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

against thromboembolism. This possibly contributes to the difference in the incidence of thromboembolic complications between the two groups.

This study has not shown compelling evidence in support of its claim. It probably emphasizes the importance of prophylaxis for thromboembolism in high-risk patients undergoing OPCAB.

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Reply to the Editor:

Dr Ngaage brought up interesting remarks that we would like to address. The two cohorts of patients that we compared were not exactly *selected*. The beating heart coronary artery bypass (OPCAB) cohort included 500 consecutive cases of coronary artery revascularization representing 95% of all traditional coronary artery bypass graft (CABG) cases done by our group during that period (98% for 1999 and 2000). Only very hemodynamically unstable patients requiring high doses of inotropic drugs or patients having specific technical difficulties, such as deep intramyocardial internal thoracic artery or tight posterior adhesions precluding safe dissection, were rejected for the OPCAB approach. The cohort of patients in whom cardiopulmonary bypass (CPB) was used comprised all patients operated on from April 1998 through March 2000 (corresponding to 2 "clerical years" for the archive department) who underwent CABG

TABLE 1. Demographics and preoperative risk factors for OPCAB and CPB patients

	OPCAB	CPB	P value
Age (y)	64 ± 10	63 ± 9	NS
Sex ratio	3.54	3.71	NS
Diabetes (%)	25	21	NS
HBP (%)	47	54	NS
Tobacco (%)	32	29	NS
COPD (%)	11	9	NS
Redo (%)	7	7	NS
MI <30 days (%)	16	18	NS
Previous CVA (%)	9	7.3	NS
Carotid bruit (%)	16	13	NS
PVD (%)	19	14	NS
Unstable angina (%)	68	72	<.05
LVEF (%)	54 ± 13	54 ± 15	NS
LVEF <40% (%)	14	17	NS
Left main >50% (%)	30	28	NS
Preoperative IABP (%)	7	3.5	<.05
Territory involved	2.7 ± 0.6	2.6 ± 0.54	NS

HBP, High blood pressure; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction; CVA, cerebrovascular accident; PVD, peripheral vascular disease; LVEF, left ventricular ejection fraction; IABP, intra-aortic balloon pump; NS, not significant.

TABLE 2. Surgical data for OPCAB and CPB patients

	OPCAB	CPB	P value
Grafts/patient	3.08 ± 0.89	2.91/0.67	.006
Ischemic time (min)	30 ± 11	43 ± 16	.001
Grafts/territory	1.16 ± 0.26	1.14 ± 0.34	.25
Postop IABP (%)	0.8	2.9	.01

on CPB with no other associated procedures. No cases were excluded. Therefore, these two cohorts were obviously not matched. However, they were not "selected" or "chosen" either. Furthermore, as seen in Tables 1 and 2, they were both comparable in terms of preoperative risk factors and surgical data. Preoperative intra-aortic balloon pumping was used more often in the OPCAB group, but postoperative balloon pumping use was more frequent in the CPB groups. Globally, the perioperative use of balloon pumps was comparable (7.8% vs 6.4%, $P = .33$) for both groups.

We are aware that most of the thromboembolic complications occurring postoperatively are not clinically detected. Because this study was retrospective, we were limited in clinical manifestations of venous

thromboembolic disease as they were reported in the patients' charts. These are the manifestations that are important and matter for both the patients and the clinicians. For clerical purposes, events were similarly reported for both groups. For a vast majority (>95%) of patients, the saphenous vein was also harvested and used as a vascular conduit, regardless of the technique used, which consequently should not be taken as a *heterogeneous* issue. In our practice at the Montreal Heart Institute, thromboembolic prophylaxis has never been routinely used for either *on-pump* or *off-pump* cases. Emphasis was put on early mobilization and physiotherapist care. No patients in either cohort reported in the current study received any prophylaxis against thromboembolism. Whether this was good or