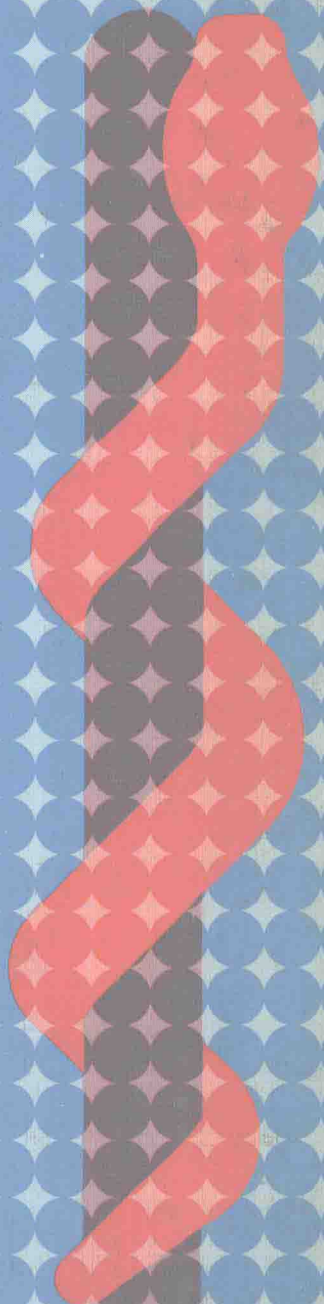
Methods in angiology

Marc Verstraete (ed.)



Instrumentation and Techniques in Clinical Medicine vol 2

Martinus Nijhoff

METHODS IN ANGIOLOGY

A PHYSICAL-TECHNICAL INTRODUCTION WRITTEN FOR CLINICIANS BY PHYSICIANS

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1980
MARTINUS NIJHOFF PUBLISHERS / THE HAGUE / BOSTON / LONDON

Distributors:

for the United States and Canada

Kluwer Boston, Inc.
190 Old Derby Street
Hingham, MA 02043
USA

for all other countries

Kluwer Academic Publishers Group
Distribution Center
P.O. Box 322
3300 AH Dordrecht
The Netherlands

Library of Congress Cataloging in Publication Data

Main entry under title:

Methods in angiology.

(Instrumentation and techniques in clinical medicine; v. 2)
Bibliography.
Includes index.
1. Blood-vessels – Diseases – Diagnosis. I. Verstraete, Marc. II. Series.
RC691.5.M47 616.1'3 80-16003

ISBN 90-247-2376-0 (this volume)
ISBN 90-247-2349-3 (series)

PRINTED IN THE NETHERLANDS

METHODS IN ANGIOLOGY

INSTRUMENTATION AND TECHNIQUES IN CLINICAL MEDICINE

Volume 2

Methods in Angiology:
A physical-technical introduction written for clinicians by physicians

edited by M. Verstraete

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Table of contents

Introduction: critical appraisal of the fifteen chapters

D.E. STRANDNESS, JR.

This book brings the reader up to date on the progress in one of the most rapidly changing fields in medicine. If one simply reviews the titles of the chapters, it is clear that, with few exceptions, the topics discussed are not, in fact, of recent vintage. The major change is that the methods available are being applied on a greater scale in recent years to elucidate many of the physiological changes that occur secondary to a wide variety of peripheral vascular disease. Until recently, angiology has been largely a descriptive discipline with an insufficient amount of effort devoted to rigorously defining the pathophysiology of vascular disorders and their modification by therapy. Thus, it appears that angiology as a specialty is at long last beginning to assume its rightful place with its companion cardiology, which has approached the problems of cardiac function in a more quantitative manner.

The structure of this volume is unique in that each subject is not only presented by a qualified expert but is also subjected to an outside review by an equally competent scientist who supplied a critique of the presented material. This approach is certainly unique and might be confusing to the newcomer to the field but it tends to highlight both the areas of agreement and those which still remain a source of some confusion and disagreement. For me, reading the comments literally side by side in this chapter was a refreshing and stimulating way of reviewing a topic. It is clearly the intent of the editor to present in an open and occasionally critical, fashion honest differences that can be of great importance in assessing the proper place of the subjects. To this end, the material has in large part met this goal.

While the introduction to most texts is of a general, often philosophical nature, my role will be entirely different. Even though my bias is toward more widespread utilization of many of these methods, there is evidence that some are being misused in the study of many clinical problems. Thus, I will attempt to also be critical of those areas where it appears that such an approach is justified. The end-result for the reader will be not only a

critical commentary, chapter by chapter by selected experts, but an overall assessment of the volume by me which may in some instances be in fundamental disagreement with the conclusions of the authors.

Chapter 1

There is little doubt that the electromagnetic flowmeter has become the most direct method of measuring velocity and volume flow in an exposed vessel. It is remarkable that this technique, which is almost 50 years old, is still undergoing modification and refinement. This method of measuring flow has been used most extensively by physiologists for both acute and chronic studies. It is, in fact, this discipline which is most familiar with its problems and limitations. While it is natural that this type of measuring system should be used by surgeons with vessels exposed at the time of operation, it is in this area where it appears that the problems have not been fully appreciated.

