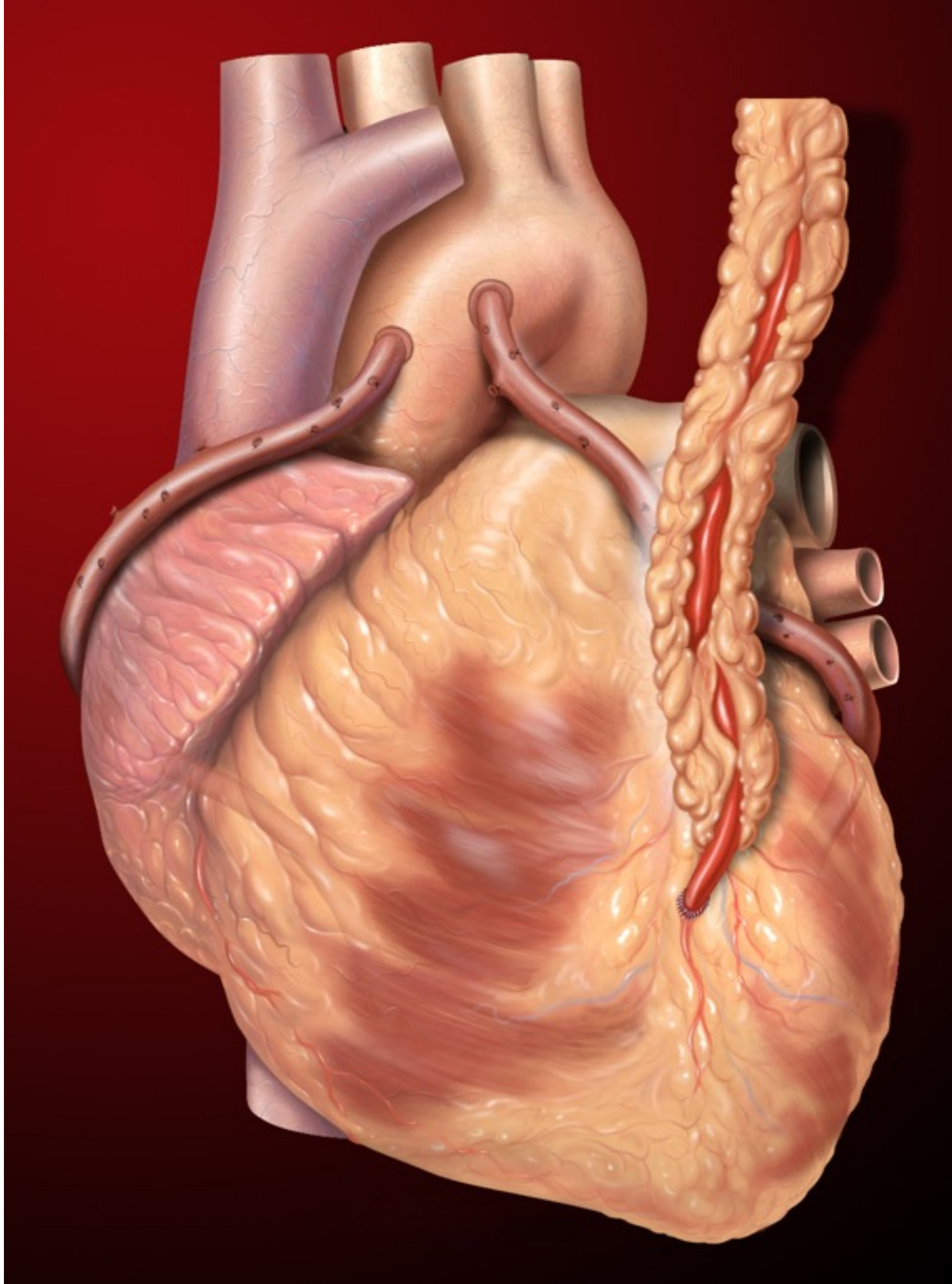
Evidence and Practice:
How Surgeons Know Their Operations Work

David Jones, MD, PhD
Harvard Medical School

How Do We Know Surgery Works (or not)?

