

THE MEDICAL SOCIETY OF NOVA SCOTIA

NOVA SCOTIA DIVISION OF THE CANADIAN MEDICAL ASSOCIATION

MEMBERS OF EXECUTIVE COMMITTEE

OFFICERS

President	W. F. Mason
President-Elect	J. F. Hamm
Immediate Past President	T. J. McKeough
Chairman Executive Committee	B. J. Steele
Vice-Chairman Executive	G. C. Jollymore
Treasurer	P. D. Jackson
Honorary Secretary	A. J. MacLeod
Member-at-Large	A. M. Clark
Executive Secretary	D. D. Peacocke

BRANCH SOCIETY REPRESENTATIVES

Antigonish-Guysborough	J. E. Howard
Cape Breton	M. A. Smith, A. C. Walkes
Colchester-East Hants	D. G. Dewar
Cumberland	M. P. Quigley
Dartmouth	J. F. O'Connor, D. M. Andrews
Eastern Shore	A. C. Marshall
Halifax	M. G. Shaw, E. V. Rafuse, A. H. Parsons,
Inverness Victoria	J. O. Belen
Lunenburg-Queens	W. G. Dixon
Pictou County	D. R. MacLean
Shelburne	R. C. Montgomery
Valley	R. D. Stuart, P. Goddard
Western	D. M. Deveau
Student Member	Roy Harding
Student Member	Attilio Negro
Student Member	Mickey Oja

OBSERVERS AND STAFF

Tariff Committee	
Salaried Physicians	M. A. MacAulay
Public Relations	D. V. Willoughby
Manager — Economics Department	A. A. Schellinck
Consultant	P. F. O'Brien

OBSERVERS

Editor — The Nova Scotia Medical Bulletin	B. J. S. Grogono
Representative to Provincial Medical Board	H. J. Bland
Medical Director M.M.C. Inc.	A. W. Titus
General Manager M.M.C. Inc.	S. P. Brannan
C. M. A. Board of Directors	E. V. Rafuse
C. M. A. Council on Community Health	M. A. Smith
C. M. A. Council on Economics	
C. M. A. Council on Medical Education	B. L. Reid
C. M. A. Council on Medical Services	J. A. George
M. D. Management Limited	G. A. Sapp

STANDING COMMITTEES

	Chairman
Annual Meetings	President
Archives	S. F. Bedwell
By-Laws	A. H. Parsons
Cancer	R. C. Fraser
Child Health	N. P. Kenny
Community Health	R. D. Stuart
Discipline	President
Drug & Alcohol Abuse	H. A. Locke
Editorial Board (Editor)	B. J. S. Grogono
Emergency Medical Services	D. P. Petrie
Ethics	R. L. Langdon
Finance (Treas.)	P. D. Jackson
Hospitals	
Legislation	F. A. Dunsworth
M.M.C.*M.S. Joint	J. A. Myrden
Maternal and Perinatal Health	D. W. Cudmore
Mediation	President
Medical Education	J. D. A. Henshaw
Medical-Religious Liaison	W. A. P. Thompson
Membership Services	E. G. Nurse
Nutrition	J. T. Hindmarsh
Occupational Medicine	A. Prossin
Pap Smear	R. C. Fraser
Pharmacy	G. C. Jollymore
Physical Fitness	M. G. Shaw
President's Liaison	President
Public Relations	D. V. Willoughby
Rehabilitation	J. L. Sapp
Salaried Physicians	M. A. MacAulay
W. C. B. Liaison	G. J. H. Colwell

BRANCH SOCIETIES

	President	Secretary
Antigonish-Guysborough	B. R. Steeves	M. O'Brien
Cape Breton	M. R. Rajani	G. S. Marsh
Colchester-East Hants	R. C. D. Stewart	S. T. Cook
Cumberland	V. M. Hayes	I. F. G. Robinson
Dartmouth	J. P. Savage	H. P. Poulos
Eastern Shore	A. C. Marshall	D. P. Sinha
Halifax	E. V. Rafuse	J. P. Curry
Inverness-Victoria	R. J. Genge	N. G. Pillai
Lunenburg-Queens	R. C. Forbes	W. L. Phillips
Pictou County	M. S. Sebastian	C. R. Elliott
Shelburne	J. U. MacWilliam	F. Markus
Valley	P. D. MacLean	C. Prakash
Western	R. P. Belliveau	M. C. A. Duggan

SECTIONS

Anaesthesia	D. K. Rushton	D. Imrie
General Practice	A. H. Patterson	A. L. Steeves
Internal Medicine	B. M. Chandler	
Internes & Residents	D. Thompson	M. Gardner
Obstetrics and Gynaecology	C. Maley	R. H. Lea
Ophthalmology	E. V. Rafuse	G. J. Whiston
Orthopaedic Surgery	R. H. Yabsley	B. J. S. Grogono
Otolaryngology	K. E. Walling	G. M. Novotny
Paediatrics	N. P. Kenny	R. S. Grant
Pathology	A. S. Wotherspoon	J. T. Hindmarsh
Psychiatry	C. E. Taylor	J. W. Barteaux
Radiology	A. J. Johnson	B. D. Byrne
Surgery	S. M. A. Naqvi	C. Bugden
Urology	W. A. Ernst	W. A. Ernst

THE NOVA SCOTIA MEDICAL BULLETIN

EDITORIAL BOARD

Editor-in-Chief
DR. B. J. S. GROGONO

Associate Editor
DR. A. C. IRWIN

Dr. S. V. Anand
Dr. A. J. Buhr
Dr. M. E. Burnstein
Dr. J. H. Feindel
Dr. P. C. Gordon
Dr. A. S. Macdonald

Miss D. MacDonald
Dr. S. M. A. Naqvi
Dr. J. F. Nicholson
Dr. S. C. Robinson
Mr. J. Sansom
Dr. J. C. Vibert

Dr. J. P. Welch

Managing Editor
MR. D. D. PEACOCKE

Editorial Assistant
MRS. T. CLAHANE

Facts, Figures and Statistics

Nova Scotia Population	833,000
Estimated number of Alcoholics	20,000
Estimated Amputees	
Total (N.S.) 1975 Dysvascular	unknown
Liquor sales in N.S. (per year)	\$112,593,582
Budget — N.S. Commission on Drug Dependency (per year)	\$3,000,000
Cost of above knee prosthesis	\$1,000
Cost of below knee prosthesis	\$600
Biochemical genetic centre cost (per year)	\$20,000
Saving inpatient, one patient (per year)	\$16,000

Truth is an elusive mistress; we can never own her completely; and often deliberately twist her configuration. Medicine is dedicated to unraveling the mysterious workings of the human frame, its strange derangements and the application of appropriate remedies. This journal shows how this task is being tackled in a variety of ways.

First, Dr. Irwin gives us a welcome guide to statistics. At last we can begin to measure mathematically the results of our labours and understand statistical data so commonly used in modern manuscripts.

A glance at the medical school's activities gives us a glimpse at the future and the basic research without which our craft would be stifled. Nearly everything we learn in medical school becomes outdated in a decade. Clinical review of patients is vital to appraisal of our standard and methods of practice.

Dr. Forsythe *et al.* gives a good review of ankle injuries, clearly showing that in their hands open reduction gives the best results for displaced malleolar fractures. Dr. Clarke *et al.* show how metabolic diseases can be best managed by an overall plan.

The significance of Lecithin/Sphingomyelin ratio is a typical example of factual analysis. This is an important test in the prevention of the neo-natal distress syndrome. Here for the first time is a detailed description of how blood and meconium contamination alter the results. Similarly, only careful investigation has helped to solve the riddle of why the mortality from heart disease should be associated with water hardness. Dr. Anderson's work strongly suggests that in areas where soft water is drunk, there is a marginal magnesium deficiency leading to susceptibility to ventricular arrhythmia.

The assessment of physical fitness is not a simple matter. We welcome Dr. Bonen's assessment of cardio-respiratory capacity as a practical approach to this important guide of our health.

Finally we congratulate Dr. Murray *et al.* on their review of amputees. Their results of 94% in 396 patients are indeed remarkable, but they hasten to point out that these figures may be over optimistic. The time for referral, fitting and final rehabilitation is a measure of difficulties of adjustment, physical and mental, to an altered method of locomotion, as well as the technical challenge of providing a satisfactory functioning prosthesis. Their figures give a baseline for future developments.

The average above-knee prosthesis is heavy, expensive and cumbersome. It is difficult for an elderly person to manage and requires expert fitting. There are numerous different knee units of varying degree of safety and convenience. A below-knee amputation is infinitely easier to manage, but is still heavy (7-10 lbs) and costs \$600.

There are many new developments in prosthetics which are becoming available. The Batchford and Otto Bock modular systems are being extensively used and allow easy inter-change of parts. Immediate or early fitting or prostheses has been widely publicised by Burgess, and with experience can be applied with success to the dysvascular amputee. This together with different techniques of amputation may bring great benefit for the geriatric amputee.

How may we provide lighter, cheaper and more efficient prostheses more quickly? We need a co-ordinated effort of all those concerned with amputations. It is from the careful assessment of results, such as Dr. Murray's review that we will gauge our success. □

B.J.S.G.

ADDENDUM

The Editors would like to acknowledge the work of Dr. Ian Maxwell, the Pathology Departments and the Audio Visual Department of the Halifax Infirmary for microphotographs of mesothelioma in the February issue of the *Bulletin*.

Dr. W. F. (Bill) Mason

**PRESIDENT
1976-1977**

The Medical Society of Nova Scotia

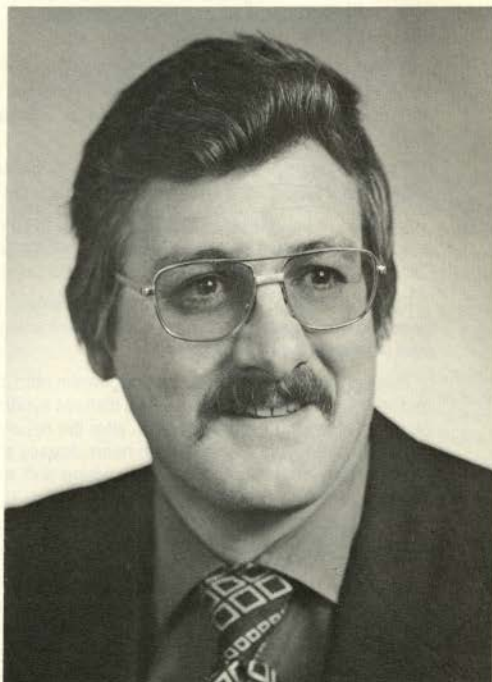
Dr. W. F. (Bill) Mason was installed as President of The Medical Society of Nova Scotia at the Annual Meeting in November

Dr. Mason was born in Wolfville and received his early education in the Annapolis Valley communities of Coldbrook and Kentville, before attending Acadia University in Wolfville. He received his B.Sc. from Acadia and attended Medical School at Dalhousie, University graduating in 1961.

Following graduation from Dalhousie, Dr. Mason entered family practice in the Western Nova Scotia community of Tusket, where he remained for three years. He then returned to Dalhousie to study radiology for the next three years and completed his residency program with a year at Harvard Medical School. After completing his residency training, he returned to Halifax and has been practicing in the Victoria General Hospital ever since.

Dr. Mason has been an active member of the Medical Society since his return and has also been active in the affairs of the Halifax Medical Society and the Section of Radiology. He has been a member of the Executive of the Medical Society, and was Nova Scotia's representative on The Canada Medical Association Board of Directors prior to his election as President of the Society.

Dr. Mason is married to the former Fran Thomson of Kentville, they have three children. When not involved in his medical practice or in Medical Society affairs, Dr. Mason often can be found participating in his two favorite activities, tennis and sailing. □



Management of Statistical Illiteracy

Aden C. Irwin,* M.D., D.P.H.,

Halifax, N.S.

In a provocative new book, Wulff notes: "Doctors often hold extreme views on statistics. Some colleagues dismiss all statistical calculations as unnecessary hocus-pocus and others trust implicitly any medical paper that has been sprinkled with P-values".¹

Most physicians currently in practice feel intuitively that some middle-of-the-road position is probably more reasonable but have inadequate knowledge on which to base a sound decision. Many received no formal training in statistics in their premedical courses, while the few lectures currently inserted into crowded undergraduate schedules are in direct competition with the more interesting (and dare I say more "relevant") subjects and these are, at best, apt to provide a frustrating and nearly worthless experience. However, even a casual perusal of current medical journals shows the increasing use of statistical techniques, and some physicians are developing an uneasy sensation that they may be missing something of value.

For those physicians with an urge to correct the "statistical deficiency" in their education (and particularly since they have all survived their rigorous medical courses), surely there must be some elementary text to which they can refer. Should they consult a statistician, however, they will be dismayed to discover that there are many dozens of books dealing with elementary statistics, and not a single one entirely suitable for their purposes. Every year, new texts are published, describing basic statistical techniques modified for application to medicine, agriculture, economics, etc. and from the publishers' "blurbs" on their dust jackets, we are led to believe that the ideal, indispensable text has appeared at last.

From personal experience, I do not believe it is possible to fully grasp all the basic concepts of statistics solely from texts. I have a moderately large collection and like the story of the curate's egg (which few persons can relate in full detail), each is "good in parts". In spite of the assertion that "statistics is not a branch of mathematics but is part of Scientific Method", some physicians are frightened by mathematics symbols and refuse to believe that statistics requires only the most elementary arithmetic and algebraic manipulations. However, in the words of the Beatles' song "With a little help from my friends", there are three paperback texts (the first two prepared by physicians) to which anyone may turn with profit.

Winnifred Castle has written what she calls a "programmed learning text".² It consists of very brief snippets of information, interspersed with questions which allow the reader to determine his own progress and his grasp of the material covered. Answers appear in a column along the side of each page and, provided they are not uncovered until an honest attempt has been made to solve each problem, it is possible to proceed with minimal assistance.

Then as a compilation and slight extension of a series of short articles published in 1976 in the *British Medical Journal*, the Deputy Editor, Douglas Swinscow, has produced a small book.³ He states that: "The purpose of statistical methods is to put numerical data into a context by which their meaning can be better judged", and then he continues: "The intention of this book is to illustrate the use of such methods". In this endeavor he has succeeded admirably, with worked examples from clinical medicine, and with additional problems complete with answers. Some may criticize his "cook book" approach, but it is one method of acquiring some basic knowledge of useful statistical techniques.

Finally, for anyone seeking more detailed coverage of this subject, Theodore Colton has prepared a larger text "... to describe in terms meaningful to physician and medical student the structure and rationale of the most common, present-day statistical methods that preclude the quantitative evidence encountered in the medical literature".⁴ In addition to the usual basic statistical techniques, he has described several types of observational and experimental studies widely employed in medical research. His text closes with two chapters — "Fallacies in Numerical Reasoning" and "Critical Reading of the Medical Literature", which are in themselves worth the price of the book.

In conclusion, any of these three books, if pursued with some degree of diligence, will provide a measure of "statistical literacy", which together with some knowledge of "numeracy", are being given increasing emphasis in all branches of medical training. Progress through them will not be uninterrupted, for the way is strewn with roadblocks and cries for help will be heard at irregular intervals. However, assistance is becoming more readily available from those who have passed the same way, and there are tangible rewards for anyone completing the journey. □

References

1. **Wulff H R:** *Rational Diagnosis and Treatment*. Blackwell Scientific Publications, Oxford, 1976 (available in Canada from J. B. Lippincott, Toronto).
2. **Castle W M:** *Statistics in Small Doses*. Churchill Livingstone, Edinburgh, 1972 (available in Canada from Longmans, Don Mills).
3. **Swinscow T D V:** *Statistics at Square One*. British Medical Association, London, 1976 (available from the publisher for US \$3.75).
4. **Colton T:** *Statistics in Medicine*. Little, Brown and Company, Boston, 1974 (available in Canada from J. B. Lippincott, Toronto).

*Professor, Department of Preventive Medicine, Dalhousie University, Halifax, N.S.

Tick Tupper Tick

Impressions of an Unusual Peep Show During "Introdal".

