chest after the operation and none needed ventilatory support.

Tushar J. Shah, MS, MCh
Department of Cardio-thoracic Surgery
Rajasthan Hospital
Camp Road, Shahibaug
Ahmedabad—380004, India
12/8/74179

Reply to the Editor:

The reasons for respiratory embarrassment in flail chest injury are multiple, but the pain arising from movement of the spiky fractured ribs during the respiratory cycle plays a crucial role. Abolition of movement at the fracture sites is a key factor in minimizing the pain and improving pulmonary function. Different techniques including the use of various suture materials have been proposed to achieve internal fixation of the fractured ribs in flail chest injury. The aim of internal fixation is not just to achieve mere proximity of the two ends of a fractured rib. It is rather stabilization which is sought, and no amount of suturing with Vicryl sutures (Ethicon, Inc., Somerville, N.J.) can help to accomplish this objective. Bringing the two ends of a fractured rib together with Vicryl sutures would continue to allow movement at the fracture site during respiration, and this would negate the very purpose of internal fixation. The major reason for the pain would continue to be present, and the paradoxical movements of the flail segment would not be effectively curtailed because of the lack of provision of rigid support to the fractured ribs. Lack of stability would also ultimately hamper the effective clearance of bronchial secretions, by coughing, and lung expansion.

Another important point raised concerns the difficulty encountered in pinning the fracture sites in awkward locations. We do not advocate fixation of every single fractured rib. Pinning of even a few easily accessible sites is sufficient to allow normal respiratory physiology and can easily be accomplished through standard thoracotomy incisions.

Finally, regarding the question of splitting of ribs as a result of the use of the technique in question, it is understandable that use of any disproportionate force could make the matter worse. On the contrary, however, gentle and careful handling can obviate such mishaps. We have never encountered insurmountable difficulty with this technique. Once the entry of the Kirschner wire into the medullary cavity of a rib has been ensured, its further negotiation across the fracture site is fairly smooth and easy.

Zahoor Ahmed, FRCS
PO Box 28233
Abu-Dhabi, United Arab Emirates
12/8/74180

A history of the valveless paraaortic counterpulsation device

To the Editor

I read with interest the article entitled "A Valveless High Stroke Volume Counterpulsation Device Restores Hemodynamics in Patients With Congestive Heart Failure

Table I. *History of paraaortic counterpulsation device as a left ventricular assist device*

<i>First author</i>	<i>Year</i>	<i>Name of device</i>	<i>Recipients (duration)</i>
Nose ²	1963	Auxiliary left ventricle	Dogs (short-term study)
Gabby ³	1981	Extra-aortic balloon counterpulsation	Dogs (short-term study)
Nanas ⁴	1984	Aortic counterpulsation device	Sheep (2-90 days)
Utoh ⁵	1993	Extracorporeal pulsatile assist device	Calves (6-24 days)
Nanas ¹	1996	Paraaortic counterpulsation device	Human beings (1-54 days)

and Intractable Cardiogenic Shock Awaiting Heart Transplantation" by Nanas and associates¹ in the January 1996 issue of the Journal. They reported clinical experiences with implantation of a valveless paraaortic counterpulsation device. Although all patients died while awaiting heart transplantation, I would like to congratulate Dr. Nanas and his colleague for showing promising circulatory assist performance of the device in their patients.

The concept of this type of device is not so new. This letter provides a brief historical review for better understanding of valveless paraaortic counterpulsation devices used as left ventricular assist devices (Table I). Since the first report by Nose, Schamaun, and Kantrowitz² in 1963, several studies of similarly designed devices have been presented in animal experiments.³⁻⁵ Gabby and Frater³ demonstrated the superiority of this type of device over intraaortic balloon pumping for providing circulatory assistance in a model of acute left ventricular failure. Utoh and colleagues⁵ demonstrated a 20% increase in the endocardial viability ratio and reported problems of systemic thromboembolism and bacterial infection in long-term calf experiments. Nanas and his colleagues began developing this type of device in 1984⁴ and finally applied for clinical use.¹

Junichi Utoh, MD, PhD
First Department of Surgery
Kumamoto University School of Medicine
Kumamoto, Japan

REFERENCES

1. Nanas JN, Lolas CT, Charitos CE, Nanas SN, Margari ZJ, Agapitos EV, et al. A valveless high stroke volume counterpulsation device restores hemodynamics in patients with congestive heart failure and intractable cardiogenic shock awaiting heart transplantation. *J Thorac Cardiovasc Surg* 1996;111:55-61.
2. Nose Y, Schamaun M, Kantrowitz A. Experimental use of an electronically controlled prosthesis as an auxiliary left ventricle. *Trans Am Soc Artif Intern Organs* 1963;9:269-74.
3. Gabby S, Frater RW. The extra-aortic balloon counterpulsation as an assist device. *Trans Am Soc Artif Intern Organs* 1981;27:598-603.
4. Nanas JN, Olsen DB, Hamanaka Y, Chiang B-Y, Nielsen S, Hughes S, et al. Experience with a valveless, implantable

abdominal aortic counterpulsating device. *Trans Am Soc Artif Intern Organs* 1984;30:540-4.

5. Utoh J, Whalen RL, Wilkerson BR, Fukamachi K, Harasaki H. Chronic in vivo function of a new ventricular assist device: the extracorporeal pulsatile assist device (EPAD). *Int J Artif Organs* 1993;16:91-5.

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Reply to the Editor:

Dr. Utoh makes the point that "the concept of this type of device is not so new." The counterpulsation technique has been used in many different ways. The application techniques were greatly improved to be more effective and suitable for long-term assistance.¹ The new idea for the improvement in the effectiveness of the counterpulsation technique was the use of high stroke volume in our device. This concept was the object of the discussion by Dr. Kantrowitz that followed the first presentation.² The theoretical explanation for the increased salutary hemodynamic effects of a high stroke volume counterpulsation device is based on the Suga-Sagawa law.³ On the basis of this law, for a given cardiac situation, the lower the left ventricular end-systolic pressure the higher the left ventricular stroke volume. For a counterpulsation device, the

higher the stroke volume the lower the left ventricular end-systolic pressure; thus, the higher the left ventricular stroke volume the better the systemic perfusion. The optimal counterpulsation volume in comparison with the capacitance of the arterial systemic bed has not been thoroughly investigated.

John N. Nanas, MD, PhD
Spyridon D. Mouloupoulos, MD, PhD
University of Athens School of Medicine
"Alexandra" Hospital
Athens, Greece

REFERENCES

1. Nanas J, Mouloupoulos S. Counterpulsation: historical background, technical improvements, hemodynamic and metabolic effects. *Cardiology* 1994;84:156-67.
2. Nanas J, Olsen D, Hamanaka Y, Chiang B-Y, Nielsen S, Hughes S, et al. Experience with a valveless, implantable abdominal aortic counterpulsating device. *Trans Am Soc Artif Intern Organs* 1984;30:540-4.
3. Suga H, Sagawa K. Instantaneous pressure-volume relationships and their ratio in the excised supported canine left ventricle. *Circ Res* 1974;35:117-26.

12/8/75203