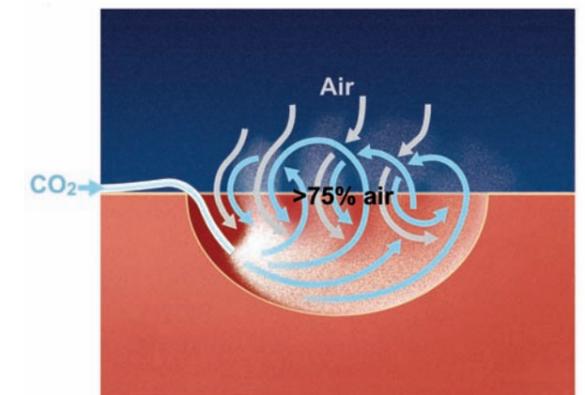


CarbonMini™ Diffuser tip



Avoid turbulence!

Less effective de-airing devices create turbulence even at low CO₂ flows. This results in a continuous mix with the surrounding atmosphere and a high percentage of air will still be present in the thoracic cavity. Turbulence makes de-airing impossible.



As long as air is present there is a risk for air embolism! Even air bubbles as small as 25 µl obstructing cerebral arterioles for less than 30 seconds cause an impaired cerebral function⁹.

**Complete de-airing
is achieved with
CarbonAid®
&
CarbonMini™!**