The use of diaphragmatic flaps in cardiac surgery *To the Editor:*

I would like to congratulate Mineo and Ambrogi¹ on their article titled, "The Diaphragmatic Flap: A Multiuse Material in Thoracic Surgery." I completely agree that the diaphragmatic flap is an excellent material for defect or fistula closure and for suture line protection in the thoracic cavity.

They cited Petrovsky's work² (completed in 1948 but reported in 1961) with the use of diaphragmatic muscle grafts for reconstructive work in the thorax and abdomen. The readers might be interested to know that he³ also published a series of 100 clinical cases involving reinforcement of cardiac aneurysms by use of a mobilized diaphragmatic muscle. His was one of the first (and is still the world's largest) published clinical series concerning cardiomyoplasty. However, as late as the early 1960s the muscle flap was not being electrically stimulated; consequently, some of the flaps in Petrovsky's series became fibrotic and sclerotic.

Several years ago, the diaphragmatic flap for cardiac surgery was investigated at Moscow's Bakulev Institute for Cardiovascular Surgery and at the Vakhidov Scientific Center for Surgery. Because the idea of using the skeletal muscle to correct right atrial insufficiency is highly attractive,⁴ we performed canine model experiments using the diaphragmatic flap to study dynamic atriomyoplasty. After first creating a model of tricuspid atresia, we performed the Fontan procedure (ie, an anastomosis between the right

atrium and the pulmonary artery) and reconstructed the anterior wall of the right atrium by use of the flap as follows⁵:

Two flaps were tailored, one from the anterior wall and one from the appendage of the right atrium. The pulmonary artery was then widely opened and a C-shaped flap was formed. The first flap was sutured to the fibrous anulus of the tricuspid valve to completely isolate the right ventricle from the pulmonary circulation. Next, we sutured a flap from the atrium and a flap from the pulmonary artery, forming the posterior wall of the future "new" chamber, then tailored a flap from the diaphragm and sutured this flap to the right atrium, forming its new anterior wall.

Next, we attached electrodes connected to the neurostimulator, which was programmed for cardiosynchronized stimulation of the diaphragmatic muscular flap as follows: impulse burst 3 to 9 V, pulse frequency 10 to 100 Hz, impulse 0.1 to 1.8 seconds.

Signs of right heart failure in the new chamber were apparent immediately after the procedure. However, when we started stimulation, the picture changed. Mean pulmonary artery pressure and mean arterial pressure increased. Pressures in the new chamber and inferior vena cava were reduced. As a result of these investigations, we were able to substantiate that use of dynamic atriomyoplasty would improve hemodynamics, and we felt confident in recommending this method to support the atrium's work during the first, and most difficult, days after the Fontan procedure.

On the basis of our results and those of Mineo and Ambrogi,¹ I believe that, if there are no contraindications to its use, the diaphragmatic flap is excellent for reconstructing heart defects, for cardiac part substitution, for defect or fistula closure, and for suture line protection in the thoracic cavity. When electrically stimulated, the flap can be used during cardiac surgery to assist in contraction.

Valeri S. Chekanov, MD, PhD, DSc(Med)
Clinical Professor of Medicine
Director, Basic Cardiovascular Research
Milwaukee Heart Institute
Sinai Samaritan Medical Center
Milwaukee, WI 53201-0342

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