

High-Frequency Chest-Wall Compression, Patient Safety, and the *n*-of-1 Construct

In this issue of *RESPIRATORY CARE*, Allan and colleagues report on the safety of high-frequency chest-wall compression (HFCWC, with The Vest, Hill-Rom, St Paul, Minnesota) in the 48 hours following thoracic surgery.¹ The study is long overdue and is the first examination of the general safety and hemodynamic consequences of HFCWC in a patient population that may be predisposed to hemodynamic compromise. Allan et al give us a well designed study that effectively tested the general safety and hemodynamic consequences of HFCWC in the early postoperative course of the thoracic-surgery patient. There were no major adverse events, which is noteworthy, given the anecdotal mythology that seems to hover in the mist concerning HFCWC and the cardiothoracic-surgery patient. Perhaps the most important finding was that patients who expressed a preference for either HFCWC or conventional manual chest physiotherapy preferred HFCWC by more than two to one.

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In our practice at the Cleveland Clinic, we frequently employ HFCWC in the postoperative critical care of cardiothoracic and vascular surgery patients. Yet, if one were to give even the most perfunctory glance at Hill-Rom's list of relative contraindications to HFCWC (Table 1), one might have a great deal of reticence in the clinical application of HFCWC in a postoperative cardiothoracic patient. A complaint of "chest wall pain" might be a rather common finding in a postoperative cardiothoracic practice, and if such a complaint were raised, it could in theory prohibit HFCWC in postoperative care. Given Hill-Rom's inventory of relative contraindications, one must wonder if HFCWC ought to be prescribed at all for the cardiothoracic patient. Yet, historically, we have used HFCWC on our postoperative cardiothoracic patients. Why do we do this? Although the study by Allen and colleagues demonstrates the safety of HFCWC in this patient group, it does not speak to or demonstrate the clinical utility or efficacy of HFCWC. Indeed, the clinical efficacy and utility of HFCWC in the adult postoperative population remains controversial.²

The consideration of HFCWC as a safe adjunct, after nearly 2 decades of routine clinical application, illustrates a greater practice issue that seems endemic in the current landscape of respiratory care. The fundamental question is, in a world

Table 1. Manufacturer's List of Relative Contraindications* to High-Frequency Chest-Wall Compression With The Vest

Intracranial pressure > 20 mm Hg, or patient in whom increased intracranial pressure should be avoided
Uncontrolled hypertension
Hemodynamic instability
Pulmonary edema associated with congestive heart failure
Bronchopleural fistula
Subcutaneous emphysema
Large pleural effusions or empyema
Recent esophageal surgery
Active or recent gross hemoptysis
Pulmonary embolism
Uncontrolled airway at risk for aspiration (tube feeding or recent meal)
Distended abdomen
Bronchospasm
Suspected pulmonary tuberculosis
Transvenous pacemaker or subcutaneous pacemaker
Recent epidural spinal infusion or spinal anesthesia
Recent spinal surgery or acute spinal injury
Rib fractures, with or without flail chest
Surgical wound or healing tissue, recent skin grafts or flaps on the thorax
Burns, open wounds, or skin infections on the thorax
Lung contusion
Osteomyelitis of the ribs
Osteoporosis
Coagulopathy
Complaint of chest-wall pain

* The decision to use The Vest for airway-clearance therapy in the presence of these conditions requires careful consideration and assessment of the individual patient's case.

"gone mad" over evidenced-based choice of therapies, why do we continue with therapies and practices that are fundamentally based on embedded cultural tendency, outdated practice guidelines, custom, gestalt, habit, and institutionalized convention? Why do we treat our patients based on decisions that are not grounded in a thoughtful review of current best evidence individualized for present patient context? Why do we act as automatons when we have access to and knowledge of evidence that either contradicts or offers no support for our actions?

As respiratory therapists in hospital practice, we "act" in the setting of unit-based or hospital-based communities. Custom, habit, and entrenched cultural norms suggest the rules that govern ordinary interactions among members of this community. Frequently these unit-specific or hospital-specific norms are so pervasive and embedded that they remain im-

perceptible and a challenge to modify even if they are ineffective or counterproductive. Unit-specific norms govern the relationships between therapists, nurses, and doctors, and may allow disadvantageous practices to persist even in the face of conflicting evidence, reasoned dispute, and established clinical guidelines. Unit-based or culturally driven therapy may be rather arbitrary and is regularly driven by anecdotal experience. The well versed, well informed individual may feel that he or she cannot change the existing local culture because it remains grounded in incomplete or obsolete knowledge of optimal care.

Perhaps we should be rethinking the use of HFCWC in the postoperative cardiothoracic patient. The current practice may be more conservative than necessary, and this may be limiting our therapeutic options for this very fragile yet eminently recoverable patient population. In my experience, when applied appropriately, HFCWC achieves the clinical goal of enhanced chest clearance.

I am impressed with Hill-Rom's Web site for The Vest (<http://www.thevest.com>). In a very straightforward manner they direct the therapist to use The Vest in an assessment-driven, evidence-based fashion. "The decision to use The Vest system for airway-clearance therapy...requires careful consideration and assessment of the individual patient's case." That sentence is an elementary summation of the concept of the patient-specific "*n-of-1*" trial.

In its idealized form, the *n-of-1* trial is a single-patient randomized double-blind multiple-crossover comparison of an active drug against a placebo.³ However, that highly idealized trial construct is frequently impossible to achieve in the critical care setting. The need for treatment prohibits the conventional application of a randomized double-blind study. One must temper the model to achieve an assessment-driven examination of the therapeutic options and their clinical effect. The *n-of-1* trial is a means of structuring treatment decisions with and for the patient, in a highly individualized fashion, and monitoring the patient's responses to each treatment. This process calls for the formation of clinical inquiries that drive the therapeutic options or choices. The patient's response(s) to a therapy prompts the clinician to reassess the patient and reformulate a clinical inquiry, which in turn necessitates the formation of further therapeutic options that will beget further clinical questions.^{4,5} The *n-of-1* model of patient care is precisely what we do much of the time, but in an informal, undeveloped, and haphazard manner; thus, we often fail both to optimize therapy and to learn from our experience. The obvious exception to this arbitrary practice

is, of course, the well developed therapist-driven protocol service.⁶

Regardless of our current practice, we must explore with intellectual rigor innovations in thought, technology, and clinical practice. The mindful clinician will seek to develop innovative therapeutic options in an *n-of-1* framework. The *n-of-1* construct is the platform from whence our therapeutic options rise in a way that, to Sackett, represents the "conscientious, explicit, and judicious use of current best evidence applied to the decision making process concerning the care of individual patients."⁷ Therefore, it is essential that we as a profession expand and cultivate the utilization of an assessment-based, evidence-grounded practice model in every clinical setting and patient contact. The *n-of-1* construct is a context-specific framing device that heightens, in an adaptive fashion, our embedded, therapeutically elite thought process. *N-of-1* thinking is not reactive; rather, it is an authentic, exceptionally adaptive, knowledge-driven way of thinking about and caring for our patients.

Clearly, the judicious investigation and clinical application of contemporary technologies and therapies is an aspect of compassionate care. Indeed, a thoughtful appreciation and working knowledge of current thought and therapeutic options remains both an ethical duty and a moral imperative. The *n-of-1* trial is the archetypical patient centered, evidence-based, care process. This practice model allows us to rewrite patient care strategies that remain co-attendant with any highly individualized patient context. The *n-of-1* construct fashions novel practice topographies in the delivery of evidence-based assessment-driven care to our patients.

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