experimental aortic surgery: increased heat shock protein content is associated with ischemic tolerance of the spinal cord." It is already known that induction of heat shock proteins (HSPs) by whole body hyperthermia can reduce ischemia reperfusion injury,² and we agree that hyperthermic pretreatment could induce tolerance against a severe spinal cord ischemic insult. However, we have one question. It has not been demonstrated that HSP72 is induced in motor neurons or glial cells. Manzerra and Brown³ demonstrated that the heat shock response occurred in glial cells, not in motor neurons, of rabbits after administration of a hyperthermia-inducing drug. On the other hand, Xia and coworkers⁴ demonstrated that whole-body hyperthermia induced HSP72 in motor neurons of the rat spinal cord. It is possible to speculate that glial cells may be a preferential target for the hyperthermia-inducing drug, or there may be differences in stress responses between rabbit and rat spinal cord. However, our previous reports have demonstrated that preconditioning with 10 minutes of ischemia enhanced and prolonged the HSP72 gene expression and protein levels in motor neurons, sparing the neuronal cells from the subsequent lethal ischemia.⁵ Our result revealed that HSP72 messenger RNA and protein were induced as a "molecular chaperon" in motor neurons after ischemia. Therefore authors should demonstrate temporal profiles of HSP72 in histochemical study or in situ hybridization study.

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A gauze sponge cannot act as a gas diffuser in cardiac surgery when it gets wet

To the Editor:

In an effort to improve deairing in cardiac surgery, Martens and colleagues¹ used a gauze sponge to reduce the outflow velocity of carbon dioxide delivered from a thin, open-ended tube. The proposed method is no doubt both simple and inexpensive. Their study included patients operated on through a complete median sternotomy or through a right anterolateral minithoracotomy (7-cm skin incision). Gauze sponges were used in combination with carbon dioxide insufflation through a standard perfusion line or a Veress needle. In the standard cardi thoracic wound cavity, they at best reached a mean carbon dioxide content of 52% (range 10%-85 %) with the open-ended perfusion line and of 81% (range 35%-100%) with the gauze sponge added. In the minithoracotomy the mean carbon dioxide content at best reached 97% (range 95%-100%) when applied with a Veress needle together with the gauze sponge.

Apparently, the gauze sponge improved the carbon dioxide deairing substantially, especially in the minimally invasive wound. In the standard chest wound the carbon dioxide content was lower and had a much wider range. The lower carbon dioxide levels in the standard chest wound may have been due to a greater diffusion rate between carbon dioxide and ambient air. The wound opening was wider, and according to Fick's law of diffusion, the diffusion flux is proportional to the area through which the diffusion occurs. Because of the smaller dimensions of the minimally invasive wound, the distance be-

tween the carbon dioxide sampling device and the carbon dioxide supply may also have been smaller, which could have influenced the readings. However, these distances are not reported in the study. The use of rough suction impairs carbon dioxide deairing,² because its effect of 20 to 25 L/min is several times greater than the inflow of carbon dioxide. Because the time and duration of the carbon dioxide measurements were not presented, however, and the conditions regarding suction thus may have varied, these influences cannot be evaluated.

There is another and more important possible explanation for the wide range and lower means of the carbon dioxide levels measured in the standard open chest wound. Because of their hydrophilic properties, gauze sponges are used to absorb fluids. When a gauze sponge gets wet, as it easily does in the cardiothoracic wound, its structure collapses, and it loses its function as a diffuser. In a not yet published study, we have shown that a diffuser must be positioned inside the wound cavity, several centimeters below the wound edge, to provide a high degree of deairing. In contrast, carbon dioxide delivered above the wound opening and falling down by gravity into the wound will rapidly become diluted with ambient air through diffusion. Thus the gauze sponge may be exposed to blood and other liquids during surgery.

After having read Martens and colleagues' report,¹ we tested a gauze sponge for carbon dioxide deairing of a cardiothoracic wound model positioned in a fully ventilated operating theater. Suction was not used. A dry gauze sponge (in front of a small tube), positioned near the diaphragm, provided a mean carbon dioxide content of 97.5%, as measured at the topmost part of the right atrium (8 cm from the gauze sponge). When the gauze sponge was wetted with water, however, the measured mean carbon dioxide content immediately decreased to 30%, at which level it remained. We have designed a gas diffuser,² which may solve this problem. It is a thin tube (2.5 mm inner diameter) with a diffuser at the end. The diffuser is a small piece (18 × 14 mm) of soft polyurethane plastic foam with open cells. We tested the gas diffuser along with the gauze sponge. The gas diffuser, positioned as the gauze sponge, produced carbon dioxide contents greater than 99.5% not only when dry but

