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Bicycle stress echocardiography

UPRIGHT VERSUS SUPINE

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Several studies have explored the differences between upright and supine posture during bicycle exercise. Some of these differences have direct relevance to exercise echocardiography and should be considered when performing the test and analyzing the results. It should be noted that no study has compared directly the two-dimensional echocardiographic findings during these two forms of stress testing.

When patients with chronic stable angina are exercised in the supine and upright postures, chest pain is provoked with approximately equal frequency.³⁻⁵

**Bicycle exercise in either
position is equally likely
to provoke ischemia.**

This occurs despite a greater workload attained in the erect position.^{3,5} Currie et al.³ studied 43 patients with a history of chest pain but no prior myocardial infarction. Angina developed in 31 patients during upright bicycling. Maximum workload was significantly higher during upright exercise. Thadani and co-workers⁴ reported similar results in 20 male patients with stable angina. They performed invasive studies at rest and during exercise and reported significant differences in the hemodynamic response between the two postures. Heart rate, arterial pressure, and stroke index increased to a greater degree with upright exercise, while angina developed in all patients during both tests.

Freeman et al.⁵ studied 37 patients

Second of Three Articles

- Bicycle Stress Echocardiography – Techniques
- Bicycle Stress Echocardiography – Upright vs Supine
- Stress Echocardiography – Bicycle vs Treadmill

during upright and supine multiple gated cardiac blood pool scintigraphy. Maximum heart rate and systolic blood pressure were lower during supine exercise. While changes in left ventricular end-diastolic and end-systolic volumes

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UPRIGHT VS SUPINE BICYCLE ERGOMETRY

Comparable Areas

- Chest pain provoked with equal frequency
- Ejection fraction similar

With Upright Ergometry

- Attained significantly greater workload & exercise duration
- Higher heart rate & double product

With Supine Ergometry

- Higher left ventricular end diastolic pressure & volume
- Higher wall stress & increased myocardial oxygen demand

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were position dependent, ejection fraction and segmental wall-motion responses were comparable between the two positions. The authors concluded that both postures were equally useful for detecting the presence and extent of coronary artery disease.

These clinical investigations suggest that bicycle exercise in either position is equally likely to provoke ischemia. However, important differences, relevant to echocardiography, do exist. The exercise-induced increase in left ventricular end-diastolic pressure (which often accompanies ischemia) may be less with upright exercise.⁴ This may reflect differences in systemic venous return (i.e., preload) between the two positions. A larger left ventricular end-diastolic volume during supine exercise would be associated with higher wall stress and increased myocardial oxygen demand. This may partially account for the equal prevalence of ischemia, despite a lower workload during supine exercise.

The greater increase in left ven-

tricular contractility during upright versus supine exercise⁴ has implications for echocardiographic study. A more "normal" global left ventricular response to exercise in the sitting position could potentially mask an induced wall-motion abnormality. Thus, a small region of ischemia might be more easily overlooked during erect exercise, when the increase in stroke index is higher. While this theoretically would favor supine exercise, the clinical significance of this observation is unproven.

Thus, differences exist between supine and upright exercise. A higher workload is generally attained in the upright position and this is associated with a greater increase in left ventricular systolic function and arterial pressure. One might, therefore, expect a more hyperdynamic response in normal areas during upright stress. The extent of this response and its effect on the ability of echocardiography to detect induced wall-motion abnormalities are unknown. During supine exercise, a

more marked increase in preload occurs. The larger increase in left ventricular volume may lead to a greater rise in wall stress. This may explain the observation that ischemia develops at a lower workload in the supine posture.

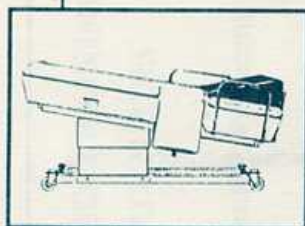
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