Successful reduction of air emboli during open heart procedures

The CarbonAid® and CarbonMini™ CO2 diffusion catheters protect patients by minimizing air emboli, by increasing bacteriostasis and by repelling particulate contamination during surgery.

The CarbonAid Carbon Dioxide (CO2) Diffuser is clearly a beneficial adjunct to open heart surgery—any time the heart is opened, especially for valve surgery, the advantage of a consistent, non-turbulent CO2 atmosphere for the heart is an obvious improvement for patient recovery because air microemboli are greatly reduced.1,4 This product is available in sizes for adult and pediatric surgery (Figure 1). The new “CarbonMini” size is useful in minimally invasive adult cases as well as pediatric procedures.1

Two additional benefits of proper CO2 diffusion for all cardiac cases
In addition to reduction of air emboli, two important benefits of proper CO2 diffusion are:
- Creation of a protective barrier against airborne particles from the surgical team/operating room ventilation (Figure 3)12,13
- AND the bacteriostatic effect of an improved CO2 atmosphere (Figure 3) may reduce infectious occurrences including endocarditis.11

These two benefits of the CO2 field result from use of the CarbonAid diffuser and apply to all cardiac cases, not just open heart procedures such as valves.

Neurological sequelae of cardiovascular surgery are devastating
Cognitive deficit after valve replacement surgery has been well documented and is irreversible in older patients.5-9 Studies have shown the benefit of efficient CO2 flooding during open heart surgery.9,10

Reduction of air emboli decreases operative time
Operative time that comes at a high cost per minute can be decreased by as much as 15 minutes per case if there are few or no air bubbles present after cardiac closure.4,10 CO2 insufflation of cardiac wounds using only a cannula is not nearly as effective as the CarbonAid diffuser.4 De-airing is not as complete due to turbulence created in the pericardial cavity when plain tubing is used (Figure 2).4

Figure 1. CarbonAid and CarbonMini Carbon Dioxide (CO2) Diffusers

Figure 2.
A. CO2 fed into a pericardial cavity with a simple tube creates turbulence that mixes regular air (up to 75%) with the infused CO2. B. The CarbonAid diffuser feeds CO2 in a non-turbulent manner creating a complete de-airing of the pericardial cavity and a protective layer of CO2 that may ensure reduction of microemboli, repel small particles and provide a bacteriostatic effect.1,4, 11,12

Figure 3. CO2 has bacteriostatic properties creating an unfavorable environment for growth.11 The protective environment of a CO2 atmosphere that is created by CO2 diffusion may repel particulate matter away from the pericardial cavity.12,13
Endocarditis reduction decreases hospital costs
Treatment of endocarditis is estimated to cost between $47,577 to $98,294. Use of the CarbonAid CO2 diffuser can reduce surgical infection thus offsetting its cost.

Below are important excerpts from published articles about proper CO2 diffusion:

**Reduction of microemboli** from cardiac wound insufflation with CO2 (de-airing):

> “Thus, a mere decrease of the number of microemboli had a beneficial effect, whereas CO2 insufflation not only decreases the number of emboli but probably also decreases the harm they can do.” Svenarud, et al. 2004

**De-airing (insufflation) of the cardiothoracic wound** (or cavity) with a diffuser versus conventional open-ended tubing:

> “This study showed that the gas-diffuser produced efficient de-airing of a cardiothoracic wound model at CO2 flows of ≥ 5 L/min, whereas an open-ended tube did not achieve this.” Svenarud, et al. 16

> “This study demonstrated that a carbon dioxide flow of 10 L/min the gas provided efficient air displacement (≤1% remaining air) in a cardiothoracic wound cavity.” Svenarud, et al. 17

> “There may be a solution to the problem with inefficient CO2 de-airing. First, the CO2 flow must be high enough to counteract diffusion with ambient air. Second, the delivered CO2 must have a low velocity to avoid turbulent mixing with ambient air. Conventional open-ended tubes provided a poor and varying de-airing of the wound cavity model (18%-96% remaining air) . . . . The gas diffuser provided an almost complete de-airing of the model (<0.2% remaining air) at flows of 5 to 10 L/min.” Persson and Van Der Linden 4

**Carbon dioxide** has long been known to inhibit the growth of bacteria:

> “To sum up, 100% CO2 significantly decreased the growth rate of S. aureus at body temperature. The inhibiting effect of CO2 increased exponentially with the duration of the exposure. The bacteriostatic effect of CO2 could help to explain the low infection rates after laparoscopic procedures.” Persson, et al. 18

**Reduction of airborne-particles** in the cardiac wound:

> "In conclusion, intraoperative wound ventilation with CO2 in the cardiothoracic wound using a gas diffuser may not only prevent air embolism, but may also significantly reduce the risk of airborne contamination and postoperative wound infection in cardiac surgery." Persson and van der Linden 19

> “This study provides supportive evidence . . . that intraoperative wound ventilation may be a simple complement to prevent direct airborne contamination.” Persson and van der Linden 19

A less turbulent CO2 atmosphere provides your patients with the best opportunity for the shortest operative time, reduced neurological complications, reduction of airborne contamination and less infection with the CarbonAid and CarbonMini CO2 diffusion catheters.

References:


CAUTION: Federal law restricts this device to sale by or on the order of a physician. Refer to the Instructions for Use that accompany each valve for indications, contraindications, warnings, precautions and possible complications. For further information, visit www.onxlti.com.