Unfortunately, in clinical situations, the nature of the vessel wall at the site of measurement is unpredictable in terms of wall thickness and constituents. Thus, the conductivity of the vessel wall remains an unknown which must be recognized. Also, the type of velocity profile present is not known, particularly when the flowmeter is used on vessels which are in close proximity to a bifurcation or atherosclerotic plaque. It is also unwise for clinicians to depend upon the manufacturer's assurance that electrical and occlusive zero are identical.

The major point to remember with this type of measurement is that the measured flow is, in fact, an approximation and that the extent of its relationship to reality remains an unknown. A suitable compromise in utilizing the electromagnetic flowmeter intelligently is to assess the per cent change in flow that occurs in response to a vasodilator such as papaverine. This, in combination with measurements of the pressure gradient across the corrected segments (where feasible), will provide some assurance that the operative procedure has been successful. However, one must recognize that this immediate flow change may not be predictive of the immediate or long term hemodynamic results. In conclusion, it is correct to state that these deceptively simple devices are probably best used for research purposes and by those who are prepared to familiarize themselves with the problems and pitfalls that can accompany their use.

Chapter 2

The plethysmograph has returned to its proper place as a method for

investigating peripheral vascular dynamics. There is little doubt that it remains the best method of measuring limb blood flow. As the reader will note, the methods have been adapted and modified for purposes not originally envisioned by those who developed the technique. A point well taken is with regard to the relationship between the volume pulse amplitude and absolute levels of blood flow. While it can be shown that, in general, an increase in pulse amplitude is accompanied by a rise in blood flow, the relationship is clearly not linear. Also, those systems which are time-consuming in application, such as the water filled systems, are not useful clinically but are excellent for research purposes.

The mercury in silastic strain gauge provides an excellent compromise with regard to the other plethysmographic systems. The theoretical and practical problems with this system have been extensively evaluated and found to be solvable. Further, many of the newer systems can be calibrated electrically with the results comparing favorably with those carried out by mechanical means. This further simplifies their use since the calibration is done with the gauge on the limb. Thus, compensation for temperature changes are not as serious a problem, which can be the case when the gauge is removed from the limb for calibration.

Impedance plethysmography, on the other hand, poses more difficult problems. As rightly noted, the waveforms recorded are very similar to those obtained by other methods. However, attempts at quantitation have not been uniformly successful and this fact must be appreciated. If quantitation of flow is desired, then these systems should not be used. In spite of this obvious limitation, the impedance method has been successfully applied for the evaluation of the flow changes produced by acute deep venous thrombosis.

As properly emphasized, the analysis of the volume pulse waveform is best done in the clinical setting by visual inspection. While there is no doubt that the waveform can be quantitatively analyzed, it does not offer any advantages over simple inspection. The ability to sense the small volume changes in the digits does permit measurement of digit blood pressure and reappearance time after a reactive hyperemia test. Digit pressures are particularly useful in documenting the presence of occlusive disease in the hand in patients with cold sensitivity.

As detailed in the chapter on plethysmography, there has been voluminous work done on the blood flow in normal limbs with arterial disease under resting conditions and following some form of stress. There is nearly uniform agreement that flows at rest are not useful clinically since they are nearly always within the normal range. However, this is clearly not the case in those areas where regional ischemia may be profound, such as the forefoot and digits when ischemic rest pain is the problem. The blood flow changes brought about by chronic arterial occlusion are best

determined when the circulation is called upon to increase its flow in response to some form of stress. The peak flows attained are rarely as high as in normals and the recovery time is delayed. Further, it is possible to show that the observed flow response can vary depending upon the level and extent of the arterial occlusion and the functional capacity of the collateral circulation.

CHAPTER 3

The chapter by Lassen and Holstein is a refreshing look at the continued use of isotopes since they emphasize those applications which show promise in clinical practice. As indicated, the measurements of muscle and skin flow are being used less frequently since other simpler methods of assessing the presence and degree of arterial obstruction are now available. In fact, it has been largerly due to the influence of Dr. Lassen that the importance of perfusion pressure, both as an index of occlusion and prognosis, is becoming better understood and accepted by the medical profession.

The importance of the concept of skin perfusion pressure cannot be overemphasized. Many physicians might argue, of course, that it is flow and not pressure that is most critical since tissue death occurs because of inadequate perfusion, not pressure. While this is true, pressure remains the simplest, most objective method of predicting whether or not an open lesion or amputation will heal.

Also, as indicated by the authors, they are searching for other, simpler methods of measuring skin perfusion pressure. This is due to the fact that the procedure is tedious, time-consuming, and uncomfortable for the patient. Nonetheless, the concept remains a valid one which, with improvements in methodology, will become of increasing importance in clinical medicine. It is hoped that the remarkable achievements by Dr. Lassen's group will continue to the benefit of not only the patients we all serve but to those of us who are often faced with difficult therapeutic decisions in patients with threatened tissue loss.

CHAPTER 4

The chapter by FitzGerald on ultrasonic techniques presents the current state of the instrumentation and its clinical use in straightforward simple terms. While this approach will not appeal to the experienced user, this is essential background information which must be properly understood if these techniques are ever to be usefully applied in the clinical situation. The