Every two years, Dalhousie University opens her doors to the world. For an invigorating forty-eight hours, the general public pounds with varying degrees of interest and indifference through the learned portals to peer at every conceivable educational and creative achievement that the professors, staff and students can muster. Hundreds of hours preparation must go into this project, and many must feel a sense of frustration as they endeavour to explain some simple hypothesis to a layman or sit patiently beside the beleaguered exhibit.

It is impossible to encompass every department. You must chose your topic. If it's classics, you can find different displays of ancient robes and literature carefully arranged beside impressive busts of Homer and Virgil. If you like English literature, a group of experts wait to discuss your favourite author or poet be it Shelley, Chaucer, Shakespeare or Margaret Atwood. In the physics department you can play with laser beams, or enjoy the super conductivity of low temperature research, or study the fascinating trails of an air flow in the wind tunnel. The Life Science building bursts with biological activity and you can test your physiological fitness on an ergometric bicycle.

It is the medical school, however, that concerns most physicians and for this brief interlude we can peer into its inner physiological skeleton and ask "What does a medical school do beside provide an arena for the lecturer and the place for students to repose?"

The Medical School's Impact

Surely the Tupper building is one of the most functional and elegant medical schools in the world. Once past the windy ramparts you can relax and enjoy the historical impact of the foyer. The austere gaze of the founders of Nova Scotia's Medical School peer down from the walls. Sir Charles' bust inspires you to think what makes a medical school? The display of Nobel laureates of medicine and physiology reminds us of the fantastic genius and dedication of the masters of the past. Metchnikoff and Ehrlich, Kocher, Kossel, Pavlov, Alexis Carrel and Sir Ronald Ross, men who lived 70 years ago yet whose names are the very bricks of every medical student's curriculum.

Three students are waiting to tell us of the medical school's displays and activities. The Department of Continuing Medical Education emphasizes that learning never ceases in a doctor's life and a letter from Dean Hatcher tells us that there are more students of Biochemistry, Physiology and Anatomy studying in the Medical School than there are medical students. So we can start our tour and the few extracts presented here are an appreciative token of the enterprise and initiative that is evident from a brief glimpse by an outsider.

The spur of enquiry is alive and well and permeates the atmosphere. It is this mixture of research and practical medicine that makes the medical school so fascinating. If you ask the average medical student what he or she is going to do "I'm going to be a general practitioner," is the reply.



"The Tupper" is windy but graceful.

In the day's peep show of Dalhousie's activities, those who are not directly concerned can sample some of the extraordinary activities — the cataloguing of oligonucleotides in Biochemistry gives clues to the evolution of the cells composition: the pharmacology of synapses allows a study of drugs in the control of Parkinson's Disease; anatomical electron microphotographs reveal details of leucocytes; electro-physiological studies help in the repair of nerve injuries. Many other intriguing problems are actively being tackled.

Who knows? We have the ingredients for a host of Nobel prizes and the heart of an outstanding medical school.

*Into an unknown world
We cast the web of our intelligence,
Shaping the fragile threads of thought,
Training our finite powers
'gainst
The infinite complexities of Nature*

PHYSIOTHERAPY DISPLAY



Nancy Doane demonstrates an ergometric bicycle which records pulse rate against work.



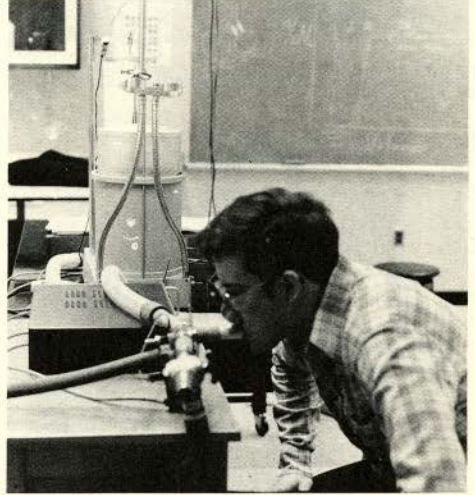
Nancy Mail shows some of the prostheses made with the cooperation of Prosthetic Department, Camp Hill. The department cooperates in teaching an active programme for amputees. Prostheses shown are below knee and above knee "cast" prostheses which are fitted immediately after amputation or after the initial dressing.

PHYSIOLOGY DISPLAY

Projects demonstrated included:

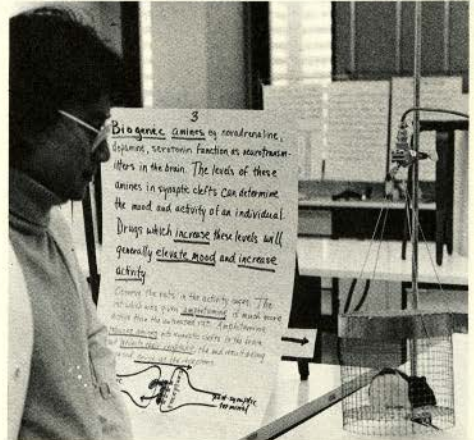
1. Gregor and Wolf — EMG computer analyses. These will enable a physician to have EMG analysed over the phone.
2. Dykes and Terzis — Electrophysiological studies in man and primates. New knowledge had been gained of the pattern of peripheral innervation. New ways are being developed to suture damaged peripheral nerves.

Josenhaus, Rice, Branshaw — Analysis of ventilation distribution of inspired gases.

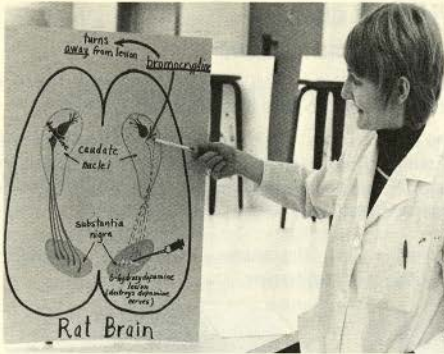


Dr. Bill Rice inspires oxygen and expires into an apparatus which measures the nitrogen dilution.

PHARMACOLOGY DISPLAY



Effect of drugs on synapse. Research by Dr. White tests many different agents whose activity is measured by movements of a Rat suspended in a cage.



A rat is sensitised to "Dopa" by destroying this pathway with hydroxydopamine.



This rat turns in circles and is particularly sensitive to Bromocryptine.



Activity of the heart — Hamsters with cardio-myopathic hearts are compared with normal hamsters.

The Blood-Brain Barrier¹

The capillaries in the brain differ from those in the rest of the body by having 'tight-junctions' between cells.



normal capillary



brain capillary

(Cross-section)

Blood-Brain Barrier — A very important mechanism which protects the brain from noxious agents. Many methods are used to study effects on this "Tight Junction".

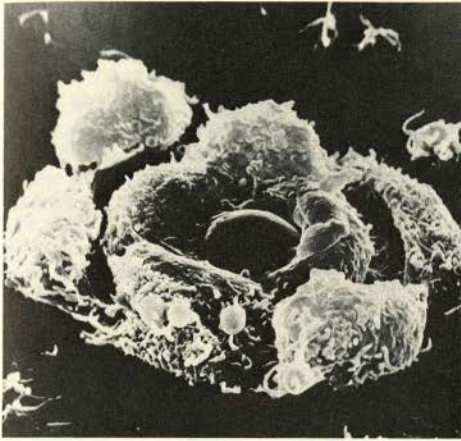
Common Pharmacological Errors

- I. Anatacids (containing Al) antagonise Tetracycline.
- II. Antacids with Sodium Bicarb, Diovol, Enos, should not be given with diuretics.
- III. Alcohol potentiates antihistamines. (eg. Coricidin and Benedryl.)
- IV. Sleeping pills may combine with anticoagulants. (eg. Phenobarb with Warfarin).

ANATOMY DISPLAY



Fitness, Self-determination, Reproductive system, Siamese twins, Numerous electron microphotographs, Newt, Lobster



This is an electron photograph of a leucocyte. Special studies have been carried out to examine necrotaxis. Antibiotics decrease, ascorbic acid enhances, caffeine decreases activity.

BIOCHEMISTRY DISPLAY

DNA
RNA
Messenger RNA
Transfer RNA
Proteins
Enzymes
Lipids

The basis of cells evolution
Dr. Doolittle *et al.* have carried out extensive research on cataloguing the nucleotide structure of *B. coli* and blue-green algae. This has led to an understanding of the structure and evolution of cell composition.



Ron MacKay demonstrates the elaborate analysis of oligonucleotides which have been derived from blue-green algae. Tissue is dried, emulsified, tagged by radioactivity and analysed for nucleotide as seen on the chart. □

B.J.S.G.

Acknowledgement

Thanks to the Audio Visual Department, Tupper Building, Dalhousie University for developing and printing of photographs. □

HEARING SCREENING FOR NEWBORNS Grace Maternity Hospital Halifax, N.S.

The Nova Scotia Hearing and Speech Clinic in cooperation with Grace Maternity Hospital will initiate an "at risk" file and behavioral hearing screening test for all newborns at Grace. Using the recommendations of the International Conference on Early Identification of Hearing Loss held in Halifax in September, 1974, the program is designed to identify deaf children at birth, and those with a severe hearing loss as soon as possible thereafter. The protocol for the procedure is as follows:

1. Parental and medical records information will be pooled to establish an "at risk for hearing loss" file;
2. All babies will be evaluated using an arousal test;
3. Family physicians will be notified of those children considered "at risk for hearing loss" and those who fail the screening test. Physicians will be asked to be especially tuned to the question of hearing loss at all pediatric visits.
4. All children failing the screening protocol will be scheduled for further follow-up appointments at the N.S. Hearing and Speech Clinic.

The program at Grace blends well with a similar procedure in operation at the I.C.U. of the I.W.K. The only difference is the hearing test itself. At Killam the test is administered via the "crib-o-gram", a device being field tested by the N.S. Hearing and Speech Clinic, IWK, and Stanford University. The procedure involves the same stimuli and a similar response mode, but is done manually.

The combined "at risk" file and behavioral test, according to data obtained from nearly 100,000 babies tested in countries all around the world, will identify approximately 80% of the deaf children at birth. A child is considered "at risk" if he falls into one or more of the following groups:

1. Family history of congenital sensori-neural hearing loss in first cousins or closer
2. Bilirubin count ≥ 20 mg/100 ml serum
3. Congenital rubella
4. Defect of ear, nose, or throat
5. Birth weight ≤ 1500 grams.

There is good evidence that the 20% not identified may, in fact be born normal, but have a latent onset of deafness within the first six months of life. All those known to be in that category have been on the "at risk" register.

If there are any questions about the testing procedures or the administration of the system, please contact:

George T. Mencher, Ph.D.,
Director, Nova Scotia Hearing and Speech Clinic
c/o Izaak Walton Killam Hospital for Children
5919 South Street
Halifax, N.S., B3J 3G6 □

Malleolar Fractures of the Ankle

A Review of 100 Cases*

M. G. Forsythe,** M.D.,
D. P. Petrie,*** M.D., F.R.C.S.(C), and R. E. Stalker,†
Halifax, N.S.

One hundred cases of malleolar fractures of the ankle treated at the Victoria General Hospital in 1971 - 1973 were reviewed. Open reduction gave the most consistent satisfactory results and was superior to closed reduction. There was a late incidence of osteoarthritis in 18%.

MALLEOLAR FRACTURES

The history of the treatment of ankle fractures can be divided into six periods.¹ From earliest times to 1768 — the Hippocratic Era — a period of confusion; from 1768 until 1815, made famous by Sir Percival Pott, associated with bimalleolar ankle fractures; then follows Dupuytren, 1815-1840, who described a malleolar fracture with a high fibular fracture; then 1840 to 1872 which marks the Maisonneuve period. (He described a high fracture of the fibula which accompanied an external rotation injury of the ankle.) From 1872 until 1922 monographs of Tillaux and Destot heralded the X-ray findings in ankle injuries.

Lauge-Hansen described a classification of ankle fractures based on a mechanism of injury in 1951², open reduction with internal fixation was popularized by Mueller *et al.* in Switzerland³.

FRACTURES AROUND THE ANKLE

These can be divided into three groups:

1. Those involving the dome of the talus.
2. Those involving the lower aspect of the tibia extending into the joint.
3. Malleolar fractures. (The group included in this study.)

CLASSIFICATION

The classification used here is that recommended by Mueller *et al.* in Switzerland³.

Type A — The adduction type. The fibula fractures either below or at the level of the tibiofibular syndesmosis.

Type B — The external rotation type. There is an oblique fracture of the fibula which occurs in the coronal plane and may be associated with a medial malleolar avulsion fracture or a deltoid ligament tear. Isolated medial malleolar fractures or tears of the deltoid ligament also fall into this group.

Type C — A lateral malleolar fracture occurring proximal to the inferior tibiofibular syndesmosis. There is often severe medial malleolar avulsion or deltoid ligament tear.

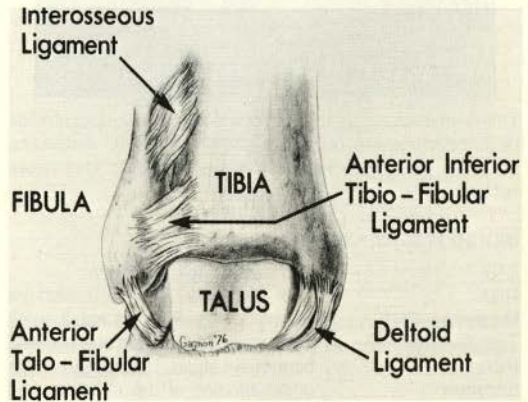


FIGURE 1
Basic Anatomy

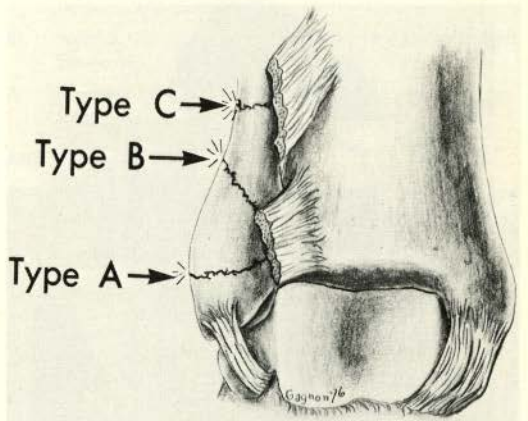


FIGURE 2
Types of Ankle Fractures

TREATMENT

The main objectives are to restore fibular length, to reapproximate ligaments, to ensure congruous articular surfaces without step deformities, and accurate talar reduction in the ankle mortise. Acceptable anatomical limits are less than 0.5 centimeters of fibular shortening, less than 0.5 centimeters of posterior displacement of the distal fibular

*Patients treated at the Victoria General Hospital, Halifax, N.S.

**Orthopedic Resident, Department of Surgery, Faculty of Medicine, Dalhousie University, Halifax, N.S.

***Assistant Professor, Department of Surgery, Faculty of Medicine, Dalhousie University.

†Fourth Year Medical Student, Dalhousie University.

fragments, up to 2 millimeters of widening of the inferior tibio-fibular syndesmosis, and not more than 3 millimeters separation of the medial malleolar talar space.

The importance of accurate reduction lies in the concentration of stress forces on the tibiotalar contact area, which lessens if there is lateral shift of the talus. Some authors have shown that one millimeter of lateral displacement of the talus in the ankle mortise results in 42% reduction of the contact surface area³.

METHODS OF TREATMENT

Open reduction

Indications for open reduction in this series were — inability to obtain satisfactory closed reduction — and inability to maintain reduction in a plaster cast.

