Mechanisms of Change: Animal Models in Osteopathic Medical Research

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To irrigate too much is as detrimental as too little or not at all. ¹
Possibly less is known of the lymphatics than any other division of the life-sustaining machinery of man. ²

Andrew Taylor Still, MD, DO

In the epigraph’s first quotation, Still was referring to the effects of using manipulative treatment to regulate the flow of fluids—both arterial blood and lymphatic—to the tissues and organs. Too much is as bad as too little.

The lymphatic system has long been viewed by the osteopathic medical profession as having a key role in maintaining health and anatomic function.³ Adequate irrigative flow is vital to the tissues, supplying the basic elements for cellular respiration and byproduct removal. It is also critical at the system level for proper immune function.

The use of manual manipulation to improve lymphatic flow has been a part of the profession since its earliest days.³ However, do any of these treatments actually move lymph at any level? Osteopathic clinical practice strongly suggests that effleurage moves lymph from the extremities while various pump techniques move these fluids through the larger lymphatic channels.³ To date, no direct evidence has been provided for lymphatic movement as a result of osteopathic manipulative treatment (OMT). Unfortunately, nearly 100 years later, the second epigraphic quotation for the present article—“[p]ossibly less is known of the lymphatics than any other division of the life-sustaining machinery of man”—still rings true.² Our knowledge about the influence of OMT on the biomechanics of the lymphatic system has simply not been advancing.

This year, however, finds the osteopathic medical profession on the verge of a “watershed” moment for research in this area. The American Osteopathic Association’s (AOA) editor in chief, the associate editors of the JAOA (myself included), and the JAOA’s Editorial Advisory Board are pleased to congratulate E. Marty Knott, OMS VI; Johnathan D. Ture, PhD; Scott T. Stoll, DO, PhD; and H. Fred Downey, PhD, for writing an article that has the potential to change the way osteopathic physicians practice medicine, think, and conduct research by presenting them with the George W. Northup, DO, Medical Writing Award for their October 2005 contribution to THE JOURNAL, “Increased lymphatic flow in the thoracic duct during manipulative intervention.”⁴

Based on work conducted with an animal model, this proof-of-concept article demonstrates increased lymphatic flow in the thoracic duct (TDF) as a result of abdominal and thoracic pump techniques. It is my hope that the work of these researchers will provide renewed interest in the use of lymphatic pump techniques among osteopathic physicians and medical researchers.

Since its inception, the George W. Northup, DO, Medical Writing Award has been awarded to only one other set of researchers who used an animal model to demonstrate the effectiveness of osteopathic principles and practice.³ In that 1997 article, Brian H. Hallas, PhD, and colleagues⁵ developed a rat model to evaluate osteopathic treatment principles for the clinical management of arthritis.

Animal models for the evaluation of osteopathic principles and practice are badly needed within the profession so that our researchers can more easily extend clinical investigations into studies of the underlying biology of treatment mechanisms, which often cannot be ethically or practically evaluated in human subjects. In 2000, MarkAlain Déry, DO, MPH, and colleagues⁶ provided an animal model for lymphatic pump techniques that showed increased lymph distribution in rats. The canine model used by Knott and coauthors⁷ provides another excellent platform for future research efforts—especially in light of the National Center for Complementary and Alternative Medicine’s⁸ decision to support the work of researchers who study promising manual therapies. In particular, the National Center for Complementary and Alternative Medicine is interested in promoting the work of researchers who investigate the mechanisms rather than the efficacy of manipulative and body-based practices. The need for appropriate and reproducible animal models that measure and evaluate the anatomic and physiologic underpinnings of OMT is clear.

The effect of lymphatic techniques on human physiologic function has long been of interest to osteopathic medical researchers.⁹ Indeed, the 2002 Northup Award—winning article by Thomas Breithaupt, PhD, and coauthors⁸ described the effects of lymphatic pump techniques (continued on the next page)

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on the efficacy of influenza vaccination. Since the early 1900s, articles have appeared in the literature on the effects of lymphatic pump techniques on various physiologic variables, many demonstrating positive effects. Although these techniques were probably used to advantage during the great influenza pandemic of 1918–1919, they did not come into popular use for treating patients with influenza until the later epidemic of 1936–1937.