after having been completely dipped in water. The foam material in our gas diffuser is hydrophobic. Because of its elastic properties, the foam does not collapse even if it is soaked, and as the gas is blown through the diffuser large parts of its cell structure will remain clear. If the gas diffuser gets partly covered with tissue or blood, the carbon dioxide gas will, according to the law of least resistance, automatically be redirected inside the diffuser foam to exit through a clear part, and its function will remain. Thus the hydrophobic and elastic properties of the gas diffuser enable it to function well even if it is in direct contact with the wet inner wound. Although the foam material is hydrophobic, the foam may absorb and store a liquid by capillary forces if it is completely drowned and at the same time compressed in the liquid, just as a car wash sponge would. If the gas diffuser unexpectedly becomes soaked through with blood or water, a short compression with the tip of a finger will evacuate the fluid and restore full function. The same does not hold true for a wet gauze sponge because of its lack of hydrophobic and elastic properties.

To sum up, the gauze sponge has inherent properties that make it unsuitable for carbon dioxide deairing. It stops functioning as a gas diffuser when it gets wet.

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Reply to the Editor:

We appreciate the comments of van der Linden and Persson. They report their own experiences with carbon dioxide protec-

tion, which support our intraoperative findings and conclusions drawn from measurements of intrathoracic gas concentrations. They promote the use of a self-designed tool to insufflate carbon dioxide with the argument that a sponge used as a diffuser could get wet and lose its diffusing properties. In our experience, a sponge-covered infusion line sutured to the side of the pericardium (as described in our article) does not get wet; if it were to do so, it could easily be replaced with a dry one.

However, avoidance of gas jets to reach high and stable concentrations of carbon dioxide can be achieved with other diffusion devices as well, as we have shown with a commercially available perforated drain, with which we measured $93.7\% \pm 6\%$ at 4 L of flow. Regarding minimal invasive procedures, the sponge-covered, reusable Veress needle performed excellently (reaching a mean concentration of $97.5\% \pm 2\%$), and problems related to wet sponges were not observed. But of course, there is plenty of room for new developments.

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Thromboembolic complications after beating heart coronary artery bypass operations

To the Editor:

Beating heart coronary artery bypass surgery (OPCAB) is gaining wider acceptance because of the potential benefits of eliminating cardiopulmonary bypass and its deleterious effects. The report of Cartier and Robitaille¹ is therefore interesting and adds to the genuine perturbations of this technique. However, some aspects of the study raise concern.

Cartier and Robitaille conducted a retrospective study of the thromboembolic complications after OPCAB and compared it with a selected group of patients who had coronary artery bypass grafting using cardiopulmonary bypass (CABG). They reported the incidence of thrombotic complications as 1% in 500 OPCAB patients in a 4-year period and 0.5% in 1476 CABG patients selected from the latter 2 years of

the study period. Admittedly, 3 of the 5 OPCAB patients in whom thrombotic complications developed had predisposing factors. Two had deep vein thrombosis ipsilateral to the leg where a preoperative intra-aortic balloon pump was inserted. The third had chronic renal failure and was being treated by hemodialysis.

No prophylactic regimen for preventing thromboembolism was adopted in the OPCAB patients in this study.

The retrospective study of the prevalence of postoperative thromboembolic complications is hindered by the nature of the investigation. There are many symptom-free patients with thromboembolism (up to 44.8% of patients have deep vein thrombosis after CABG)² that will be missed. Also, there are patients with mild symptoms who would not have been investigated appropriately, and yet others who have thromboembolic complications after hospital discharge and receive treatment at a different facility.

The selection of the CABG patients for comparison with the OPCAB group is worrisome. The CABG patients were chosen from a fraction of the study period for the OPCAB patients, and little is known about the patient characteristics and operative and postoperative variables of the two groups. Comparing these unmatched heterogeneous groups of patients who had different surgical myocardial revascularization techniques, operating times, and intraoperative and postoperative management, without controlling for effect modification by these variables, will prejudice the result.

It has been suggested that patients who have leg vein harvest demonstrate circulatory disturbances in the venous system of the donor legs.³ This, combined with leg wound problems and, sometimes, delayed mobilization, distinguishes the patient with saphenous vein harvest from the patient whose leg veins were not harvested. This also adds to the heterogeneity of the groups.

Thromboembolic prophylaxis is effective in patients undergoing cardiac surgery⁴ and is commonplace. The authors eruditely enunciated a formidable and impressive discussion of the hypercoagulability of major tissue trauma and median sternotomy, which are integral to cardiac surgery. It is therefore intriguing that the OPCAB patients did not receive any prophylaxis