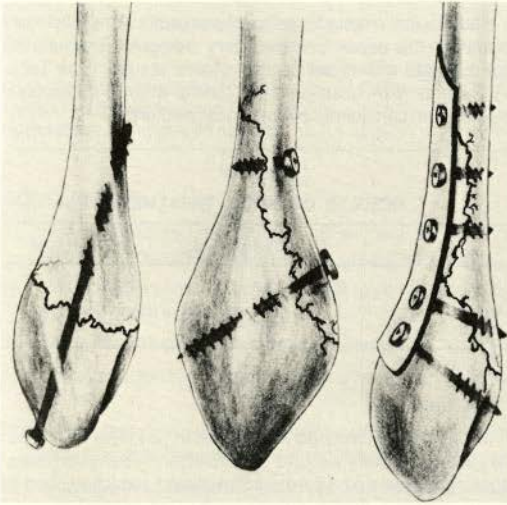


FIGURE 3

Internal Fixation of Lateral Malleolus

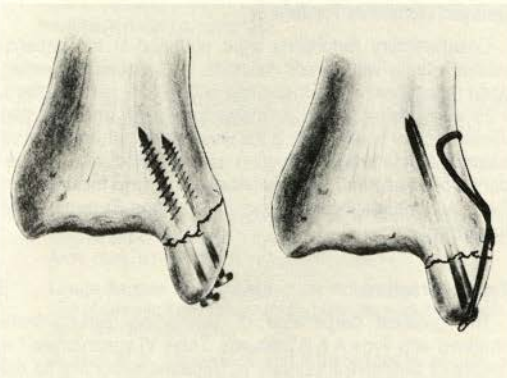


FIGURE 4

Internal Fixation of Medial Malleolus

Open reduction was carried out on all unstable malleolar fractures using the technique recommended by Mueller *et al.*³ A long malleolar screw was used from the tip of the fibular or two small navicular screws were used to fix oblique fractures of the fibula. Deltoid ligament tears were sutured with Ticon. Medial malleolar fractures were fixed internally with one or two screws. Small fragments were repaired with a navicular screw or tension band technique as shown in Figure 4.

Preoperative X-rays included AP (to illustrate the position of the talus in the ankle mortise), lateral (to assess the posterior displacement of the fibula), and oblique views (to show the tibiofibular syndesmosis and the tubercles of Tillaux-Chaput and Lafort-Wagstaffe).

MATERIAL

One hundred patients with ankle injuries treated at the Victoria General Hospital between 1971 and 1973 were reviewed as follows: 56 by telephone, 14 by questionnaires, and 30 by return visit. X-rays of all 100 were reviewed. The average period of follow-up was three years and eleven months.

TABLE I
QUESTIONNAIRE SENT TO PATIENTS

1. Do you have any pain in your ankle?
If so: a) with minimal exercise only?
b) with much exercise?
c) constantly?
d) disabling?
2. How long were you off work?
3. Do you have any swelling, with or without exercise?
4. Do you have a deformity?
5. Do you have a limp?
6. Do you feel your ankle has normal movement now?
7. Comments.

There were 55 males and 45 females with an average age of 39.5 years and 43.5 years respectively with a range of 15-79 years. There were fifty right and fifty left ankles with no bilateral injuries.

PATIENT CRITERIA

Injury

The mechanism of injury, associated injuries, and incidence of the fracture types are shown in Table II & III.

TABLE II
MECHANISM OF INJURY & INCIDENCE
OF TYPE OF ANKLE FRACTURE

	A	B	C	TOTAL
Object fell on leg	0	1	0	1
Patient fell with twist	4	42	11	57
Tripped over an object	0	1	0	1
Assault	1	0	0	1
MVA	8	8	2	18
Slipped on ice	0	18	4	22
TOTALS	13	70	17	

TABLE III
ASSOCIATED INJURIES
WITH TYPE OF ANKLE FRACTURE

	A	B	C	TOTAL
No associated injury	4	61	15	80
Ipsilateral tibial fracture	1	0	0	1
Hand fracture	1	2	0	3
Multiple Injury	7	7	2	16
Compound Ankle Fracture	1	1	0	2

The Type A compound fracture was treated with debridement and closed reduction and the Type B was treated with open reduction, both with satisfactory results.

Treatment

Initially 47 patients had an open reduction and 53 had closed reduction. Of these 53, ten subsequently had open reduction and 12 were undisplaced malleolar fractures treated by closed methods.

Postoperative Management

There was no significant difference between the time spent in plaster and those treated by closed or open means, or those with an unsatisfactory result. Closed reduction and open reduction were kept an average of six weeks and five weeks non-weight bearing, and 5.2 weeks and 6.5 weeks weight bearing respectively. The present regime consists of three weeks non-weight bearing and six weeks weight bearing for stable closed reduction and rigid open reduction, and six weeks non-weight bearing and three weeks weight bearing for unstable closed or nonrigid open reductions.

Time Off Work

The average time off work in 76 patients was 14.7 weeks, and ranged from 1-104 weeks. The one patient who was off work 104 weeks had bilateral femoral fractures as well as massive pelvic injuries.

Males Vs. Females

Male results were slightly better than the females, being 80 percent satisfactory with the females being 74.8 percent satisfactory. The males were slightly overweight for norms of their age and height, and the females were moderately to grossly overweight for norms of their age and height.

Complications

There were two early complications: 1) skin blisters and 2) superficial infection which cleared with antibiotics. There was no deep sepsis. The late incidence of degenerative osteoarthritis was 18 percent. Degenerative arthritis was diagnosed on the basis of clinical symptoms and signs felt to be due to degenerative change in the ankle joint manifested by the radiological findings of sclerosis, joint space narrowing, talar shift, and osteophyte formation.

RESULTS

Clinical

Clinical results were based upon pain, swelling, deformity, limp, and normal motion. Patients who had disabling pain, constant swelling or deformity or any combination of three of

the headings listed in Table IV were considered to have unsatisfactory results. Table IV summarizes the clinical results. Tolerable pain was defined as pain at the end of a day's work or pain occurring after maximum exercise. Over all 78 percent of patients had a satisfactory clinical result.

TABLE IV
CLINICAL RESULTS

	PAIN	SWELLING	DEFORMITY	LIMP	NORMAL MOVEMENT				
None	— 45	Constant	— 10	Yes	— 22	Yes	— 16	Yes	— 72
Tolerable	— 49	End of Day	— 35	No	— 78	No	— 84	No	— 22
Disabling	— 6	None	— 55						
									Satisfactory — 78%
									Unsatisfactory — 22%

Radiological

Radiological criteria for satisfactory results were previously defined in this paper. Unsatisfactory radiographic results did not correlate with unsatisfactory clinical results. (See Table V) Patients with unsatisfactory clinical and/or radiological results were considered overall unsatisfactory.

TABLE V
RESULTS OF INITIAL TREATMENT

	Clinical Result		X-ray Result	
	S	U	S	U
Open	39	8	37	10
Closed	38	15	35	18

Initial Treatment

Initial treatment was carried out within two days of injury in 78 cases, and there were 10 unsatisfactory results from initial open reduction and 18 from initial closed reduction. Ten of these eighteen ankles subsequently had secondary open reduction. The results of initial treatment are summarized in Table V.

Delayed Definitive Treatment

Unsatisfactory reductions were obtained in ten patients treated initially with closed methods, and all had secondary open reductions. Six of these had satisfactory results after a 1.25 week delay before definitive treatment, and four had unsatisfactory results after a 2.5 week delay before definitive treatment. Anatomical reduction was obtained in all secondary procedures and the secondary procedures included two Type A fractures, seven Type B, and one Type C ankle fractures.

Type of Fracture

The greatest percentage of satisfactory results were obtained with Type A & B fractures. Table VI summarizes the results of definitive treatment of fractures according to the type. Results are felt to be better now because anatomical restoration is attempted in the severely displaced fractures by the more frequent use of internal fixation.

TABLE VI
RESULTS OF DEFINITIVE TREATMENT
ACCORDING TO FRACTURE TYPE

Type	Open Reduction	Unsatisfactory Result	Closed Reduction	Unsatisfactory Result	Percent Satisfactory
A	5	1	8	1	84.7%
B	40	7	30	6	82.9%
C	12	6	5	1	45.2%

SUMMARY

In 100 cases of ankle fractures reviewed, open reductions gave 79.8 percent satisfactory results and closed reductions 56.6 percent satisfactory results, and no reduction 100 percent satisfactory results. (See Table VI) Type A and B fractures had the best results.

TABLE VII
SUMMARY OF RESULTS

	Satisfactory Results
Open — displaced fractures	79.8%
Closed — displaced fractures	56.6%
No reduction — undisplaced fractures	100.0%

CONCLUSIONS

- 1) Open reduction resulted in 79.8 percent satisfactory ankles and closed reduction 56.6% satisfactory ankles.
- 2) Unsatisfactory results did not appear to be influenced by the time spent in plaster.
- 3) The average time off work was 14.7 weeks.
- 4) The late incidence of degenerative osteoarthritis was 18 percent.
- 5) Unsatisfactory results are usually due to unacceptable reduction or subsequent loss of reduction.
- 6) Although the numbers were probably too few to draw any definite conclusions, tears of the deltoid ligament associated with lateral malleolar fractures did not appear to have any influence in the final result.
- 7) Open reduction, when indicated, achieves the aims of treatment most consistently. □

Acknowledgment

I would like to acknowledge Dalhousie University Artist Mr. Gagnon for his assistance with the illustrations in this paper.

References

1. **Ashhurst, Astley and Bromer, Ralph S:** Classification and Mechanism of Fractures of the Leg Bones Involving the Ankle, *Arch. Surg.* 51-129, 1922.
2. **Lauge-Hansen N:** Fractures of the Ankle, Part IV, Clinical Use of Genetic X-ray Diagnosis and Genetic Reduction, *Arch. Surg.* 64:488-500, 1952.
3. **Mueller M E, Allgower M and Willenegger H:** Manual of Internal Fixation, Springer and Verlag, Berlin, Heidelberg, New York, 1970, Translated by J. Schatzker, 193-210.

An extensive bibliography is available from the authors.

HEALTH CARE
EVALUATION
SEMINAR

This Seminar will take place at Memorial University of Newfoundland, St. John's, Newfoundland from August 29 — September 2, 1977.

Tuition is \$100.00 and food and lodging will be arranged by the University.

Some scholarships and travel awards are available.

Deadline for applications is June 1, 1977, with forms and further information available from:

Health Care Evaluation Seminar
 c/o Patricia Bruce-Lockhart
 Division of Community Medicine
 Faculty of Medicine
 Memorial University of Newfoundland
 St. John's, Newfoundland
 A1B 3V6



V. F. (VERN) CLAHANE

Representing



Gardiner Realty

Office 422-9301

Home 477-5706

Surgical Milestones

Microsurgery Makes a Debut in Halifax

Although microsurgery has been used for a number of years in otorhinolaryngology, only recently has it been used in reconstructive surgery of the limbs.

Manus Canada, (the authoritative name for the Canadian Society for Surgery of the Hand) held a special meeting in Halifax on May 26, 1976. Dr. Jim Ross and Dr. Robert Hakstian presided over a series of exciting papers on microsurgery. Techniques evolved largely during the past ten years now make it possible to successfully suture vessels of one millimeter and repair nerves by fascicular anastomosis with much greater expectation of functional recovery. The techniques are not too complicated but are demanding. Electrophysiological methods are being developed which promise to bring a new dimension to reconstructive surgery.

Electrophysiological Evaluation in Peripheral Nerve Surgery

Dr. Julia Terzis, from Dalhousie University, reviewed current problems associated with peripheral nerve repair.

Previous nerve suture techniques largely involve the epineural repair which leads to incomplete recovery in many instances. The introduction of microsurgical techniques has allowed nerve repair to be executed at the level of the nerve fascicle with improved results. Perineural or fascicular repair and extensive nerve autografting has enabled surgical reconstruction of brachial plexus injuries and prevention of limb amputations.

For several years Dr. Terzis has been developing electrophysiological recording procedures for assessing intraoperatively the degree of nerve function during the surgical repair of peripheral nerves and the pattern of nerve distribution in skin flaps to be used to cover areas in need of sensation. At this meeting Dr. Terzis presented the results of some recent work performed in conjunction with a neurophysiologist, Dr. Robert Dykes, who specializes in the study of cutaneous sensation.

Dr. Dykes, also from Dalhousie University, reviewed the methods previously used to define the area served by one spinal root in man and monkeys. In his laboratory this

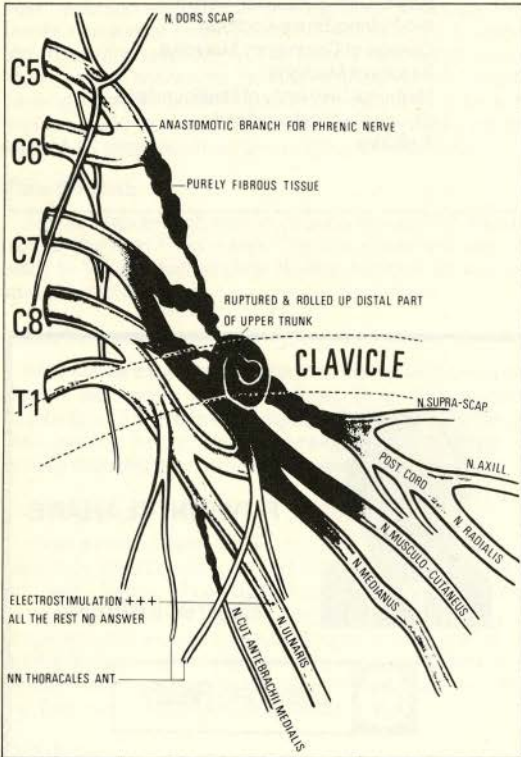


FIGURE 1

After Exposure

Shows extensive lesion of Brachial Plexus in which previous types of nerve repair were largely unsuccessful.

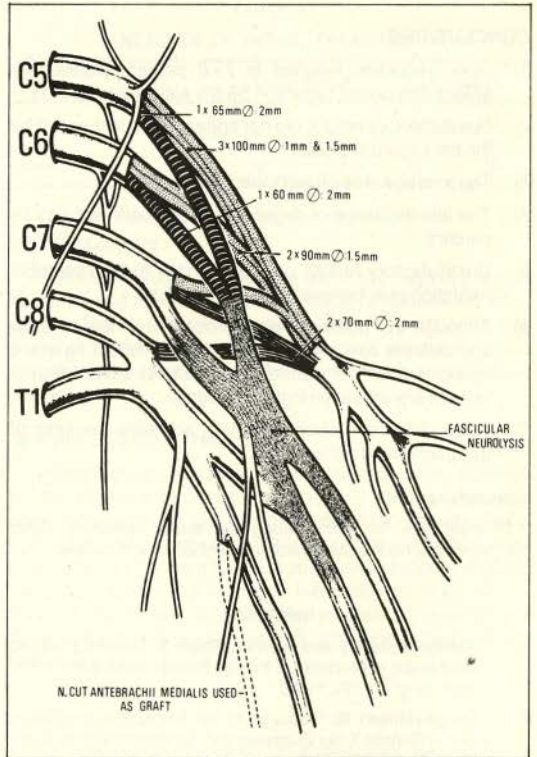


FIGURE 2

Repair Done

Newer types of nerve grafting and fascicular repair which promise to give greatly improved results.

cutaneous area, the dermatome, has been defined without the confounding effect of spinal inhibitory processes by using electrophysiological recordings of the fibers in the spinal root. The results show a large degree of variation among individuals and argue that such electrophysiological methods should be used to assess nerve function in man before surgical repair of peripheral nerve lesions occurs.

Preliminary work in selected clinical cases with severe nerve lesions where a combination of electrophysiological recordings and microsurgical nerve repairs was used, has yielded encouraging results. Routine application of these techniques in peripheral nerve surgery requires that larger series be tested over a longer period of time before widespread use can be recommended.

New Surgical Instruments and Suture Materials

On display there was a whole new battery of microsurgical instruments and microscopes, currently used for reconstructive surgery. Television was linked to some of these demonstrations and a beautiful film demonstrated the anastomosis of vessels one to two millimeters. Both the femoral artery and vein in a rat can be accurately resutured and this is used as a training exercise. 10 "0" sutures or finer are neatly inserted. Vascular clamps still have to be developed which do not traumatise the vessel.

Microsurgical Pioneer Explains Application of New Techniques in Microvascular and Nerve Anastomosis

Dr. Kleihert, President of the American Society of Surgery of the hand, himself a pioneer in this field reported some of his criteria. Successful microsurgery requires simple tools, magnification of six times or more, and an optical loop or an operating microscope. There must not be tension or trauma to the vessel. Heparin and antibiotics were used and vein anastomosis was more important and difficult than the arterial suture. In reimplantation of digits or thumb, a number of points were important.

