Letters to the Editor

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- Include no more than 500 words of text, three authors, and five references
- Type with double-spacing
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The helix and the heart

To the Editor:

It is indeed an honor for me to be cited within the text of an important lecture, the content of which has now been published in the Journal.¹ Is it not incumbent, however, on those making the citation to ensure that it is scientifically correct? Sadly, the statements attributed to me by Buckberg² are fundamentally wrong, and I know from correspondence during the past 12 months that he is well aware of this fact. I refer, of course, to the extensive coverage devoted in his lecture² to the “unique myocardial band” proposed by Torrent-Guasp as the basis of the architecture of the ventricular mass.³ In his latest review, Buckberg² referred to my study with computed tomography after transcatheter pneumatic spreading of the myocardial network as supporting the concept of this hypothetical “unique band.” In reality, the study revealed the connective tissue scaffold of the ventricular musculature to be aligned in multiple spirals, not in the fashion that would provide a plane of cleavage for unwrapping a solitary muscular element within the biventricular myocardial mass. I showed by subsequent histologic examination that the perfusion of gas at high pressure through coronary arteries destroyed and dried out the myocardial mass. After shrinkage, it is the connective tissue scaffold that remained preserved, with some remnants of myocardium in its lattice. The connective tissue matrix, when imaged in slices taken from the left ventricular base to the apex by computed tomography, was seen to be arranged in a series of spirals, descending from the base of the left ventricle to the apex, with other spirals turning in opposite direction and thus ascending from the apex to the base. The existence of these multiple spirals produces a manifold set of planes of cleavage along which the myocardium can be severed. This is in keeping with the classic studies of Benninghoff and Görtler, as confirmed by many other gross morphologists. The findings, however, lend no support whatsoever to Torrent-Guasp’s concept of a “unique

myocardial band” taking its origin from the aorta and inserting into the pulmonary trunk after having encircled the cavities of both ventricles. Buckberg is entirely wrong, therefore, when he suggests that my investigations are supportive of the concept reported so extensively in his recent review.²

It is true that I myself was initially intrigued by the concepts of Torrent-Guasp, because they emphasized the existence within the ventricular myocardium of a sequence of longitudinally aligned fibers.⁴ This finding is of both educational and functional significance. I subsequently realized, however, that the concept had been stretched beyond the bounds of scientific credibility. For example, the embryologic hypotheses advanced recently by Buckberg and his associates, including Torrent-Guasp, to support their hypothesis bear no resemblance to the known facts of cardiac development.⁴⁻⁷ More importantly, my continuing morphologic and histologic investigations have confirmed that there are no fibrous tissue sheaths within the ventricular myocardium encasing a “unique myocardial band.”⁸ Any attempt to reveal such a structure by dissection is of necessity artifactual, because it can be achieved only by destroying the fibrous spatial netting when attempting to reveal the myocardial structure. In fact, it is the dense oblique transmural netting of the myocardium within its fibrous tissue matrix that produces the versatile functional pattern in which mural thickening can be accommodated to the working conditions of the ventricle, namely to the state of its end-diastolic filling. These oblique transmural forces intercept the longitudinal transmission of forces along the prevailing tangentially orientated myocardial fibers.^{9,10} The assumption of Buckberg² that the “unique myocardial band” proposed by Torrent-Guasp is the only vehicle along which forces are transmitted throughout the ventricular wall is scientifically unsound. In particular, Buckberg should not attempt to

support his spurious concepts by misinterpretations of my own works.

Paul Lunkenheimer, MD
Experimental Thoracic and
Cardiovascular Surgery
University Clinic of Münster
Münster, Germany

Reference

1. Lunkenheimer PP, Muller RP, Konermann CHR, et al. Architecture of the myocardium in computer-tomography. *Invest Radiol.* 1984;19:271-8.
2. Buckberg GD. Basic science review: the helix and the heart. *J Thorac Cardiovasc Surg.* 2002;124:863-83.
3. Torrent-Guasp F, Buckberg GD, Clemente C, Cox JL, Coghlan HC, Gharib M. The structure and function of the helical heart and its buttress wrapping. I. The normal macroscopic structure of the heart. *Semin Thorac Cardiovasc Surg.* 2001;13:301-19.
4. Lunkenheimer PP, Lunkenheimer A, Torrent-Guasp F. Kardiodynamik: Wege zur strukturgerechten Analyse der Myokardfunktion. In: Zolch KA, editor Beiträge zur Kardiologie. Heppenheim. 1985.
5. Benninghoff A. Über die Entwicklung der Muskelarchitektur im Innern der menschlichen Herzkammern. *Morph. Jahrbuch* 63, 1929.
6. Goertler KL. Normale und pathologische Entwicklung des menschlichen Herzens. In: Zwanglose Abhandlungen aus dem Gebiet der normalen und pathologischen Anatomie. Heft 3. Stuttgart: Georg Thieme. 1958.
7. Moormann A, Webb S, Brown NA, Lamers W, Anderson RH. Development of the heart 1. Formation of the cardiac chambers and arterial trunk. *Heart.* 2003;89:806-14.
8. Lunkenheimer PP, Redmann K, Cryer CW, Richter KD, Niederer P, Whimster WF, et al. The difficult access to morphology of the heart: clinical implications. *Technol Health Care.* 1994;2:155-73.
9. Redmann K, Lunkenheimer PP, Scheld HH, Dietl KH, Fischer S, Cryer C, et al. Inhomogeneities in wall stress measured by microergometry in the heart muscle in situ. *Technol Health Care.* 1997;5:123-34.
10. Lunkenheimer PP, Lunkenheimer A, Whimster WF, Edel G, Stroh N, van Aken H. Local myocardial and global ventricular function compared during positive inotropic medication. *Bas Res Cardiol.* 1986;81 (Suppl):59-71.

