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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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

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 traditiional 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 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

wrong could be debated, but one fact remains: thromboembolic complications have been an unusual cause of early postoperative morbidity or mortality in our experience, as shown by the 0.5% incidence that we reported in the CPB group. In an article by Clagett and associates,[1] there was no mention of specific prophylaxis for cardiac surgery. Nevertheless, we do agree on the importance of prophylaxis in OPCAB surgery. So far, we have not found any negative side effects associated with it. Since we started applying this policy to all our OPCAB patients, we have seen an obvious decrease in the incidence of thromboembolism without any increased bleeding complications or transfusion needs.

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Single fiber skeletal muscle transplantation or purified myoblast engraftment?

To the Editor:

We read with interest the article of Suzuki and colleagues,[1] "Single Fibers of Skeletal Muscle as a Novel Graft for Cell Transplantation to the Heart." They investigated the feasibility of single skeletal muscle fibers as a vehicle to deliver putative myoblasts-myotubes into the myocardium in rat models. They further demonstrated the improvement of cardiac function and histologic evidence of cell proliferation and survival after single muscle fiber engraftment into the infarcted myocardium.

This is an important study in skeletal myoblast transplantation for cardiac repair, because mechanisms for improvement of cardiac function after myoblast transplantation have not been clearly identified. Although clinical application of myoblast transplantation for cardiac repair is already being assessed in phase I human studies,[2] many questions regarding the optimization of the transplantation conditions and procedure remain unanswered.[3]

It appears logical to consider that the number of myoblasts that repopulate the infarcted myocardium must be important. In all other experimental studies, a significantly larger number of cells were implanted. Improvement in myocardial function has been directly related to the number of cells injected which in rodents is 3 to 6 million cells and large animals as many as 1 billion cells. Suzuki and colleagues[1] in their study used only 4 single fibers per heart for injection. According to their findings, each single fiber retained 20 myoblasts, as assessed by immunostaining for M-cadherin, meaning that only 80 myoblasts were transplanted. Therefore myoblasts had to undergo extensive proliferation after transplantation to achieve an optimum cell count for beneficial effect. It seems unreasonable to expect that as few as 4 single skeletal fibers (80 myoblasts) would bring about significant improvement of heart function. From the figures shown, the extent of repopulation of the myocardium with cells is unclear, and only a few myotubules have been formed, which would be unlikely to improve cardiac function significantly in a severely damaged heart.

The disadvantages pointed out by Suzuki and colleagues[1] of using expanded cultures of myoblast as opposed to single fibers are only theoretic. The problem of embolism from myoblast injection has never been reported, even when they are injected intra-arterially or intracoronarily.[4,5] Similarly, in clinical perspective, delaying an elective operation on a patient in stable condition to expand the myoblast number is not a major problem. Our experience and the current literature do not indicate that repeated passaging of myoblasts leads to significant deterioration or problems.

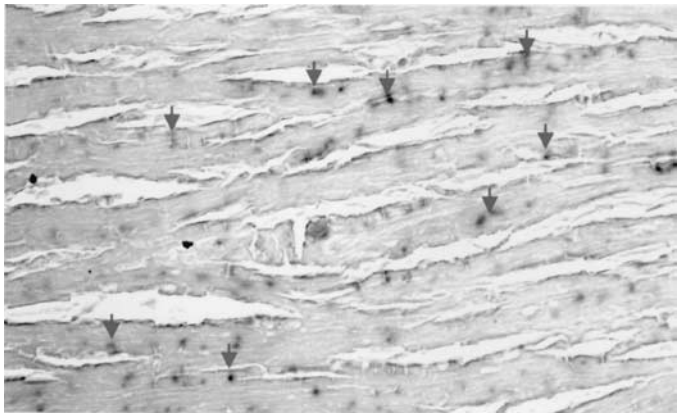

Figure 1. Xenotransplanted human skeletal myoblasts carrying *lacZ* reporter gene with nuclear localization signal in porcine heart model of chronic ischemia at 6 weeks after transplantation. Tissue sections were stained with X-gal according to standard protocol. *Arrows* represent donor human myoblast nuclei.

One of the important findings in this article is the development of multinucleate branching myotubes. Because the grafted myofibers were postmitotic, it was deduced that skeletal myoblasts were the source of the newly formed fibers. In a porcine model of chronic ischemia with transient immunosuppression, we implanted *lacZ*-positive human myoblasts of greater than 95% purity. At 6 weeks we demonstrated similar formation of new branching centrally located multinucleate myotubules. Most of the nuclei stained positively for β-galactosidase (Figure 1). We believe that after myoblast transplantation neomyogenesis results in fibers with phenotypic features similar to skeletal and cardiac muscles and that this is the mechanism of improvement in cardiac function.

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