- a) At the site of the accident, the detached limb should be cleaned and packed in a polythene bag with ice but not frozen.
- b) A crushed extremity should not be reimplanted.
- c) Reimplantation was more applicable for multiple defects, not for the single amputation of the index or little finger.
- d) If possible everything should be repaired at the same time — vein, artery, nerve, bone, and tendon.
- e) Large gaps should be bridged by grafts — vein, artery, and nerve, within hours.

He showed some remarkable examples of reimplanted digits.

Further Applications

Now it is possible to suture small arteries and veins. Exciting possibilities are toe transplantation to replace fingers, free transplantation of muscle, transplantation of sensory skin to replace a bed sore.

Dreams of the Future

Just when surgery seems to have reached a stage when further development is unlikely, a major revolution occurs. No doubt the next ten years will break down many preconceived notions.

Just a few years ago, primary nerve and tendon repair were regarded as improper. Now they are an urgent necessity. Great defects in the brachial plexus can be bridged by nerve grafts.

Once electrophysiological methods have been evolved, proximal nerve root injuries and even cauda equina lesions may be amenable to repair. What about the spinal cord? Perhaps Dr. Murray's work may yet be resuscitated as it is known that spinal cord regeneration does occur before axons get incontestably confused and regress.

We look forward to papers by these distinguished authors and feel sure we have the talent in Nova Scotia for a first class team to cooperate in the provision of this new branch of surgery. □

B.J.S.G.



Manuge Galleries Limited

- We specialize in Canadian paintings of the 19th & 20th centuries.
- Our collection includes work by the Group of Seven, Robert Pilot, Goodridge Roberts, Alan Collier, Tom Roberts, Tom Forrestall, John Little and many others.
- Most paintings purchased as a wall decoration can be depreciated and many professionals in Canada are selecting high quality original art for their offices. This may be done on a lease-purchase basis.
- We have more than 600 paintings in inventory.

MANUGE GALLERIES LIMITED
1674 Hollis Street
(adjacent to the Halifax Club)
Halifax, N.S.
Telephone: Halifax 902-423-6315

Effect of Blood or Meconium on the Lecithin/Sphingomyelin

Ratio and the Bubble Stability Test

Zenora Rackham,* B. Sc., Alice Giles,* B.Sc. and
S. C. MacLeod,** M.D. F.R.C.S. (C).

Halifax, N.S.

The determination of the amniotic fluid lecithin/sphingomyelin ratio and the bubble stability test is a valuable aid in the clinical assessment of fetal lung maturity. In most cases the L/S ratio is either high or low but in the critical intermediate range it is important that the effect of any biological contaminants be taken into account. This study was carried out to assess the effects of varying concentrations of blood and meconium contamination on the L/S ratio and the bubble stability test.

The measurement of amniotic fluid phospholipids is widely utilized for the clinical assessment of fetal lung maturity prior to selective termination of pregnancy^{1,2}. This approach is based on the fact that the etiology of neonatal respiratory distress syndrome (RDS) has been known to involve a deficiency of pulmonary surfactant. Since the major components of lung surfactant are a number of phospholipids, the measurements of these substances in the amniotic fluid provides an index of the likelihood of the postnatal development of RDS.

Our laboratory has been performing clinical tests as an aid to obstetricians in the management of high risk pregnancies. There are two methods that we use for the measurement of amniotic fluid surfactant: the bubble stability test or shake test, and the Lecithin/Sphingomyelin ratio (L/S ratio). The shake test is a modification of the method first described by Clements¹. The L/S ratio was based on the work by Borer and Gluck². A positive shake test or a sufficiently high ratio (i.e. a ratio > 2.0), indicate pulmonary maturity with very little risk that the fetus will develop respiratory distress at birth^{2,3}. Conversely, a negative shake test or an L/S ratio of 1.5 or less indicate that a possibility exists for the development of RDS, and this risk factor has been found to increase as the ratio decreases.

At present, all amniotic fluid specimens coming to our laboratory are first screened by the shake test. Fluids giving a positive result do not require an L/S ratio determination; those having either an intermediate or negative shake test result require further determination of an L/S ratio. The accuracy and reliability of our assay of amniotic fluid in the presence of blood or meconium contaminant have been of major concern. At least 20% of all fluids obtained contain some level of blood. Numerous investigations have been made to evaluate the effect of blood or meconium on both the L/S ratio and the shake test^{4,5} and the results appear to vary according to different laboratory procedures. It was, therefore, necessary to investigate the effects of blood or

meconium on both the L/S ratio and the shake test under the specific conditions used in our laboratory. This study was carried out as an aid to clinicians in their interpretation of the L/S ratio and the shake test of contaminated fluids.

METHODS AND MATERIALS

The late gestational fluids used for this study were obtained from the case room of the Grace Maternity Hospital in Halifax, Nova Scotia. Specimens were collected at the time of delivery from a total of ten patients. Fluid specimens from early gestation were obtained at the time of therapeutic abortions performed at the Victoria General Hospital.

L/S Ratio Determination.

A modification of Borer and Gluck's technique² was used for the extraction of the phospholipids, thin layer chromatography, and densitometry. The thin layer chromatography plates were commercially obtainable, precoated silica gel G plates (250 μ). After separation of lecithin and sphingomyelin, plates were sprayed with phosphomolybdic acid, then charred and the colored areas were measured on a Zeiss spectrophotometer by reflectance densitometry.

Shake Test

Our experience with the shake test of Clements *et al*¹ did not show a good correlation with the L/S ratio and fetal outcome. With modification and a standardization of the shaking method we were able to set up our own bubble stability test. Three tubes labelled 1, 2 and 3 were set up each containing 1:1, 1:1.3 and 1:2 ratio of amniotic fluid to alcohol. To tubes 2 and 3, 0.125 mls and 0.25 mls of physiological saline (0.9% NaCl) were added. To each of the three tubes were added 0.5 mls of 90% ethanol to give a uniform volume of 1 ml. The tubes were capped and placed on a specially designed block mounted on a "Red Devil" Paint Shaker, and shaken ten minutes, thus standardizing the shaking procedure and ensuring that all test tubes were uniformly shaken. The tubes were read fifteen minutes later. If there were no bubbles in any of the tubes, a score of zero was obtained, resulting in a negative shake test. If there were bubbles in tubes 1 and 2, but not in 3, the surfactant test was termed intermediate. When all three tubes contained bubbles, the surfactant test was termed positive.

Effect of Blood or Meconium Contamination

Material and fetal blood were added to the fluid specimens in various concentrations ranging from 0.5% to 25%. To another set of specimens, meconium was added in various concentrations ranging from 0.1% to 5%. To assess the effects of blood or meconium on the bubble stability test a scoring system was designed as follows. A score of 1 was given to tubes containing one ring of bubbles. Tubes with two rings of bubbles were assigned a score of 2. Tubes with three

*Research Technicians, Endocrine Laboratory, Department of Obstetrics & Gynecology Faculty of Medicine, Dalhousie University, Halifax, Nova Scotia

**Associate Professor, Department of Obstetrics & Gynecology, Faculty of Medicine Dalhousie University.

rings were given a score of 3. Tubes with four rings of bubbles received a score of 4. The sum of scores for all three tubes was then utilized in the overall evaluation of the effect of blood of meconium or the bubble stability test. L/S ratios of the contaminated fluid samples were carried out as described.

Ancillary Study

Surfactant content was measured in pure blood and meconium as follows: Blood and meconium diluted with saline to give 50.0% solutions were handled in a manner identical to that described for the L/S ratio. The L/S on the blood was 1.33 and the shake test showed a strongly positive score of 12. The L/S ratio on meconium was 2.0 with a positive bubble stability test and a score of 3.

RESULTS

Effect of Blood or Meconium on Amniotic Fluids with Low L/S Ratios and Negative Shake Test

Table I shows the change in L/S ratios in early gestational fluids with the addition of blood over a range of 0.5% to 25.0% of blood. Although there was no correlation between

the concentration of blood and the increase in the L/S ratio, the L/S ratio increased to close to the intermediate range (1.5 → 2.00). One ratio increased from 0.91 to 1.63 at 5% level of blood. Another sample increased from 0.76 to 1.66 at 25% blood level.

The bubble stability test showed a significant change with the addition of higher concentrations of blood (Table II). A negative surfactant test became intermediate when there was as little as 1.0% blood in the fluid and consistently false positive at levels of 5.0% blood or more. The L/S ratio seemed to be less susceptible to false interpretation due to the influence of blood.

Table III shows an increase in the L/S ratio of early gestational fluids with increasing concentrations of meconium. It is evident that the L/S ratio increases progressively and at the higher concentrations of meconium frequently becomes intermediate or greater than 2. An L/S ratio of 0.79 increased to 2.33 at 5% meconium. This increased ratio could influence a clinician in the interpretation of the results, as the L/S ratio could be falsely high. The bubble stability test showed no significant changes with the exception of one fluid which became positive at a high concentration of meconium (Table IV).

TABLE I
EFFECT OF BLOOD ON LOW L/S RATIOS

Gestation	% Blood re: Amniotic Fluid						
	0.0	0.5	1.0	2.0	5.0	10.0	25.0
34 wks.	0.76	...*	1.04	1.16	1.44	1.40	1.66
18 Wks.	1.05	1.04	0.87	1.15	1.15	1.05	1.36
19 wks.	0.81	0.92	1.14	0.89	0.91	1.07	1.34
16 wks.	0.52	0.62	0.66	0.76	1.07	1.24	1.02
17 wks.	0.91	1.10	1.07	1.28	1.63	1.36	1.37

*Not measured

TABLE II
EFFECT OF BLOOD ON NEGATIVE SHAKE TEST

Gestation	% Blood re: Amniotic Fluid						
	0.0	0.5	1.0	2.0	5.0	10.0	25.0
34 wks.	0 neg.	...*	3 Int.	3 Int.×	5 Pos.	6 Pos.	6 Pos.
18 wks.	0 neg.	0 neg.	1 neg.	2 Int.	9 Pos.	8 Pos.	10 Pos.
19 wks.	0 neg.	0 neg.	2 Int.	3 Int.	4 Pos.	9 Pos.	9 Pos.
16 wks.	0 neg.	0 neg.	2 Int.	3 Int.	7 Pos.	7 Pos.	10 Pos.
17 wks.	0 neg.	1 neg.	2 Int.	3 Int.	5 Pos.	7 Pos.	10 Pos.

*Not measured
×Int. Intermediate

TABLE III
EFFECT OF MECONIUM ON LOW L/S RATIOS

Gestation	% Meconium re: Amniotic Fluids						
	0.0	0.1	0.2	0.5	1.0	2.0	5.0
18 wks.	0.74	0.91	1.04	1.22	1.72	1.76	2.33
18 wks.	0.51	1.13	1.42	1.57	1.59	1.78	2.13
17 wks.	0.81	0.95	1.16	1.20	1.27	1.44	1.47
16 wks.	0.74	0.95	0.95	0.96	1.02	1.03	1.28
17 wks.	0.63	0.71	0.81	0.95	1.08	0.95	1.12

TABLE IV
EFFECT OF MECONIUM ON NEGATIVE SHAKE TESTS

Gestation	% Meconium re = Amniotic Fluid						
	0.0	0.1	0.2	0.5	1.0	2.0	5.0
18 wks.	3 neg.	2 neg.	1 neg.	2 neg.	1 neg.	6 Pos.	0 neg.
18 wks.	0 neg.	0 neg.	0 neg.	0 neg.	0 neg.	2 neg.	2 neg.
17 wks.	0 neg.	0 neg.	0 neg.	0 neg.	0 neg.	0 neg.	0 neg.
16 wks.	2 neg.	2 neg.	1 neg.	0 neg.	0 neg.	0 neg.	0 neg.
17 wks.	2 neg.	1 neg.	1 neg.	0 neg.	0 neg.	0 neg.	0 neg.

TABLE V
EFFECT OF BLOOD ON HIGH L/S RATIOS

Gestation	% Blood re = Amniotic Fluid						
	0.0	0.5	1.0	2.0	5.0	10.0	25.0
40 wks.	2.00	2.86	2.31	1.73	2.22	2.42	2.57
40 wks.	5.08	2.97	3.00	2.70	2.05	2.32	2.08
38 wks.	6.15	5.88	5.81	3.88	2.99	2.31	1.54
39 wks.	2.15	2.05	1.74	1.70	1.95	1.86	1.81
40 wks.	6.50	6.92	4.50	3.99	3.74	3.63	3.50

TABLE VI
EFFECT OF BLOOD ON POSITIVE SHAKE TESTS

Gestation	% Blood re = Amniotic Fluid						
	0.0	0.5	1.0	2.0	5.0	10.0	25.0
40 wks.	5 Pos.	5 Pos.	5 Pos.	9 Pos.	8 Pos.	12 Pos.	12 Pos.
40 wks.	5 Pos.	5 Pos.	8 Pos.	10 Pos.	10 Pos.	10 Pos.	11 Pos.
38 wks.	8 Pos.	9 Pos.	9 Pos.	9 Pos.	9 Pos.	10 Pos.	10 Pos.
39 wks.	6 Pos.	6 Pos.	6 Pos.	9 Pos.	11 Pos.	11 Pos.	12 Pos.
40 wks.	9 Pos.	9 Pos.	9 Pos.	12 Pos.	12 Pos.	12 Pos.	12 Pos.

TABLE VII
EFFECT OF MECONIUM ON HIGH L/S RATIOS

Gestation	% Meconium re: Amniotic Fluid						
	0.0	0.1	0.2	0.5	1.0	2.0	5.0
40 wks.	2.11	2.49	2.37	2.00	1.55	2.05	...*
38 wks.	4.72	5.23	4.41	4.62	3.80	4.39	3.93
41 wks.	7.44	4.75	5.14	4.67	4.99	5.17	4.61
38 wks.	4.61	4.88	3.97	2.30	4.22	3.34	3.08
39 wks.	3.73	3.76	2.75	3.80	3.45	2.81	2.51

*Not measured

TABLE VIII
EFFECT OF MECONIUM ON POSITIVE SHAKE TEST

Gestation	% Meconium re: Amniotic Fluid						
	0.0	0.1	0.2	0.5	1.0	2.0	5.0
40 wks.	4 Pos.	4 Pos.	4 Pos.	4 Pos.	3 Int.	2 Int.	...*
38 wks.	9 Pos.	7 Pos.	6 Pos.	7 Pos.	5 Pos.	7 Pos.	6 Pos.
41 wks.	8 Pos.	8 Pos.	8 Pos.	5 Pos.	3 Pos.	3 Pos.	3 Pos.
38 wks.	12 Pos.	12 Pos.	10 Pos.	8 Pos.	8 Pos.	8 Pos.	5 Pos.
39 wks.	6 Pos.	5 Pos.	4 Pos.	4 Pos.	2 Int.	2 Int.	1 Neg.

*Not measured

Effect of Blood or Meconium on High L/S Ratios and Positive Shake Test

With increasing concentrations of blood, L/S ratios that were greater than 2.0 tended to be lowered to the intermediate range. An L/S in the intermediate range (1.5-2.00) could, therefore, be falsely low as blood seemed to lower the L/S ratios.

A ratio of 6.15 was decreased to 1.54. (Table V). The effect of blood on a positive shake test led to an increase in the final score. e.g., a score of 5 at 0% blood was increased to 12 at 25% blood (Table VI).

Amniotic fluid with L/S ratios over 2 were decreased by the addition of meconium. If the initial ratio is very high it will be unlikely to fall below the critical intermediate range (1.5-2.0). A ratio of 7.44 was lowered to 4.61 with 5% meconium (Table VII). The addition of meconium to late gestational fluids significantly affected the bubble stability test. With the addition of high concentrations of meconium, a strongly positive shake test became intermediate and, in one case, changed from a score of 6-positive to 1-negative with 5% meconium (Table VIII). A fluid contaminated with meconium could therefore give a falsely negative shake test. A bubble stability test on meconium stained fluid is therefore unreliable.

DISCUSSION

Our results show that the average L/S ratio measured in samples of pure blood was 1.33. It is reasonable to expect that increasing amounts of blood present in the amniotic fluid would tend to raise the fluid L/S ratio towards 1.33. Thus, we have shown that amniotic fluid specimens having an L/S ratio less than 1.0 increased proportionally in the presence of increasing blood contamination, but did not appear to result in false positive results (>2.0). On the other hand, amniotic fluid L/S ratios that were originally high were decreased by the addition of blood. Blood contamination could lead to a significant change in the shake test results. As pure blood specimens yielded highly positive readings, a fluid specimen having a negative shake test became intermediate or positive with the addition of increasing concentrations of blood.