Bloodletting, c. 1859. Public Domain. Courtesy of The Burns Archive - Burns Archive via Newsweek, 2.4.2011

The Emergence of Coronary Artery Bypass Grafting (1910, 1960, 1968)



The Initial Efficacy Claims

"Addendum: Since this article was submitted for publication, a coronary mammary anastomosis between the right mammary and right coronary artery, using the tantalum ring, has been successfully performed on a 38-year old patient at Van Etten Hospital, Bronx Municipal Hospital Center, New York, on May 2, 1960. The patient is doing well and is intended to report the case in detail in a separate communication." Goetz et al., *JTCVS* 41 (1961): 386.

"Fifteen patients were operated upon without mortality. Postoperative angiographic catheterization has demonstrated excellent function of the grafts." Favaloro, *ATS* 5 (1968): 339.

"There was a direct correlation between the angiographic findings and the clinical evaluation: 40 patients with patent, well-functioning grafts were free of angina. In contrast, patients with poor angiographic results remained highly symptomatic." Favaloro et al., *Chest* 56 (1969): 283.

"Arteriographic proof that the pathological ligature has been removed effectively and myocardial perfusion has been restored is prima facie evidence that the needs of that particular individual have been met. The cardiologist who would loudly deny the existence and validity of such factual evidence by refusal to examine it is, in my opinion, allowing emotion to prevail over scientific evaluation." Effler, *ATS* 8 (1969): 377.

Cardiologists' Critiques

"Accompanying this excitement, however, is an uneasiness that by simple common consent, rather than by rational analysis of data, we may be adopting for general use a form of therapy that has yet to prove its effectiveness in a rigidly controlled clinical trial … is the genie, even now, escaping from the bottle, and will he all too soon control us?" Braunwald, *Hospital Practice* 6 (1971): 9.

"The F.D.A., therapeutic trials committees, granting authorities, and responsible journal reviewers require airtight controlled trials of new (and, thank heaven, old) pills and injections. Somehow, the mystique of surgery -- the presumed efficacy of a mechanical rearrangement of tissue -- makes these natural referees suspend disbelief in a way that no pill could." Spodick, *Circulation* 44 (1971): 302.

"So randomization from the first patient is not only a more precise method of arriving at the evaluation of a new therapy, but is also a more ethical way to practice medicine." Chalmers, *ATS* 14 (1972): 325.

The VA Cooperative Study and Surgeons' Responses

VA Cooperative Study: 596 patients with chronic stable angina were randomized to medical (n=310) or surgical (n=286) treatment. At 36 months, there was no significant difference in survival rates (87% vs. 88%). However, in patients with severe left main disease, analyzed separately, surgery did provide a survival benefit. Murphy et al., *NEJM* 297 (1977): 621-627.

Typical critiques of the VA Study:

- Operative mortality rates in the study were too high, especially compared with elite centers.
- Graft patency rates were too low.
- Survival rate in the medical group was high, suggesting that these were healthy CAD patients.
- Many patients randomized to medical therapy crossed over to surgery.
- The operations were performed 1972-1974; techniques (and outcomes?) had improved by 1977.

"The insistence on the use of prospective randomized studies for the evaluation of surgical diagnostic and therapeutic techniques reflects a naive obsession with this research tool … Any attempt to discredit the entire procedure on the basis of a highly restricted study and to insist that such a study is the only scientific basis for assessment is, itself, unscientific." DeBakey and Lawrie, *JAMA* 239 (1978): 838, 839.

Reply: "Neither dogmatic assertions nor screams of outrage will take the place of the firm data required to assess the efficacy of coronary bypass surgery." Braunwald, *Am J Card* 42 (1978): 162.

The Inevitable Limits of Randomized Trials in Surgery

Operator skill: should trials be done by the best surgeons, or by typical surgeons? Should trials be done early in the history of a procedure, before it becomes entrenched, or only once surgeons have optimized the procedure and their skill (i.e., to give the procedure the best chance of demonstrating its success)?

Time lag: any study that includes long-term outcomes (e.g., 3- to 5-year survival) will be published many years after the operations were performed. Will the results still be meaningful if surgeons have innovated and improved (presumably) the procedure in the meantime?

Blinding: randomized trials of medications are routinely doubled blinded: neither the patients nor the evaluators know which treatment the patient received. This is much more difficult to do for surgical procedures. Are non-blinded randomized trials still useful?

Sham Controlled Surgical Trials

Arthroscopic surgery for osteoarthritis of the knee. 180 patients randomized to arthroscopic débridement, arthroscopic lavage, or placebo surgery (patients in the placebo group received skin incisions and underwent a simulated débridement without insertion of the arthroscope). There were no differences in knee-specific pain scales or in function measures between the three groups at one or two years. Mosely et al., *NEJM* 347 (2002): 81-88.

