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This Week's Citation Classic

Lown B, Amarasingham R & Neumann J. A new method for terminating cardiac arrhythmias. *J. Amer. Med. Ass.* **182:**548-55, 1962.
[Harvard School of Public Health Cambridge, MA and Peter Bent Brigham Hospital, Boston MA.]

The authors introduce an entirely new concept for treatment of attacks of rapid heart action, as well as a new method involving use of a brief electrical pulse across the chest wall to abolish the tachycardia. The electric pulse is delivered within a safe part of the cardiac cycle. [The *SCI*® indicates that this paper has been cited over 300 times since 1962.]

Bernard Lown
Professor of Cardiology
Harvard School of Public Health
Boston, MA 02115

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"Perhaps the seed of the idea to develop a new approach for controlling tachycardias of all types was planted during the many night vigils with patients afflicted with these cardiac disorders who did not respond to diverse drugs. But like most novel ideas, it was based on an unproved hypothesis. I surmised that the abnormal mechanism was the result of an electrical accident which, if once terminated, was unlikely to recur. The arrhythmia was maintained by a recirculating wave of excitation. This possibility had already been demonstrated in the medusa at the turn of the century by the American marine biologist A. C. Mayer.[1] My idea was simplicity itself, namely: to block passage of the depolarizing electrical wave by making cardiac fibers refractory. This could be achieved by an externally delivered electrical pulse across the intact chest.

"While the concept was straightforward, its implementation was complex. It was well known that electricity could injure as well as stop the heart entirely. The question therefore was not only whether the concept was correct but how to make electricity safe for human use. After a year of arduous effort, we found that an underdamped sine wave was effective in animal models and caused but minimal heart damage. Further experimentation demonstrated that if electrical shock was synchronized to discharge outside the brief ventricular vulnerable period following each heart beat, electrical pulses could be administered with great safety. This method of delivering a synchronized DC pulse across the chest has been designated cardioversion. The application of this method is worldwide; its prompt acceptance and incorporation into routine clinical practice testifies to the fact that a therapeutic need has been met.

"Yet implementing this idea was by no means simple. The early experience brings a flood of memories that will provoke unease. No one was initially willing to submit patients to this procedure. The authorities of my hospital discouraged its use. The first patient subjected to this procedure was in a small outlying hospital following a mitral valve operation. As soon as the thoracotomy incision was closed, the surgeon applied the electrode paddles to the chest wall. As I pressed the button on the primitive cardioverter, there was an enormous explosion. A fire started in the operating room. What had happened was that without my knowledge, the surgeon had placed an alcohol soaked sponge on the patient's chest beneath each elecrode paddle to obtain a better electrical contact. The 3000 volt discharge ignited the alcohol, causing a fire. Needless to say, I was never invited back to that hospital.

"There were other difficulties. Research grants were not forthcoming, as the idea was assessed as outlandish. Furthermore, my credentials were deemed inadequate in the field of bioengineering. Private funds provided by Dr. Fredrick Stare, chairman of my department at the Harvard School of Public Health, permitted this work to be carried out. In retrospect, it is ironic that the report of this investigation was refused publication because the reviewer felt that it had little relevance. However, it was accepted for presentation at the annual meeting of the Society for Clinical Investigation and reached the medical and scientific community through the mass media.

"Like the proverbial pebble cast in the water, the ripple effect of this work has been profound. It directly influenced the development of demand pacemakers; it contributed to the emergence of the coronary care unit; and helped focus attention on the formidable, out-of-hospital problem of sudden death, claiming over 400,000 lives annually in the USA."

1. Mayer A G. *Medusae of the world.* Washington, DC: Carnegie Institution. 1910. 3 vols.