Meconium contamination tends to increase the L/S ratio so that fluid specimens with ratios that were less than 1.0 were elevated to a falsely high L/S ratio. The presence of meconium depressed high L/S ratios but did not result in a ratio less than 1.5. The shake test results showed that increasing concentrations of meconium decreased the amount of bubbles. Thus, a meconium stained fluid could be reported as having a falsely intermediate or negative surfactant test because of meconium contamination.

We conclude that our surfactant test can be influenced by blood and meconium contamination. Therefore, the result from a shake test on a blood or meconium stained fluid should be interpreted with caution because of the possibility of a false positive measurement. In the cases where information regarding the state of fetal lung function is critical to the course of pregnancy management, it is important that amniotic fluid should be tapped in sufficient amount (>6.0 ml) to allow for L/S ratio determination. □

References

1. **Clements J A, et al:** Assessment of the risk of the respiratory distress syndrome by a rapid test for surfactant in amniotic fluid. *New Engl. Med.* **286:**1077, 1972.
2. **Gluck L, et al:** Diagnosis of the respiratory distress syndrome by amniocentesis. *Am. of Obst. and Gyn.* **109:**440, 1971.
3. **Lindback T, et al:** Amniotic Fluid phospholipid determination by bubble stability test and quantitative lipid analysis. *Acta Obstet. & Gynecol. Scand.* **53:**359, 1974.
4. **Buhi WC, et al:** Effects of Blood or Meconium on the determination of the Amniotic Fluid Lecithin/Sphingomyelin Ratio. *Am. J. of Obst. and Gyn.* **121(3),** 321, 1975.
5. **Wagstaff T I, et al:** Factors influencing the measurement of the Lecithin/Sphingomyelin in amniotic fluid. *J. Obst. & Gyn. Brit. Comm.* **81:**264, 1974.

POSITION WANTED

Dictatypist with Medical Terminology seeking position in Halifax area.

Completed course in Medical Transcription at Mount Saint Vincent University.

Would consider working on a volunteer basis for a trial period.

(Applicant is Blind)

Please contact: Miss Anne Masterton
6327 Edinburgh Street
Halifax, Nova Scotia
B3L 1N3
Phone: 455-8317



PETER R. ARNOLD, C.L.U.
CONSULTANT

"Inflation Insurance?
Talk to us about it!"

ManuLife

THE MANUFACTURERS LIFE INSURANCE COMPANY
6024 QUINPOOL ROAD, HALIFAX, N.S.
429-2410 (902) 429-2335

The Role of a Nurse-Coordinator in the Management of Chronic Metabolic Diseases in Children

J. T. R. Clarke,* M.D., Ph.D., F.R.C.P.(C),
D. M. d'Entremont,† R.N., B.N. and
M. W. Spence,‡ M.D., Ph.D.,

Halifax, N.S.

INTRODUCTION

During the past two years, we have been developing a nurse-coordinator centered system for managing children with chronic metabolic diseases. Our primary objective is to provide these children optimum medical care with minimum disturbance of lifestyle and development. The nurse-coordinator fulfills four important functions: communication, counselling, education and coordination. She maintains continuing contact with families throughout the Maritimes, reinforcing genetic and nutritional counselling and helping parents to understand the basic nature of complex illnesses and their day to day management. She coordinates the activities of various medical specialists and allied health personnel and ensures the delivery of special dietary products used in the treatment of many chronic metabolic diseases in children. Experience with the management of phenylketonuria (PKU), galactosemia, maple syrup urine disease (MSUD), and other diseases, has shown that this system reduces parental anxiety, increases the independence of families involved with these disorders, reduces both unscheduled out-patient and in-patient hospitalization and improves the care of affected children.

THE PROBLEM

The management of children afflicted with rare chronic metabolic diseases, such as PKU and galactosemia, poses some unusual problems that are not easily overcome by traditional methods of health care delivery. Because individually the diseases are rare, most physicians have little experience with their management. Successful treatment often hinges on preventing the accumulation of harmful metabolites in the patient's body. Since the source of these metabolites (e.g. phenylalanine in patients with PKU) is usually dietary, one of the most important aspects of treatment is the prescription of a special, restricted diet which, while limiting the intake of potentially harmful compounds, provides a sufficiently well balanced intake of nutrients to sustain normal growth and development. This is particularly important when the potentially harmful compound is an essential amino acid (e.g. phenylalanine), since over-zealous dietary restriction of one of this group of

nutrients invariably produces retardation of growth and development and, in some cases, death.

The development of palatable, imaginative and nutritious therapeutic diets is a challenging undertaking that is greatly facilitated by the use of special dietary products (e.g. Lofenalac). These products substitute for a major foodstuff, such as milk, but have one or more amino acids removed. However, they do not contain sufficient amounts of the restricted nutrient to support normal growth and are, therefore, potentially dangerous. Optimum treatment then requires a careful balance of the intake of certain nutrients through the prescription of a special therapeutic diet, coupled with close clinical and biochemical monitoring to ensure that this balance is maintained. Needless to say, this is often a complex process that is made more difficult by the fact that the optimum dietary requirements of children with metabolic disorders are often profoundly altered by minor intercurrent illness. Since treatment is long-term and spans that period when the developing child is particularly vulnerable to malnutrition, careful continuing follow-up is essential.

We find that few parents have heard of the disease that afflicts their child before the diagnosis is made. Even after the initial shock, they often experience extraordinary anxiety related to feelings of guilt, uncertainty and inadequacy with respect to the day-to-day management of their child's disease. As a result, they make frequent, time-consuming demands on their family physician that could be reduced by long-term counselling and support.

The treatment of inherited metabolic diseases usually involves a number of allied health personnel, such as nutritionists, social workers and public health nurses. Coordination of care becomes increasingly difficult as the number participating in management increases, but it is essential for optimum treatment.

OBJECTIVE

The primary objective in managing children with chronic metabolic diseases in the Maritimes is the provision of good medical care in such a way that optimum health, growth and development can be achieved with minimum disturbance of lifestyle, such as extended hospitalization. To meet this objective, we realized the need to provide both facilities and personnel for the diagnosis, treatment and follow-up of children with a variety of inherited metabolic diseases. In addition, we realized that continuing, reliable genetic and dietary counselling to parents was essential over extended periods of time, and when possible should be achieved in the patient's home. Thus, it was necessary to reinforce personal counselling and instruction by intermittent telephone calls and the development of information brochures and protocols.

*Assistant Professor, Department of Pediatrics, Dalhousie University; and Director, Biochemical Genetics Clinic, Izaak Walton Killam Hospital for Children and Atlantic Research Centre for Mental Retardation, Halifax, N.S.

†Nurse-coordinator, Biochemical Genetics Clinic, Atlantic Research Centre for Mental Retardation.

‡Associate Professor, Department of Pediatrics, Dalhousie University; and Director, Atlantic Research Centre for Mental Retardation.

Mailing Address: Dr. J. T. R. Clarke, Department of Pediatrics, Room C-R1, Clinical Research Centre, Dalhousie University, Halifax, N.S.

ORGANIZATION

Children with hereditary metabolic disease requiring specialized dietary treatment are randomly distributed throughout the Maritimes (only four are in the immediate Halifax area). The formidable task of coordinating their care at the local level has been entrusted to a nurse-coordinator, trained in the management of inherited metabolic diseases, to ensure a continuing and reliable avenue of communication among parents, local allied health professionals and the consultants in Halifax who prescribe and monitor dietary treatment. As shown in Figure 1, she serves as the final common pathway of communications between the various consultants and the patient. It should be emphasized that the organization depicted in the Figure is a communications network only; responsibility for care continues along traditional lines. That is, primary medical care remains the shared responsibility of the family physician and the appropriate consultant (pediatrician, nutritionist, geneticist, etc.) in the Biochemical Genetics Clinic.

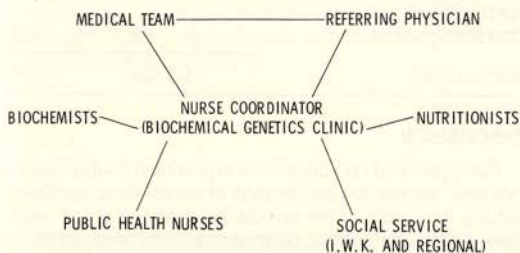


FIGURE 1

Diagrammatic representation of the central role of the nurse-coordinator in the interaction between various health care professionals involved in the management of children with inherited metabolic diseases.

OPERATION

The role of the nurse-coordinator begins at diagnosis. She sits in on discussions between various consultants, including the geneticist and the nutritionist, and the patient's parents so that she understands clearly the advice and instructions given. She immediately begins to notify and organize the services the patient will require at the local level.

Once a patient is discharged from hospital, a process that can be accelerated by having support services organized well in advance, the coordinator provides continuing contact with the family, usually by telephone, and occasionally by home visits. Her contacts range in frequency from four to five times a week or more initially, to once every two to three weeks as the parents become more confident and the patient's management becomes stabilized. Through direct contact and the use of explanatory brochures and algorithms, she reinforces genetic and nutritional counselling, and trains the parents in the management of their child's illness. Families thus become increasingly self-reliant and less dependent on others in recognizing and handling minor problems. The extent to which parents can learn to cope successfully with their child's illness has impressed us.

The coordinator organizes the activities of various medical subspecialists and allied health professionals at the local level, as well as at the medical centre. She establishes and

maintains contact with regional public health nutritionists and public health nurses to reinforce counselling and training and to support the family at home. She also deals with the very considerable problems associated with acquiring special dietary products, biochemical monitoring, and arranging for special services when necessary.

She is in constant contact with a specialist in biochemical genetics, a therapeutic nutritionist and various other specially skilled professionals. When requested, she also maintains contact with the family physician, supplementing continuing direct communication between consultant and family physician.

RESULTS

The Biochemical Genetics Clinic has operated with a nurse-coordinator centered system of organization for a little over two years. Some of the results must still be considered largely subjective and all are preliminary.

Active involvement of the coordinator in the long-term, day-to-day management of chronic metabolic diseases in children has had at least two major effects on demands on traditional modes of health care delivery, both to some extent predictable. First, we found that parents became confident enough to handle minor problems without repeated consultation with a physician; in particular, the number of telephone calls caused by feelings of anxiety and uncertainty was reduced. Secondly, we have observed a reduction in unscheduled contacts with hospitals. Figure 2 shows the effect of the nurse-coordinator's intercession on hospitalization in Halifax of two unrelated children from Prince Edward Island who had MSUD.

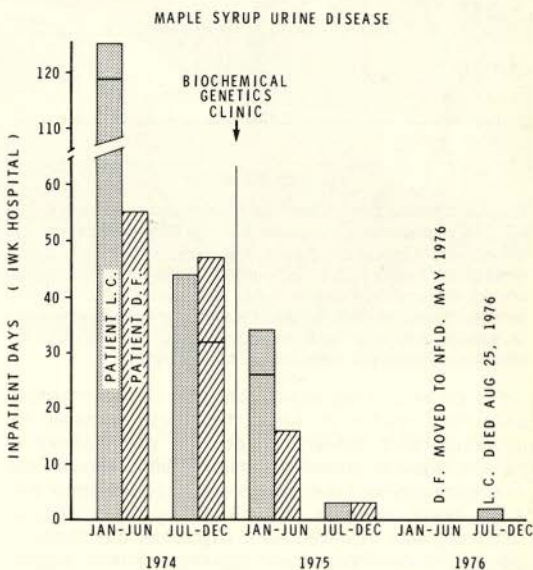


FIGURE 2

Hospitalization in Halifax of two patients with maple syrup urine disease from Prince Edward Island before and after involvement of a nurse-coordinator (indicated by arrow). Birth dates: L.C., 7-12-73; D.F. 28-3-74. When more than one admission occurred during a particular six month interval, the duration of each is shown by a horizontal line across the bar.

A marked decrease in long-term hospitalization was achieved with the institution of coordinated care, even though coordination was from a long distance. A major reason for the hospitalization of L.C. in 1975 was to correct moderately severe malnutrition that developed as a result of a breakdown of traditional communication prior to the involvement of the nurse-coordinator. Subsequently, only one short period of elective hospitalization was necessary, and the general health of the child was improved considerably. Unfortunately, the patient succumbed to sudden overwhelming disease late in 1976.

Figure 3 shows the number and nature of hospital contacts made over a four-year period by a patient from the Halifax area who had methylmalonic acidemia. Notice that although the number of contacts did not decrease significantly with the intercession of the nurse-coordinator, the nature of the contacts changed dramatically. Contacts had previously been unscheduled and crisis stimulated, whereas, afterward they were scheduled and rarely progressed to hospitalization.

PATIENT G. M. (METHYLMALONIC ACIDEMIA)

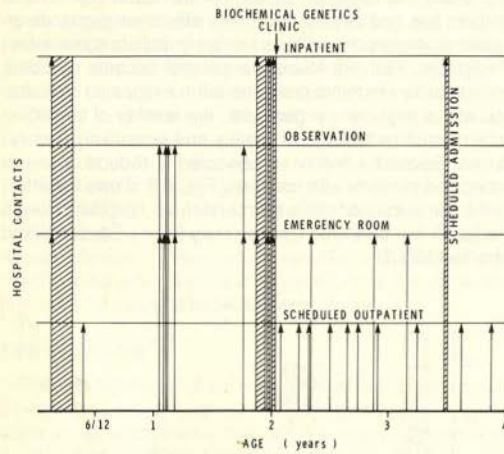


FIGURE 3

Hospital contracts by a patient with methylmalonic acidemia before and after involvement of nurse-coordinator (indicated by the arrow at the top). The duration of in-patient hospitalization is indicated by the width of the hatched bars. Each arrow indicates a single hospital contact; the length of the arrow shows the nature of the contact, e.g. emergency room contact followed by admission to observation unit (a special observation and treatment unit in hospital used for intensive management of less than 12 hours duration).

It is too early to say with certainty that children managed under this system do better than those managed by traditional health delivery modes. The small number of patients available precludes formal statistical analysis and thus, evidence that the children are indeed doing better is to some extent anecdotal. Notwithstanding the scarcity of supporting data, however, serial psychometric evaluations, growth and development and parental testimony suggest strongly that the children do indeed thrive better than they did previously.

In terms of cost to the province, Table I shows the contrast between the cost of hospital contacts by patient G. M. before and after the involvement of the nurse-coordinator. Costs of hospitalization in the neonatal period have been omitted from these data. The costs for comparable periods of time before

and after intervention by a nurse-coordinator were over \$17,000 and under \$1000 respectively. The cost of operating the Biochemical Genetics Clinic with a nurse-coordinator, who currently handles 20 similar patients, and we feel could handle 60 or more, is less than \$20,000 per year. The saving is obvious.

TABLE I
COSTS OF HOSPITALIZATION OF PATIENT WITH METHYLMALONIC ACIDEMIA BEFORE AND AFTER INVOLVEMENT OF NURSE-COORDINATOR IN MANAGEMENT

	Before (1972-74)	After (1974-76)
Inpatient days and cost @ \$152/day	111 \$16,872	5 \$760
Observation visits and cost (estimated)	6 \$ 420	0 0
Emergency Room visits and cost @ \$12/contact	10 \$ 120	3 \$ 36
OPD visits and cost @ \$12/contact	1 \$ 12	10 \$120
TOTAL COST	\$17,424	\$916

DISCUSSION

Participation of non-physicians in providing medical care is not new, witness the proliferation of paramedical specialists adding their skills to the cumulative expertise of the health care team. The number of specialists now involved in the care of patients with complex and long-term problems has made coordination of the activities of the various members of the team an exacting task. Traditionally this has been done by the family practitioner or primary contact specialist. In selected instances, however, the job of coordination has been entrusted to a non-physician. A noteworthy example is the system developed by Scriver and his colleagues² for the management of hereditary metabolic diseases in the Montreal area.