Vertebroplasty for osteoporotic spinal fractures. 131 patients randomized to vertebroplasty or a simulated procedure without cement. Patients in both groups had immediate (and similar) improvement in pain and disability scores. Kallmes et al., *NEJM* 361 (2009): 569-579.

Meniscectomy for degenerative meniscal tear. 146 patients randomized to arthroscopic partial meniscectomy or sham surgery. There was no significant difference between the groups in meniscal evaluation scores or knee pain after exercise at one year. Sihvoven et al., *NEJM* 269 (2013): 2515-2524.

What Does It Take to Provide Convincing Evidence of Efficacy?

Do we need sham-control trials of simple laceration closure?

Could we do sham-control trials of gender reassignment surgery?

What about appendectomy vs. antibiotics for acute appendicitis?

What about CABG vs. PCI vs. medical management of chronic stable angina?

Conclusions and Further Reading

- Robert H. Goetz, Michael Rohman, Jordan D. Haller, Ronald Dee, and Stephan S. Rosenak, "Internal Mammary-Coronary Artery Anastomosis: A Nonsuture Method Employing Tantalum Rings," *Journal of Thoracic and Cardiovascular Surgery* 41 (1961): 378-386.
- Richard Gorlin and Warren J. Taylor, "Selective Revascularization of the Myocardium by Internal-Mammary-Artery Implant," *New England Journal of Medicine* 275 (1966): 283-290.
- René G. Favaloro, "Saphenous Vein Autograft Replacement of Severe Segmental Coronary Artery Occlusion," *Annals of Thoracic Surgery* 5 (1968): 334-339.
- René G. Favaloro, Donald B. Effler, Laurence K. Groves, William C. Sheldon, and Mohammed Riahi, "Direct Myocardial Revascularization with Saphenous Vein Autograft: Clinical Experience in 100 Cases," *Diseases of the Chest* 56 (1969): 279-283.
- Donald B. Effler, "The Role of Surgery in the Treatment of Coronary Artery Disease," *Annals of Thoracic Surgery* 8 (1969): 376-379.
- Eugene Braunwald, "Direct Coronary Revascularization ... A Plea Not To Let the Genie Escape from the Bottle," *Hospital Practice* 6 (1971): 9-10.
- Thomas C. Chalmers, "Randomization and Coronary Artery Surgery," *Annals of Thoracic Surgery* 14 (1972): 323-327.
- David H. Spodick, "Numerators Without Denominators: There is No FDA for the Surgeon," *JAMA* 232 (1975): 35-36.
- Jack W. Love, "In Comment: Drugs and Operations: Some Important Differences," *JAMA* 232 (1975): 37-38.
- Timothy Takaro, Herbert N. Hultgren, Martin J. Lipton, Katherine M. Detre, and Participants in the Study Group, "The VA Cooperative Randomized Study of Surgery for Coronary Arterial Occlusive Disease: II. Subgroup with Significant Left Main Lesions," *Cardiovascular Surgery* 54 suppl 3 (1976): 107-117.
- Marvin L. Murphy, Herbert N. Hultgren, Katherine Detre, James Thomsen, Timothy Takaro, and Participants of the Veterans Administration Cooperative Study, "Treatment of Chronic Stable Angina: A Preliminary Report of Survival Data of the Randomized Veterans Administration Cooperative Study," *New England Journal of Medicine* 297 (1977): 621-627.
- Michael E. DeBakey and Gerald M. Lawrie, "Aortocoronary-Artery Bypass," *JAMA* 239 (1978): 837-839.
- David S. Jones, "Visions of a Cure: Visualization, Clinical Trials, and Controversies in Cardiac Therapeutics, 1968-1998," *Isis* 91 (2000): 504-541.
- J. Bruce Moseley, K.O. O'Malley, N.J. Petersen, T.J. Menke, B. Brody, B., D.H. Kaykendall, J.C. Hollingsworth, C.M. Ashton, and N.P. Wray, "A Controlled Trial of Arthroscopic Surgery for Osteoarthritis of the Knee," *New England Journal of Medicine* 347 (2002): 81-88.
- Rita F. Redberg, "Sham Controls in Medical Device Trials," *New England Journal of Medicine* 371 (2014): 892-893.
- David S. Jones, "The Puzzle of Positive Results — Myocardial Revascularization," *New England Journal of Medicine* 372 (2015): 501-503.