

Guest Editorial

Back to the Stacks – Looking at Classic Papers Related to the Current Practice of Cardiopulmonary Bypass

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A number of philosophers and writers have eloquently expressed the importance of understanding the past.

“If you would understand anything, observe its beginning and its development” Aristotle

“History teaches everything including the future”
Alphonse Lamartine

“Life must be lived forward, but it must be understood backward” Soren Kierkegaard

“Those who cannot remember the past are condemned to repeat it” George Santayana

“If history repeats itself, and the unexpected always happens, how incapable must man be of learning from experience?” George Bernard Shaw

The history of perfusion in the perfusion literature is filled with examples of “discoveries” of new technology and “new” applications of technology. Many of these are simply “reinventions” of techniques that were previously described. One example is John Gibbon’s use of vacuum assist for venous return. His Mayo Gibbon pump used suction to augment the venous return. Following the simplification of the cardiopulmonary bypass circuit to gravity drainage, vacuum-assist was later reintroduced again in the early 1990s. There are numerous examples of early attempts to improve bypass that were “rediscovered” later.

The modern computer age has made searching for references and remote access to the current literature very easy. In the past, it was necessary to actually go to the library and search in Index Medicus for subjects related to cardiopulmonary bypass. However, there are still a limited number of full articles available online. *The Annals of Thoracic Surgery* and the *Journal of Thoracic and Cardiovascular*

Surgery are available from January 1, 1995. *The Journal of ExtraCorporeal Technology* (JECT) is now available on line from 1972. A limited amount of the Proceedings from the American Academy of Cardiovascular Perfusion (AACP) are available electronically. The journal *Perfusion* started publishing peer-reviewed AACP presentations in 1995 and *Perfusion* is available electronically online from January 1, 1997. The ASAIO journal is available online from January 1, 2000. Except for JECT, only the most recent (last 15 years) are available and many of the best years of the development of perfusion technology are not available electronically. Therefore, the present day perfusion student and clinicians need to go back to the library stacks to find the journal articles that laid the foundation for our current clinical practice. Much of the research that determines current clinical practice is not available as a pdf file, but is buried in the volumes of journals that now lie dormant on the library shelves. The library building is now often empty because students have online access to journal articles.

It is still important to review “classic” papers in the literature that continue to influence our practice today. The early articles that described case reports of new techniques and studies of new methodologies are critical to understanding the basis for our current clinical practice. Today, we primarily use systematic reviews and evidence based medicine to develop clinical guidelines, but the majority of our clinical practice is rooted in the “classic” research papers that influenced and changed the majority of the profession until it became a “standard of practice.” There are many current clinical practices that are based on this literature and there will never be a double-blinded randomized clinical trial to prove their efficacy. All we have to do is ask the questions, and the answers probably come from

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publications prior to the electronic age. For example, when and why were blood conservation methods developed, what minimum activated clotting time should be maintained on bypass, why do we use membrane oxygenators, how do we manage patients on ventricular assist devices, how do we make bypass safer and prevent air embolism, why do we use retrograde blood cardioplegia, and how do we reduce the inflammatory response?

My interest in this subject grew out of a need to stimulate perfusion students to understand the research process and appreciate the impact that research has on improving clinical practice. It is not always easy to generate student interest in designing research projects. First, it is difficult when entering a profession to have the confidence to develop a research project. That is why a mentoring process is so essential. Secondly, the design process requires a higher level of learning within the cognitive domain. To “create” new information requires competency in “evaluation” of the existing literature. This is different than many courses that students have experienced in their past where the learning process was centered on “retention” and “understanding.” The creative design process can be sometimes frustrating to students because it is less structured and the endpoints seem less clear than many of their previous learning experiences. And the publication process continues after graduation with editorial revisions of the submitted research paper.

The following is to (1): identify the limitations of research papers that are available on line (2), explain the importance of previous research and its impact of present day clinical practice using an example of a technique that has been “recycled” from the past, and (3) show that knowledge of past techniques allow you to have more options for future research and increase your potential to improve patient care. Reviewing these scientific publications with a critical eye for research methodology

identifies the gaps in our evidence-based literature and shapes our research priorities for the future. To bridge the gap between research and clinical practice, the following “classic” papers were used to demonstrate the direct connection between the research literature and clinical practice.

Blood Conservation

These articles describe paired perfusion (using the same blood primed bypass circuit for two consecutive operative procedures), the need for blood conservation due to the rapid increase in bypass procedures, and first use of cell washer for salvaging pump contents (1–3).

Management of Anticoagulation

These articles describe the basis for anticoagulation management on bypass and coincided with the clinical introduction of arterial filtration (4–8).

Membrane Oxygenation

The benefits of membrane oxygenators for long (>2 hours) perfusions were demonstrated in this paper. Shortly after, the conversion to membrane oxygenators from bubble oxygenators began as manufacturers developed new products (9).

Perfusion Safety

These two papers on air embolism and perfusion accidents alerted the surgical and perfusion community to the problems associated with cardiopulmonary bypass and suggested ways for prevention and management (10,11).

Inflammatory Response

The impact of surface contact in instigating a “whole body inflammatory response” was first outlined in this paper. The influence of materials and the pronounced effect on the pediatric patient population was evident and started the movement to change materials, develop “biopassive” surface coatings, and reduce the priming volume of the bypass circuit (12).

Enriched Blood Cardioplegia

There are so many papers on cardioplegia in the 1980s that it is hard to pick one. But this paper brings it all together in very sick patients who benefited from warm induction of glutamate-enriched cardioplegia (13).

Extracorporeal Membrane Oxygenation

Successful treatment with extracorporeal membrane oxygenation (ECMO) for pediatric patients was described using a novel statistical technique “play the winner” to allow for the randomized patient group with best survival to influence the subsequent randomization scheme. This was unique and fortunately only the one patient was randomized to conventional treatment and the rest of the patients got the new intervention, which was ECMO, and the survival rate increased (14).

Ventricular Assist

This paper described the successful use of a centrifugal pump for ventricular assist. The experience with this device in a large series of patients profoundly influenced the management of patients on subsequent ventricular assist devices (15).

An example of a perfusion technique that was “recycled” was reported in 2004 (16). This is a case report using retrograde pulmonary perfusion in the pulmonary veins with retrograde cardioplegia cannula. The patient made an uneventful recovery following transport on ECMO and an emergency pulmonary embolectomy. The use of this technique was based on a paper published in 1967 by Daily and Moulder (17). A large series of patients has now been published with excellent results using this technique (18).

CONCLUSION

Although this list of “classic” papers that I have selected represents my own personal bias and experiences, it does demonstrate to the student the link between research and clinical practice. I am sure other clinical perfusionists would pick a slightly different list of “classic” publications. It is important for students to review primary sources because as they have been referenced many times in textbooks, the information often loses its accuracy and becomes distorted. Textbooks summarize the principles and describe the clinical application that students need to know for clinical practice but rarely go into the depth required to conduct research. Students now have a greater appreciation for the impact of research on clinical practice and are motivated to begin their own journey into the perfusion profession as a contributor to the scientific literature.

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