Many of these individuals are persons with nursing backgrounds who work out of clinics established in medical centres, to provide comprehensive care for patients with specific complex medical problems. Unlike nurse practitioners, the nurse-coordinator does not substitute for the primary care physician in first contacts with patients. During the course of managing the disease, she may assume some responsibility for directing problems to the appropriate physician, but specific advice is restricted to the particular disease being managed by the clinic involved. Thus, for example, although our nurse-coordinator may be called by the mother of a child with PKU if the child develops an upper respiratory tract infection, she will counsel the parents concerning the effect this might have on the control of PKU, but she will then refer them to their family physician for definitive diagnosis and treatment.

The diseases managed so far through the nurse-coordinator include PKU and variants, galactosemia, MSUD, tryosinemia, glycogen storage disease, X-linked hypophosphatemic rickets and vitamin D-dependent rickets, methylmalonic acidemia, and mucopolysaccharide storage disease (Table II). In the few patients followed for two years or more, the amount of hospitalization required has decreased dramatically. It might be argued that the decrease in hospital

TABLE II
DISEASES MANAGED WITH THE HELP OF A NURSE-COORDINATOR BETWEEN 1974 AND THE PRESENT

Disease	Number of Patients
Phenylketonuria (PKU) and variants	8
Maple syrup urine disease (MSUD)	2
Galactosemia	5
Hereditary tyrosinemia	1
Methylmalonic acidemia	1
Hereditary rickets	
(X-linked hypophosphatemia and vitamin D-dependent types)	5
Glycogen storage disease	2
Mucopolysaccharide storage disease	4

contacts results from the changing nature of the diseases with age. So far we have not been able to quantitate the effect reliably; the number of patients is too small. However, although we acknowledge that it will likely be impossible to eliminate the need for hospitalization completely, we anticipate reducing it substantially and eliminating custodial institutionalization altogether.

Our preliminary data also suggest that patients with inherited metabolic diseases do better medically under this type of coordinated management. Thus, the need for special services is reduced, and the patient is more likely to become a productive member of the community. The long-term saving to the province could be significant.

Additional information can be obtained by contacting the coordinator, Ms. Doreen d'Entremont, 424-6491, or writing the Atlantic Research Centre for Mental Retardation, Clinical Research Centre, Dalhousie University, Halifax, N.S. □

References

1. **Committee for Improvement of Hereditary Disease Management:** Management of maple syrup urine disease in Canada. *Can. Med. Assoc. J.* **115:**1005-1013, 1976.
2. **Clow C L, Reade T M and Scriver C R:** Management of hereditary metabolic disease. The role of allied health personnel. *N. Engl. J. Med.* **284:** 1292-1298, 1971.



A DIFFERENT BODY is the most obvious change in the new Mercedes-Benz intermediate sedans, the first new cars to be built by Mercedes-Benz for this class since 1967. The body-chassis unit, which is a complete redesign, will come with a choice of four different engines: four and six-cylinder gasoline engines, and four and five-cylinder diesel engines.

ISNOR MOTORS LTD.

1743 Brunswick Street,
 Halifax, N.S.
 429-2300



Water Hardness, Magnesium and Ischemic Heart Disease*

T. W. Anderson, ** B.M., B.Ch., Ph.D.,
Toronto, Ontario.

INTRODUCTION

In most developed countries of the world, ischemic heart disease (IHD) now accounts for approximately half of all deaths in middle-aged men, and approximately one quarter of all deaths in middle-aged women. A number of risk factors have been identified that predispose to this disease but, unfortunately, the application of preventive measures often involves unpopular changes in life-style. The possibility that a simple modification in the mineral content of drinking water might achieve a substantial reduction in IHD death rates is an attractive and tantalizing prospect.

The correlation between water hardness and cardiovascular disease has now been examined in a number of countries. In some places the relationship appears to be very strong and cannot easily be explained away as being due to other factors, while in other places the relationship is weak or non-existent. Furthermore, in different situations different types of cardiovascular disease appear to be involved.

These apparent inconsistencies have led some people to doubt whether there is really such a thing as "the water factor" and in one sense the critics are probably correct, since it is difficult to reconcile the evidence with the belief that the same water factor can be operative in all situations. However, as will be shown later, there are at least two quite different mechanisms that can link water composition to cardiovascular disease, and it would be surprising if both (or either) of these mechanisms were always present to the same degree in all situations. Furthermore, with any multifactorial disease, it is inevitable that comparisons of different population groups for one variable will tend to be confounded by the presence of other, possibly stronger, variables.

Thus although most of this presentation will be concerned with our experience in Ontario, where magnesium content of the water supply appears to be the critical factor, it is not suggested that the same mechanism is necessarily responsible for the correlations seen in other parts of the world.

BACKGROUND INFORMATION

It is now almost ten years since we began to investigate the geographic distribution of cardiovascular mortality in Ontario, and found the same sort of inverse correlation between IHD mortality and water hardness that had been described previously in the United States and Great Britain. Ontario seemed to be a convenient place to investigate this phenomenon, since it has a very wide range of water hardness and a substantial geographical variation in IHD mortality.

In trying to elucidate the possible relationship between these two variables, we have followed two main paths of

*Based on a lecture delivered on September 17, 1976, in the Friday-at-Four Series, Sir Charles Tupper Medical Building, Halifax.
**Professor of Epidemiology, University of Toronto, Toronto, Ontario M5S 1A8.

enquiry, and it is gratifying that the evidence from each is now pointing toward the same answer. Our first approach was to try to identify which of the links in the chain of events, leading up to a fatal episode of ischemic heart disease, was influenced by the water factor. The second was to try to identify the substance in the water supply that was responsible for the observed differences.

As far as identifying the crucial link in the chain of events leading to IHD death, we have now collected fairly strong evidence that the geographical gradient in Ontario involves sudden death from heart disease (Figure 1), and there is little or no correlation between water composition and either non-sudden IHD death or stroke.¹⁻³ It would seem unlikely therefore that the water factor in Ontario is related to either the atherosclerotic process or to the thrombotic process. Rather, it probably influences the liability to sudden death — in other words, the tendency for the heart to develop an abnormal rhythm, particularly ventricular fibrillation.

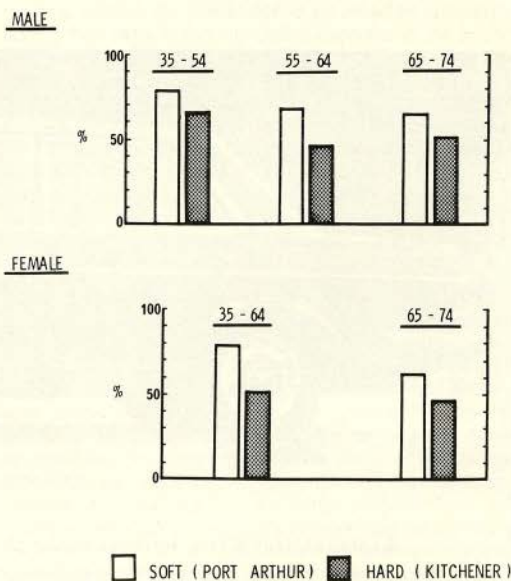


FIGURE 1

The proportion of heart attack deaths occurring suddenly (i.e., before the patient could be admitted to hospital), in Port Arthur and Kitchener, subdivided according to sex and age. Based on an investigation of all deaths occurring in the two cities over the 3-year period 1967-1969. The excess of sudden-deaths in the soft-water city is present in both sexes and all age-groups.

(Proportions of deaths have been used rather than death-rates because of uncertainty over the total size of the population from which the cases were drawn.)

The second line of attack — the attempt to identify the specific substance responsible for the water effect — requires a digression into the nature of water "hardness". This term comes from the well-known variation in the ease with which a lather can be generated in different water supplies. Thus, while rain water is very easy to wash in and feels very "soft", water from deep wells is often so "hard" as to make it almost impossible to develop a lather despite the use of large quantities of soap. As the soap is consumed, a curd tends to form which deposits around the wash basin or bath. This curd is a mixture of fatty-acid salts of metals — mainly calcium and magnesium, the major constituents of water hardness.

One of the features making Ontario a convenient place in which to study the water hardness question is the great range of water hardness shown by different municipal water supplies. This contrast is shown diagrammatically in Fig. 2, where the hardness of the water supply in Guelph is compared with that in a number of other Ontario cities, including Fort William and Port Arthur (now combined as Thunder Bay). In this diagram, for completeness, the anions are indicated for the Guelph water supply only. These are mainly bicarbonate and sulphate, substances which are in generous supply in the body and are therefore unlikely to be related to any health effects of the water supply.

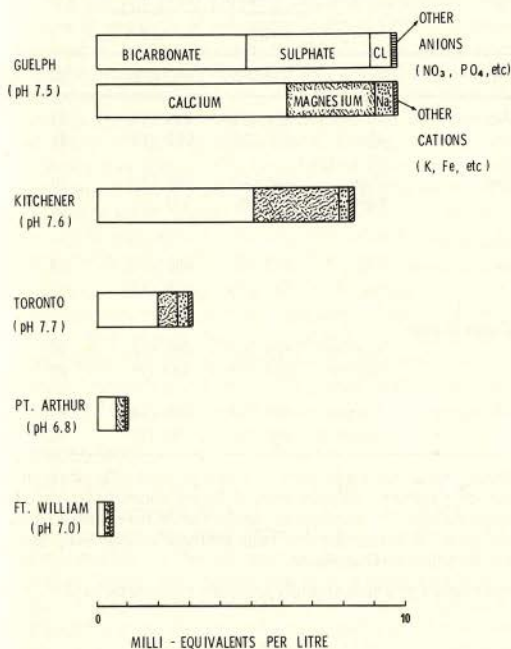


FIGURE 2

Ontario water supplies show a wide range of 'hardness', due mainly to the marked variation in the concentration of calcium and magnesium. Major anions (shown only for the Guelph water supply) are bicarbonate and sulphate.

In Ontario waters, calcium and magnesium are in a molecular ratio of approximately 2 to 1, and a variety of trace elements is usually found in conjunction with these bulk elements. However, the quantities of trace elements involved

tend to be very small both in absolute terms and in relation to dietary intake, but the water supply can act as a substantial source of both calcium and magnesium. Daily intake of water is usually in the range of 1 to 2 litres, and a figure of 1.2 litres was obtained in a recent British study.⁴ Living in Guelph and consuming 1.2 litres of water per day would provide approximately 120 mg. of calcium and 50 mg. of magnesium.

Dietary requirements of these two elements are somewhat controversial but, according to W.H.O. recommendations, the calcium intake should be approximately 800 mg. a day, while the magnesium intake should be 350 mg. a day. In fact, dietary surveys indicate that the actual daily intake of calcium and magnesium in North America is approximately 800 and 200 mg., respectively. Thus although calcium intakes appear to be adequate, magnesium intakes are well below the recommended level. The extra 50 mg. per day supplied by the drinking water in Guelph is therefore a substantial and possible critical addition to total intake.

Among the other (trace) elements usually found in hard water, lithium and chromium have also been suggested as possibly beneficial factors responsible for the water effect. However the actual concentration of these (and other) trace elements is so low as to be negligible in comparison with dietary intake, and it is therefore very difficult to believe that they can be responsible for the geographic patterns that are observed.

Although hard water may be beneficial, the opposite is also true, namely that soft water could be harmful. Since soft water is (by definition) lacking in minerals, the only way in which it could acquire toxic substances is through corrosion of pipes in the distribution system. This does in fact happen in many situations, because soft water is often corrosive, and some of the elements commonly picked up in this way (depending on the nature of the pipes) are copper, zinc, iron, lead, and cadmium. The last two have been particularly suspect as the elements responsible for the increased death rates seen in soft water areas and, although there is as yet no convincing evidence to support this view, it must be recognized that it is a very real possibility in some parts of the world. Thus although in Ontario we have seen little evidence of this mechanism being important, it is possible that in Great Britain, where there are still many lead pipes in distribution systems, sub-clinical lead poisoning may be a relatively common occurrence.

It should also be noted that an increased intake of lead and cadmium in soft water areas could be due to more than one mechanism. First, soft water is usually more corrosive than hard water due in part to its lack of minerals but also to the generally lower pH and other factors. Secondly, hard water tends to form a scale inside pipes which slows down the rate of corrosion. Third, it has been shown in experimental animals that additional calcium and magnesium in the water supply inhibits the absorption of heavy metals such as lead and cadmium that are present in either the water or the food supply.

One of the reasons for suspecting that the Ontario experience is *not* related to either cadmium or lead is the fact that there is no geographical pattern for stroke in Ontario.³ Since lead and cadmium usually exert their toxic effects through renal/hypertension mechanisms, and since hypertension is an even stronger risk factor for stroke than for heart

attack, one would expect to see the correlations between stroke and water hardness to be at least as strong as for IHD. This is indeed the case in Britain and in some parts of the United States, but in Ontario there is no sign of any relationship between water hardness and stroke mortality.

Returning to the possible influence of the bulk elements, calcium and magnesium, in addition to the reasons outlined above, we suspected that magnesium might be the substance responsible for the pattern seen in Ontario because of its known relationship to myocardial function — in particular the maintenance of a normal cardiac rhythm. In recent years there have been increasing numbers of reports in both animal and human studies that a deficiency of magnesium predisposes to ventricular arrhythmias, including ventricular fibrillation. Furthermore, it has been known for some years that in persons dying of heart attack, the myocardial magnesium tended to be low, although it has never been established whether this was cause or effect.⁶

METHODOLOGY AND RESULTS

We have therefore carried out two studies in which magnesium and calcium levels have been compared in residents of hard and soft waters of Ontario, to determine whether body concentrations of these elements reflected the differences in water-borne supplies.

The first study compared serum concentrations, and skeletal mineralization (as measured by the cortical thickness of the second metacarpal).⁵ The results of this study were disappointing, because no difference in either serum levels or skeletal mineralization could be shown between the two areas (Figure 3).

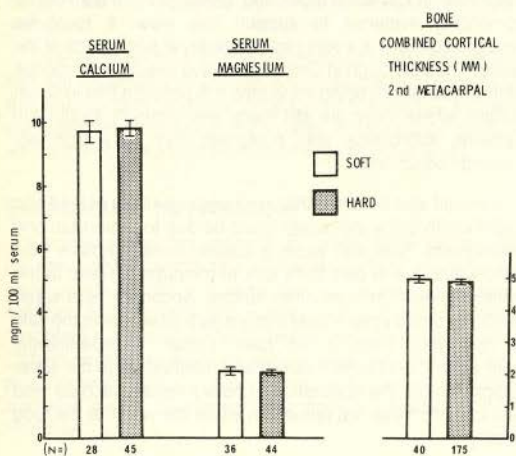


FIGURE 3

Serum levels of calcium and magnesium were found to be virtually identical in hard and soft-water residents. Measurements of bone mineralisation also showed no evidence of an inadequate mineral supply in the soft-water area.

We were somewhat more optimistic about the second study, in which myocardial concentrations were to be compared, since magnesium is primarily an intracellular rather than extracellular ion. This tissue study involved autopsy samples of myocardium and other muscle from several hard water and soft water cities in Ontario.⁷

With the cooperation of local pathologists, small samples of muscle were obtained from persons dying in five hard water and in three soft water cities. All samples were kept frozen and brought for analysis to a central laboratory in Ottawa, under the direction of Dr. L. C. Neri and his colleagues. In addition to samples of myocardium, samples were also obtained from the diaphragm (as another continuously active muscle) and the pectoralis major (as an example of a skeletal muscle). All of these samples were obtained from specified locations so that geographical variation should not be confounded by variation within the muscle itself. Only the myocardial samples showed significant regional variation, and these results are summarised in Table I.

TABLE I

		Myocardial Magnesium mg./g. dry weight		Soft/Hard (%)
		Soft	Hard	
Total		918 (54)	982 (29)	93
Age:	40	926 (30)	999 (16)	93
	40+	909 (24)	962 (13)	94
Sex:	Male	924 (46)	992 (24)	93
	Female	887 (8)	934 (5)	95
History of alcohol abuse:	Yes	913 (25)	986 (14)	93
	No.	923 (29)	979 (15)	94
Cause of death:	Accident	928 (42)	983 (22)	94
	Suicide	883 (12)	982 (7)	90
Mechanism:	Trauma	921 (49)	980 (24)	94
	Chemical	890 (5)	992 (5)	90

Mean myocardial magnesium in cases of accidental death and suicide in soft and hard water areas of Ontario, subdivided by various characteristics. The numbers of cases on which means were based are given in *italics*, and the ratio soft/hard is expressed as a percentage in the final column.