However, the basic question asked by Norman Gevitz, PhD, has remained: How much lymph would a lymph pump pump if a lymph pump could pump lymph?

Knott and colleagues adapted an animal model originally used by Schad and Brechtelsbauer for a study of conscious dogs in 1977. This model allowed Knott and coinvestigators to observe cardiac performance while obtaining direct measures of TDF in surgically instrumented canine subjects undergoing manipulative intervention and exercise.

The current award-winning article describes not only an animal model for lymphatic pump techniques, it also presents fairly definitive data suggesting an answer to Gevitz’s question. In their original contribution, Knott and coauthors enhanced the profession’s evidence base by demonstrating that the use of abdominal and thoracic lymphatic pump techniques increased TDF significantly. Although resting TDF was somewhat variable among the five animals, it was generally about 1.4 mL·min⁻¹, a figure in line with similar studies using conscious animals at rest, as noted in the article. The abdominal pump technique increased TDF to approximately 4.80 mL·min⁻¹; the thoracic pump technique increased the flow to about 3.45 mL·min⁻¹. These increases were not only statistically significant, they were generally sustained for the duration of the procedure. When investigators stopped the procedure, TDF returned to baseline levels in less than 10 seconds. These TDF increases also compared favorably with those observed during mild physical activity (approximately 5.80 mL·min⁻¹), which also decreased rapidly to baseline levels with cessation of exercise.

These data are fascinating. In addition to demonstrating that lymphatic pump techniques affect TDF, the data also show that TDF increases rapidly when the pumps are started, and, perhaps surprisingly, they decrease rapidly to baseline levels with pump cessation. In fact, preliminary data from one of the experimental animals (canine subject 1) suggested that TDF increases can be sustained for 4 minutes of pumping. These results, while in need of replication, point the way to additional studies using this animal model, as noted by Knott and coauthors. Future research may investigate the possible clinical benefits of more frequent and/or prolonged use of the techniques noted, the optimal procedure duration and combination of treatment techniques, the most effective rates of compression, and the source of mobilized lymph. Additional questions for future investigators include the reliability of the study’s results with a larger sample size, the optimal pressure to be applied for maximal TDF change, and the parameters that made the abdominal pump technique slightly more effective than the thoracic pump for this model.

An extension of the model could allow for collection of the lymph during the technique for further analysis: Do its contents change with repeated pump sessions? What is the composition of lymph in infected subjects as compared with healthy dogs? How rapidly does a substance introduced into tissue remote from the thoracic duct appear at that duct during the procedure?
The George W. Northup, DO, Medical Writing Award, is an annual award created in 1990 to honor George W. Northup, DO, who served as the American Osteopathic Association’s (AOA) editor in chief for 26 years. Thomas Wesley Allen, DO, who succeeded Dr Northup as editor in chief, proposed the award to recognize excellence in writing and scholarship in articles published in JAOA—The Journal of the American Osteopathic Association.

Each year, the AOA’s editor in chief and the JAOA’s associate editors nominate the articles to be considered. The JAOA’s Editorial Advisory Board then selects the winner from the nominees on the basis of clinical significance, scientific validity, and osteopathic content. Selection is also based on an article’s contribution to changing the way osteopathic physicians practice medicine, think, and conduct research.

This annual award is presented in the year following publication at the AOA Annual Convention and Scientific Seminar. The 2006 award was presented to Student Doctor E. Marty Knott on October 17, 2006, at the AOA’s 111th Annual Convention and Scientific Seminar in Las Vegas, Nev.*


* All articles were accessed on October 19, 2006.
Because TDF subsided to baseline levels very rapidly in the investigation by Knott and coauthors,4 their data also suggest that the procedure must be of sufficient duration that a meaningful amount of fluid be moved. But how much is a “meaningful” amount? Studies of flow composition will help begin to answer that question.

Answers to these and many other questions are now accessible to the osteopathic medical profession using this experimental model, which begins to speak to the mechanisms behind the clinical effects of lymphatic pump techniques. In fact, additional studies using this research model are already underway.16

Thus, we come back to Still’s comments about the importance of the “irrigation” by lymph and the lack of knowledge of the lymphatic system. The use of animal models for studying the biomechanics of flow during treatment and the constituents of that flow will provide not only proof of concept, but also information about the functional mechanisms that underlie OMT. It is difficult to overestimate the importance of such studies.

References