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Reply to the Editor:

The role of my basic science lecture was to provide insight into the helix and the heart, with special emphasis on the interaction between nature, the heart, and the human being. Lunkenheimer's letter expands this focus. I credited his remarkable capacity to

add connective tissue spirals to our understanding of the scaffold of organized latticework for ventricular musculature. By intention, my lecture was not limited to the heart, but rather used my awe of the cardiac synthesis of nature's recipe for integration of spirals as a centerpiece to consider structure and rhythm. Claude Bernard,¹ a father of physiology, correctly defined anatomy of dead tissue to align itself with living physiologic function, rather than blindly relying on structure for deduction.

My admiration for the synthesis of spiral structures links closely to the helix described by Torrent-Guasp for the spatial orientation of the ascending and descending components of the helical apical loop and concurs with Lunkenheimer's elegant study of the connective tissue scaffold. Does Lunkenheimer think that the spiral muscular components that are desiccated during his method of transpneumonic spreading and fill this latticework are different from the weave that surrounds them?

Does this arrangement not simply add a new dimension to the hidden cardiac spiral harmony? His anatomic observations in the dead heart blend perfectly with the dual helical spirals of DNA or the planning code, the double helix of actin, myosin, tropomyosin, the spiral configuration of calcium within each cell, and the calcium coil described in my report. Furthermore, Taccardi and coworkers² added the spirals of the conduction system to this symphony. My conclusion is that Lunkenheimer's intrinsic connective tissue framework helps to more solidly integrate dimensions. Lunkenheimer's 1997 monograph³ and his letter show he does not accept the work of Torrent-Guasp.⁴ The literature allows scientists to report observations, make conclusions, and simultaneously let the readers make their own interpretations. My report links the reciprocal spirals defined in computed tomographic scan framework with the apical loop segments displayed by Torrent-Guasp. The *Journal's* readers are also free to render individual interpretations.

Torrent-Guasp's "unique band" may show how transverse fibers of the basal loop become oblique, through the myocardial fold or twist that separates the basal and apical loops (Figure E1, online only). This structural component may alter conventional thinking, because many people (including myself) thought that the heart constricts and dilates, rather than proper

shortening and lengthening in the living organism. This active contraction has overturned the teachings of Harvey, who studied dead anatomy and then presumed for the living. This is a vital lesson, because he was our teacher but not always perfect.

I suspect that recognized embryologic cardiac development may also be questioned, because the fold or turn in developing muscle mass may reflect a more rapid growth of the *ventricle* versus the *bulbus cordis* (Figure E2, online only).⁵ I subsequently learned that Goor and Lillehei⁶ (Figures E3 to E5, online only) and Maner⁷ (Figures E6 to E8, online only) have provided data supporting how the twist evolved. Perhaps anatomists and embryologists must rethink developmental concepts, just as magnetic resonance imaging findings of reciprocal twisting for ejection and suction impose needs for new understanding on clinicians.

Lunkenheimer shows no functional evidence to sustain his jump from anatomic structure to function, a basic premise in Bernard's distinction between anatomists and physiologists. Conversely, our sonomicrometer crystals within reciprocal spiral oblique positions of the living heart (Figure E9, online only) show functional correlation with Torrent-Guasp's anatomic spatial.⁸ Lunkenheimer addresses problems with artifactual dissection as Torrent-Guasp develops the muscular band for myocardial structure by indicating a destruction of the fibrous spatial netting. However, Lunkenheimer defends the correctness of the fiber strand peel-off method (SPOT).⁴ Can anyone follow each individual uncovered fiber, unfold it to show its helical configuration, and then further unravel the helical coil within each fiber to clarify the dual helical configuration of actin, myosin, or tropomyosin? Can someone successfully follow each collagen strand living within the helical connective tissue defined by this exciting and critical computed tomographic scan? Nature made endless coils within coils, and our future role is to discover and to slowly uncover different aspects of them, just as Torrent-Guasp and Lunkenheimer have done in their important studies.

Each letter to the Editor within a scientific journal provides the reader and the writer with the chance interact about work and then let the reader reach his or her own conclusions. The truth is provided by the