Note: based on a table originally appearing in reference no. 7.

Myocardial magnesium was approximately 7% lower in residents of the soft water cities, and the difference persisted when cases were sub-divided according to age, sex, nature of death, etc. Furthermore, the median values for the soft water cities were all below the median values of all the hard water cities (Table II). (Median is more appropriate than mean, because of the small number of samples from some cities and the considerable scatter of some of the values). It is unlikely therefore that these results were due to chance, but in view of the potential importance of these findings, the study is now being repeated.

TABLE II

	N	Median	Mean (SD)	Range
SOFT				
PA	20	947	947(108)	701-1139
NB	3	946	966(69)	909-1042
PM	17	891	864(120)	533-1019
SM	11	913	930(86)	809-1064
SD	3	912	944(67)	900-1021
TOTAL	54	927	918(108)	533-1139
HARD				
BR	5	972	960(77)	832-1033
GU	3	1018	1011(25)	983-1018
ST	21	987	984(144)	613-1205
Total	29	987	982(126)	613-1205

Median, mean (and standard deviation), and range of myocardial magnesium (mcg. per g. dry weight) in accidental deaths and suicides, in 5 soft-water and 3 hard-water cities. Number of cases in each city = N.

DISCUSSION

If the current study confirms that the myocardial magnesium of residents of soft water areas of Ontario is lower than that of comparable residents of hard water areas, there would be important implications. First, it would suggest that the average North American diet is deficient in magnesium, and that steps should therefore be taken to increase the availability of this important element. Indeed, although the difference has shown up in comparisons between soft and hard water areas, it is theoretically possible that even in the hard water areas people are ingesting less than an ideal amount of magnesium, and that the potential benefit of supplementing the diet is present in both areas.

Secondly, a strong case could be made for giving supplementary magnesium to all persons at high risk of heart attack. This should first be explored by means of a randomized trial, and at present we are discussing ways of carrying out such a trial on a large enough scale to produce meaningful results reasonably quickly.

CONCLUSION

The intriguing and at times frustrating story of the relationship between drinking water and heart disease may at least be partly resolved. Although other mechanisms may be responsible for the gradients seen in other parts of the world, in Ontario there seems now to be a reasonably strong case for believing that the higher death rates in soft water areas of the province are related to a marginally inadequate dietary intake of magnesium. According to this view, the extra magnesium provided by the water supply in hard water areas of the province is enough to make a measurable difference to the prevalence of a marginal deficiency, and to affect the tendency to ventricular arrhythmias leading to sudden death.

Whether we will ever see magnesium being added to water supplies in the same way that fluoride is added to water in some communities is an open question, since it could well be more economical (and less controversial?) to add it to a particular food, in the same way that we now add iodine to salt. □

References

1. **Anderson TW, Le Riche WH, MacKay JS:** Sudden death and ischemic heart disease: correlation with hardness of local water supply. *N Eng J Med* **280**: 805-807, 1969
2. **Anderson TW, Le Riche WH:** Sudden death from ischemic heart disease in Ontario and its correlation with water hardness and other factors. *Can Med Assoc J* **105**: 155-160, 1971
3. **Anderson TW, Halliday ML:** Ontario death-rates and composition of local water supplies (in preparation)
4. **Dauncey MJ, Widdowson EM:** Urinary excretion of calcium, magnesium, sodium and potassium in hard and soft water areas. *Lancet* **i**: 711-715, 1972
5. **Anderson TW:** Serum electrolytes and skeletal mineralization in hard and soft water areas. *Can Med Assoc J* **107**: 34-37, 1972
6. **Seelig MS, Heggveit HA:** Magnesium interrelationships in ischemic heart disease: a review. *Am J clin Nutr* **27**: 59-79, 1974
7. **Anderson TW, Neri LC, Schreiber GB, Talbot FDF, Zdrojewski A:** Ischemic heart disease, water hardness and myocardial magnesium. *Can Med Assoc J* **113**: 199-203, 1975

- WILLS
- RETIREMENT SAVINGS
- R.H.O.S.P.
- INVESTMENTS
- MORTGAGES
- INCOME AVERAGING ANNUITIES

*Discuss these subjects with
Canada's leading Trust Company*

Royal Trust 

1648 Hollis St. 429-2700

Bayer's Road Shopping Centre 453-1700

The Nature and Assessment of Cardiorespiratory Fitness

Arend Bonen,* M.S., Ph.D.,

Halifax, N.S.

The role of exercise in the prevention and/or onset of cardiovascular diseases is not yet clear. However, there is evidence that exercise can reverse experimental atherosclerosis¹, and in man moderate physical activity can produce significant improvements in cardiovascular fitness at almost any age^{2,3} (Table I). Thus, the role of exercise prescription and cardio-respiratory fitness assessment are becoming more and more important. I will therefore review briefly the nature of cardiorespiratory fitness and provide a few simple guidelines for the evaluation and administration of cardiorespiratory fitness tests.

TABLE I
MECHANISMS BY WHICH PHYSICAL ACTIVITY
MAY REDUCE THE OCCURRENCE OR SEVERITY
OF CORONARY HEART DISEASE (FROM (4))

EXERCISE MAY	
INCREASE	DECREASE
Coronary collateral vascularization	Serum levels of triglycerides, cholesterol
Vessel size	Glucose intolerance
Myocardial efficiency	Obesity — adiposity
Efficiency of peripheral blood distribution and return	Platelet stickiness
Electron transport capacity	Arterial blood pressure
Fibrinolytic capability	Heart rate
Arterial oxygen content	Vulnerability to dysrhythmias
Red blood cell mass and blood volume	Neurohormonal overreaction
Thyroid function	Strain associated with psychic "stress"
Growth hormone production	
Tolerance to stress	
Prudent living habits	
Joie de vivre	

Cardiorespiratory fitness is commonly expressed in terms of maximal oxygen consumption, since this measure is dependent on the product of heart rate \times cardiac stroke volume \times arterio-venous oxygen difference. Assessment of cardiorespiratory fitness can only occur by measuring oxygen consumption during exercise to voluntary fatigue, on a bicycle ergometer or a treadmill. By definition, when the oxygen consumption does not increase with a corresponding increase in workload, then maximal oxygen consumption has been attained. Alternatively, the means are now available to approximate maximal oxygen consumption from submaximal exercise tests (see below). Such procedures are obviously preferable for older or unfit individuals, and/or for non-laboratory settings (e.g. physician's office, YMCA, schools).

Maximal oxygen consumption capacities can vary widely depending on the individual's sex, age and activity pattern

(Table II). In general the maximal aerobic capacity of women is lower than men, but this is not true when physically active women are compared to inactive men, or when younger women are compared to older men. In marathon runners, maximal oxygen consumption values of 75-80 ml/kg-min are not unusual, whereas in a sedentary overweight individual of the same age a value of 30 ml/kg-min may be found.

TABLE II
AMERICAN HEART ASSOCIATION CARDIORESPIRATORY
FITNESS CLASSIFICATIONS FOR MEN AND WOMEN (7)

WOMEN					
Maximal Oxygen Uptake (ml/kg/min)					
Age (yrs.)	Low	Fair	Average	Good	High
20-29	24	24-30	31-37	38-48	49+
30-39	20	20-27	28-33	34-44	45+
40-49	17	17-23	24-30	31-41	42+
50-59	15	15-20	21-27	28-37	38+
60-69	13	13-17	18-23	24-34	35+
MEN					
Maximal Oxygen Uptake (ml/kg/min)					
Age (yrs.)	Low	Fair	Average	Good	High
20-29	25	25-33	34-42	43-52	53+
30-39	23	23-30	31-38	39-48	49+
40-49	20	20-26	27-35	36-44	45+
50-59	18	18-24	25-33	34-42	43+
60-69	16	16-22	23-30	31-40	41+

Longitudinal studies have shown that maximal oxygen consumption decreased at the rate of approximately 0.65 ml/kg-min annually in moderately active individuals (approximately 3 miles jogging per week), and twice as fast (1.10 ml/kg-min/year) in sedentary individuals (Figure 1). Cardiorespiratory fitness levels did not decline during a 10 year period in 40-50 year old men who jogged 3-5 miles, 2-3 times per week over a 10 year period. Distance runners who were very fit in their early twenties will lose cardio-respiratory fitness at about the same rate as inactive subjects (Figure 1). Obviously the highly trained runners will be more fit than their untrained counterparts at almost any age since the initial fitness levels were quite different (Figure 1).

Approximately 10 years ago Saltin *et al*⁶ provided direct evidence that cardiorespiratory fitness was quite variable. Fitness was rapidly lost during a 21 day complete bed rest period, but during the ensuing 55 day conditioning program, fitness was restored and exceeded the pre-experimental fitness levels (Table III). A number of studies with physically unfit, middleage males have shown that cardio-respiratory fitness can be improved with regular exercise programs (Figure 1).

*Associate Professor, School of Physical Education and Supervisor, Human Performance Research Laboratory, Dalhousie University, Halifax, N.S.

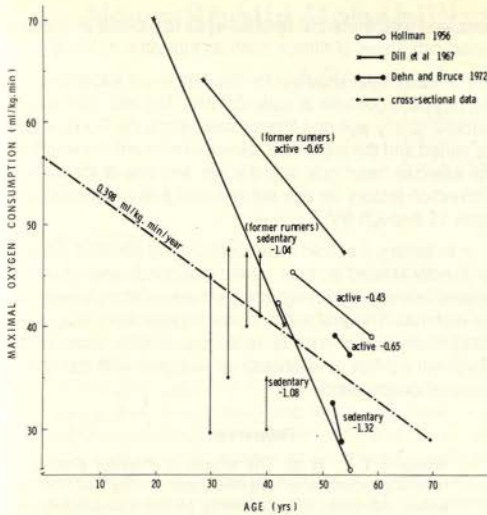


FIGURE 1

Changes in cardiorespiratory fitness (maximal oxygen intake) with age and exercise. Solid lines denote longitudinal data from active and inactive subjects. The hatched line represents cross sectional data and the arrows represent changes in fitness induced by 8-20 week exercise programs (Figure adapted from ref 2 and 3).

Questions of considerable interest are how hard, how long and how frequently someone should exercise before improvements in cardiovascular fitness become evident. Detailed guidelines for these concerns have recently been published^{5,7}. In general, exercise studies with middle-aged males have shown that improvements in cardiorespiratory fitness (i.e. maximal oxygen consumption) occur only when exercise sessions consist of 20-30 min of continuous, rhythmic activities (e.g. jogging, walking, cycling, etc.) which are repeated 2-3 times per week. The key to these activities is the heart rate, since without sufficient intensity little or no demonstrable benefits are derived (Table IV). Generally, for young men (20-30 yrs) heart rates in excess of 135-140

b/min are required for the duration of the above exercise programs. For older males a heart rate of 125 b/min or more must be sustained. It is desirable to let the subject monitor his pulse rate periodically throughout exercise and thus readjust the exercise intensity to a prescribed pulse rate.

TABLE IV
ACTIVITIES AND GAMES TO IMPROVE
CIRCULATORY FITNESS

Beneficial	Limited Benefit
Swimming	Weightlifting
Cycling	Driving car, scooter, motorcycles, etc.
Skating	Volleyball
Skating	Football
Jogging	Hiking
Hiking	Walking (briskly)
Walking (briskly)	Basketball
Basketball	Squash
Squash	Paddleball
Paddleball	Soccer
Soccer	Hockey
Hockey	Water Polo
Water Polo	Broomball
Broomball	

CARDIORESPIRATORY FITNESS ESTIMATIONS

It is difficult to assess cardiorespiratory fitness in the absence of direct oxygen consumption measurements. A variety of prediction tests are available to estimate maximal oxygen intake, but unfortunately the most popular of these are either unsafe or cannot predict maximal oxygen consumption very accurately. I have recently evaluated several well known fitness tests⁸.

Briefly, the Harvard Step Test (i.e. 5 min step test up an 18" bench) and the Cooper 12 minute run (i.e. distance that can be run in 12 minutes) are not recommended. The results are usually inaccurate since the tests are susceptible to individual motivation, are not adjustable for various age and/or fitness levels, and are unsafe or even dangerous for middle-aged, unfit individuals. In contrast, motivation is eliminated with the Astrand-Ryhmung bicycle test, since the exercise loads are submaximal and can be adjusted for age and/or

TABLE III
CARDIO-RESPIRATORY RESPONSES AT REST AND DURING
SUBMAXIMAL EXERCISE (600 KPM/MIN) AND MAXIMAL EXERCISE
BEFORE AND AFTER 21 DAYS BED REST AND AFTER 55 DAYS OF TRAINING
(DATA SUMMARIZED FROM SALTIN ET AL. (6))

Variable	REST (supine)			SUBMAXIMAL EXERCISE			MAXIMAL EXERCISE		
	Control	After 21 days bed rest	After 55 days training	Control	After 21 days bed rest	After 55 days training	Control	After 21 days bed rest	After 55 days training
O ₂ consumption L/MIN	—	—	—	1.52	1.49	1.64	43.0	31.8	51.5
Heart rate b/min	63	68	50.8	129	154	120	193	197	191
Stroke volume ml/b	103	86	93	116	88	113	104	74	120
Cardiac Output A-VO ₂ diff. (ml O ₂ /100 ml blood)	6.4	5.8	4.7	14.4	12.4	13.2	20.0	14.8	22.8
	4.2	4.6	6.6	—	—	—	16.2	16.5	17.1

fitness levels. It is therefore quite safe for most individuals as long as the exercise workloads are set to maintain heart rates at about 130-140 b/min.

The most recent fitness test, the Canadian Home Fitness Test (CHFT), does not provide a good index of cardiorespiratory fitness. The test consists of three minute stepping bouts up a double 8 inch step at a prescribed stepping rate which may be adjusted for sex and age. At the end of 3 minutes of stepping the pulse is palpated for 10 seconds and exercise is terminated or continued depending on the heart rate responses. Fitness classifications (i.e. undesirable, minimum, recommended) are then determined from the post-exercise heart responses. Studies in our laboratory indicate that the CHFT cannot differentiate subjects with minimum (44.4 ± 3.6 ml/kg.min) and recommended (46.6 ± 4.3 ml/kg. min) fitness levels on the basis of maximal oxygen consumption. Quite simply, the variations in the stepping rates (approx. $\pm 10\%$) and the errors associated with palpating the heart rate (± 10 b/min) are sufficient to negate the CHFT fitness classifications.

No doubt other fitness tests will be made available in the near future. The criteria for evaluating the validity of these tests are useful for both the paractitioner and the fitness leader. These criteria are:

- i) the test must be adjustable to accommodate the workload for differences in age, sex and fitness levels of the subject, or else the test must quite clearly define the population for which it is intended (i.e. sex, age, habitual physical activity).
- ii) the test should always be submaximal, involving large muscle groups (i.e. legs preferably).
- iii) the test should involve the measurement of at least the heart rate, and may include other factors (age, weight, blood pressure, etc.)
- iv) the results must be reliable and correlate well with maximal oxygen consumption. If these two criteria are not met, i-iii are of little consequence, since the test is probably not a valid measure of cardiorespiratory fitness.

The criteria listed above are quite rigorous and only the Astrand-Ryhming test most clearly approximates the model. The Astrand-Ryhming, submaximal bicycle ergometer test⁹ for predicting cardio-respiratory fitness, consists of riding a bicycle ergometer at a pedal rate of 50 rpm (cadence is set by a metronome) and adjusting the tension on a belt around the flywheel. The workload remains constant for the first 6 minutes and heart rates are taken during the last 10 seconds of each minute either by EKG or by palpating the pulse at the wrist or carotid artery. Exercise is continued until a steady state is attained (i.e. heart rates in two consecutive minutes differing by less than 5 beats/min) — usually for 5 to 6 minutes. If the steady state heart rate after 6 minutes is below 120 b/min, the load should be increased and the test continued until a steady state heart rate in excess of 120 b/min is obtained. Maximal oxygen consumption is then predicted from a nomogram.

Unfortunately, the accuracy of the Astrand-Ryhming test is not the best. The data were based on an athletic population and an error of $\pm 10\%$ for the prediction is not uncommon. Other investigations dealing with untrained populations have reported that the true max-VO₂ is underestimated by as much as 17-25%. The test, however, does discriminate well enough between people of poor, average and excellent fit-

ness and may therefore only be used to provide an index of broad categories of fitness such as indicated in Table I.

The equipment required for this test is not expensive and the bicycle ergometer is quite durable. The test itself is quite suitable to any age and fitness level, since the workload can be varied and the prediction takes into account the workload, the exercise heart rate, and the sex and age of the subject. Correction factors for age are required and are available for ages 15 through 65⁹.

In summary, it should be recognized that physical inactivity is directly related to poor cardiovascular fitness. Yet, with appropriate exercise programs cardiorespiratory fitness may be restored. The estimation of cardiorespiratory fitness (i.e. Astrand-Ryhming test) is relatively simple, even in the physician's office, and should be included with the normal physical examination. □

References

1. **Wong H Y C, et al:** The effects of physical exercise in reversing experimental atherosclerosis. In: Diet and atherosclerosis. Advances in Experimental Medicine and Biology. ed. by C. Sirtori, G. Ricci and S. Gorini. New York, Plenum Press, 1975, pp. 33-55.
2. **Pollock M L, et al:** Effects of frequency of training on working capacity, cardiovascular function and body composition of young men. *Med. Sci. Sports.* 1:70-74, 1969.
3. **Dehn M M and Bruce R A:** Longitudinal variations in maximal oxygen intake with age and activity. *J. Appl. Physiol.* 33:805-807, 1972.
4. **Fox S M, Boyer J L:** Physical Fitness Research Digest. 2:(4) 1-14, 1972.
5. **Exercise Testing and Training of Apparently Health Individuals:** A handbook for physicians. American Heart Association Committee on Exercise. New York, American Heart Association, 1972.
6. **Saltin B et al:** Response to exercise after bed rest and after training. *Circulation* 38, Suppl. 7, 1968.
7. **American College of Sports Medicine:** Guidelines for Graded Exercise Testing and Exercise Prescription. Philadelphia, Lea and Febiger, 1975.
8. **Bonen A:** An evaluation of three fitness tests. *Can. J. Publ. Health.* 66:288-290, 1975.
9. **Astrand P O. and Rodahl K:** Textbook of Work Physiology, Toronto, McGraw-Hill, 1970. pp. 355-357
10. **Rowell L B, et al:** Limitations to prediction of maximal oxygen intake. *J. Appl. Physiol.* 19:919-927, 1964.

Medical Estate Planning Services

Donald R. Cox

Suite 1110
Duke Street Tower
Scotia Square

Phone: 422-6314

Estate Planning Directed to the Medical Profession

Nova Scotia Rehabilitation Centre Amputee Clinic

A Review of Lower Limb Amputees

D. D. Murray,* M.D., F.R.C.P.(C),
A. H. Shears,** M.D., F.R.C.P.(C), and
J. L. Schnaffner,† B.Sc. (P.T.),

Halifax, N.S.

INTRODUCTION

In response to a prevailing, if unwritten, opinion that amputees over 60 years of age do not make significant use of prescribed lower limb prostheses, the Nova Scotia Rehabilitation Centre (N.S.R.C.) decided to review their experience concerning this question. An additional catalyst for this study was the changing pattern of prosthetic funding, which has developed a bias toward supplying those individuals who have some vocational goals or potential. The N.S.R.C. felt that if the statistics accumulated could indicate significant use of prostheses in the older age amputee, then this would lend strength to their philosophy that age and vocational potential should not be prime criteria in deciding who could be fitted with a prosthesis, when an individual's capacity to fund the prosthesis is limited.

CLINIC FORMAT

The Nova Scotia Rehabilitation Centre Amputee Clinic operates as an Outpatient referral service. The format is one of a total approach to the patient's problem, they are initially seen by the attending staff physician for medical evaluation. Details of general health, level of activity, endurance, as well as motivation, are noted. In addition, the physiotherapist charts the muscle strength, range of motion and specific stump measurements for each patient.

If on completion of the assessment the patient is a good candidate, a prescription for the prosthesis is drawn up and any foreseeable prosthetic problems are discussed with the attending prosthetist. Social Service attends to financial arrangements for the prosthetic funding, as well as board or other particulars.

The Centre has developed a routine of using two successive custom-fitted plastic laminated sockets. The first is for primary shrinkage and is fitted to a temporary leg. The patient is then gait trained and discharged during the time necessary for stump shrinkage. Stump stocks are added as the socket becomes progressively loose in its fit. A new socket is constructed for the definitive prosthesis. This method is favoured over the adjustable socket because of better stump shrinkage and shaping, as well as greater patient comfort.

REVIEW SERIES

Since its beginning, there have been approximately 800 new patients seen at the Nova Scotia Rehabilitation Centre Amputee Clinic, with a yearly average of 55 new patients.

*Associate Physician, Nova Scotia Rehabilitation Centre and Assistant Professor, Department of Medicine, Dalhousie University, Halifax, N.S.

**Medical Director, Nova Scotia Rehabilitation Centre and Associate Professor, Dalhousie University.

†Supervisor, Physiotherapy Department, Nova Scotia Rehabilitation Centre.

For the purposes of our review, a nine year period from September 1966 to December 1975 was selected to review the results of patient management of 526 charts were reviewed, 108 patients were unsuitable prosthetic candidates on the basis of poor health and 13 of these patients also had bilateral amputations. Thus 20% of new admissions were felt to be medically unsuitable for prostheses and were excluded. An additional 22 patients were excluded because they had a partial foot amputation and did not require a prosthesis leaving 396 cases for this review series.

The accepted definition of a successful candidate is one who has worn the prosthesis for the purpose of ambulation for at least one year, with or without an ambulatory aid. Those who wear the leg for cosmetic reasons and use a wheelchair were not considered successful.

A questionnaire, to determine the use of the limb for daily ambulation, was sent to those patients who were initially seen in the years 1966 to 1969. The risks and bias of this data retrieval method will be commented upon. Those patients seen from 1970 to 1975 were sufficiently familiar to the authors so that only an occasional recheck appointment was necessary to update their current status.

RESULTS

The results of our series are presented and compared with other reviews under several headings:

Number in Series

Our series contained 396 patients. This compares well with Hanf¹ (124 patients), Kerstein² (194 patients), Olejniczak³ (354 patients). The large series of Glatley⁴ (12,000 patients), and more recently Kay and Newman⁵ (6,000 patients) were from combined studies involving most prosthetic centres in the United States.

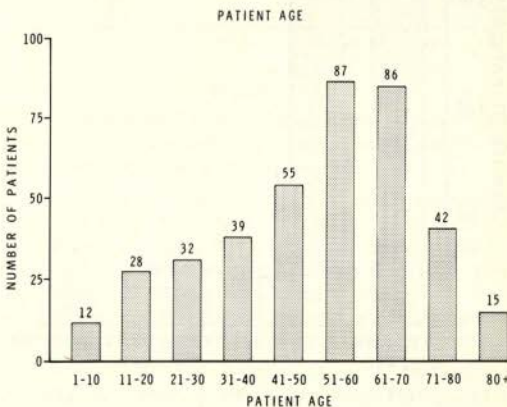


FIGURE 1

Age

In our review, the average age was 55.8 years, and paediatric patients made up less than 10% of our series. (Figure 1) This is comparable to the average in Kerstein's series of 56.8 years⁶ and Olejniczak's series of 65 years.³ Our male-female ration was 2.8 to 1, whereas in the large series of Glatley,⁴ and Kay and Newman,⁵ the ratio was approximately 3 to 1.

Site of Amputation

In our series, above knee amputees were the largest group (47%); below knee amputees comprised 40% of our patients. Bilateral amputees, Symes amputees, hip disarticulations and hemipelvectomies formed a minor percentage of patients. (Figure 2)

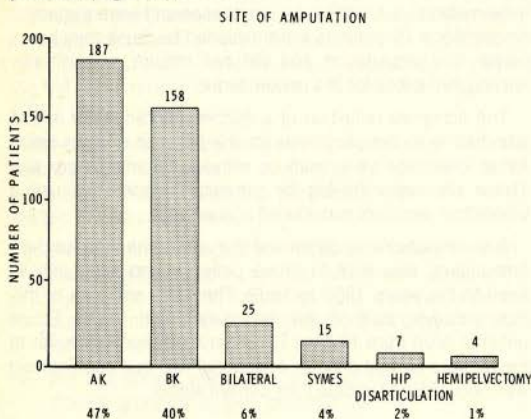


FIGURE 2

The numbers of A/K and B/K amputations were about equal in the young and middle age groups, but in the older age group, the A/K amputation site was more common than the B/K site. (Figure 3)

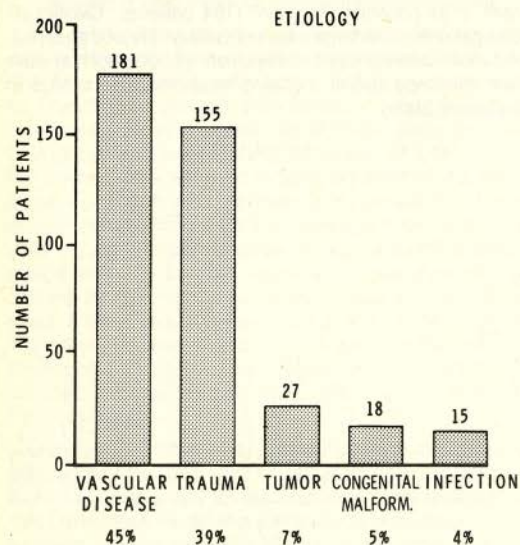


FIGURE 3

In the literature review, the series from the 1960's tended to have a higher proportion of A/K amputations. Glatley had 44% A/K and 37% B/K;⁴ Olejniczak had 73% A/K and 27% B/K.³ The more recent figures of Kay, *et al.*⁵ give figures of 32% A/K and 58% B/K. Kerstein's B/K population was greater than 60%.² Hanf¹ felt that the amputee who had vascular complications and diabetes had an odds-on chance of a good result with a primary B/K amputation.

In our series, bilateral amputees made up 6% of the number for a total of 25. A/K bilateral amputees formed about half the group (14) and bilateral B/K amputees (6) and A/K — B/K amputees (5) made up the rest. In Olejniczak's series of 354,³ he had 32 double amputees and in Hanf's series of 124 he had 7.¹ In Kerstein's series of 194 patients he had 44 double amputees and he suggested in reviewing several other series that up to 25% of all amputees will have bilateral amputations.²

Etiology

In our series, vascular disease was the commonest etiology (45%) followed fairly closely by trauma (39%). Tumor, congenital malformations and infections formed minor numbers. (Figure 4)

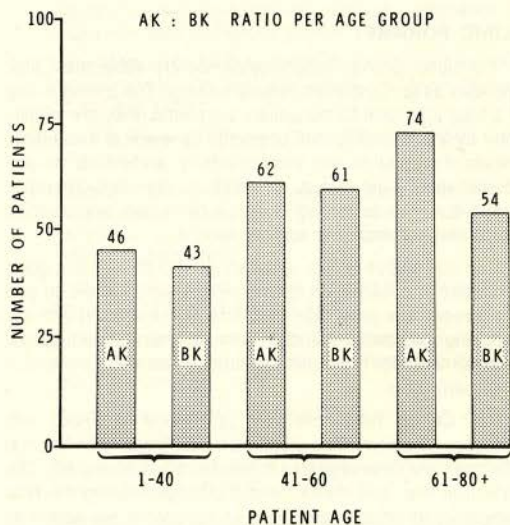


FIGURE 4

Glatley's series found 58% of amputations due to disease related causes,⁴ and the updated series of Kay, *et al.* found 70% disease related.⁵ Their figures for traumatic etiology were 33% and 22% respectively. In Olejniczak's series 83% had a vascular etiology and 31% traumatic etiology.³ Kerstein's series had a vascular etiology of 85%.

In our series, trauma was the commonest cause of amputation in the younger age group with vascular disease the usual cause for amputation in the older age group. (Figure 5)

Glatley also found trauma to be the highest etiological factor in the 41 to 50 age group.⁴ Kay, however, found the highest incidence of trauma in the 21 to 30 age group.⁵

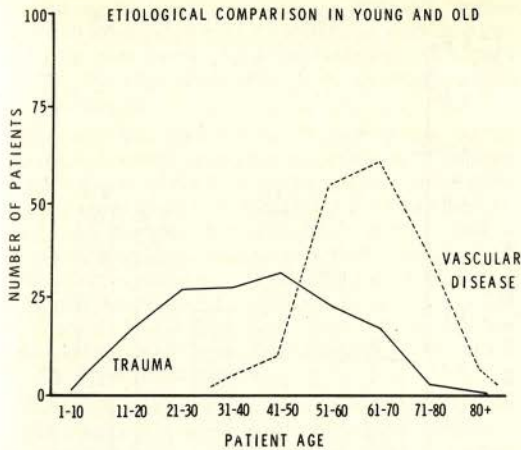


FIGURE 5

SUCCESS RATE

In computing the results of the series, special attention was directed to the patients over 60 years of age. In this older age group of 143 patients, 125 were successful prosthetic wearers, giving a success rate of 86% of those fitted in this particular group.

Of the 25 bilateral amputees fitted with prostheses, 22 were successful for at least one year, giving an 88% success rate for the group of bilateral amputees.

In the complete series of 396 patients, 371 were successful candidates, giving an overall success rate of 94%.

Unsuccessful candidates were evaluated in three different age groups. In the 1 to 40 age group, 2 hip disarticulations and 1 hemipelvectomy were unsuccessful candidates. In the 41 to 60 age group, 2 above knee amputations, 1 hip disarticulation and 1 bilateral amputations were unsuccessful. In the 61 to 80+ age group, 14 above knee, 2 below knee and 2 bilateral amputees were unsuccessful.

The literature survey showed a large variation in success rates. In Hanf's series only 48% of his patients were able to use limbs, although the average age was 65.¹ Of his group 52% were refused limbs on medical grounds. In Olejniczak's series, he had a 13% overall success rate in a similar age group.³ However, Kerstein's series from the U.S. compares closely with ours at 70% success rate.² As regards bilateral amputee success rate, in Hanf's series he had over 50% success with his small number.¹

These series are difficult to compare because of selection and definition differences concerning the successful candidate.

TIME INTERVALS

It was of interest to examine time intervals necessary for the various stages of rehabilitation from the time of the original ablative surgery to the ultimate successful use of a prosthesis. This was done in order to try and pinpoint any delays which might be occurring during the rehabilitation.

The average time interval between surgery and referral to the Amputee Clinic was 3.1 months. Young patients tend to be referred earlier with the exception of those in the 21 to 30 age group, an unexpected finding, but perhaps influenced by

the fact that those patients often had multiple injuries. (Figure 6). The average time interval between the first clinic visit and the prosthetic fitting was 3.1 months. (Figure 7).

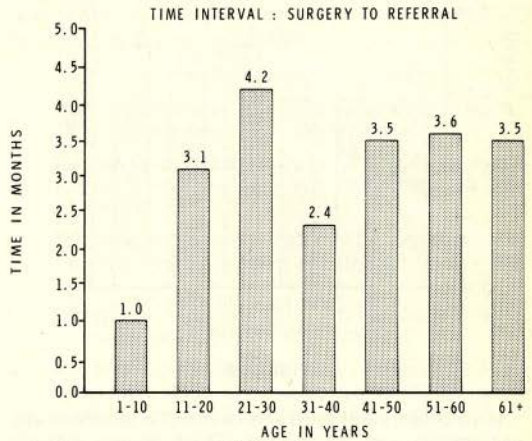


FIGURE 6

The 60+ year age group took the longest time for fitting and this was due to intercurrent health and stump problems in the elderly, and often diabetic, patient. It is of interest that the 21 to 30 year age group required the second longest period of time for prosthetic fitting, again, possibly due to complications secondary to multiple trauma.

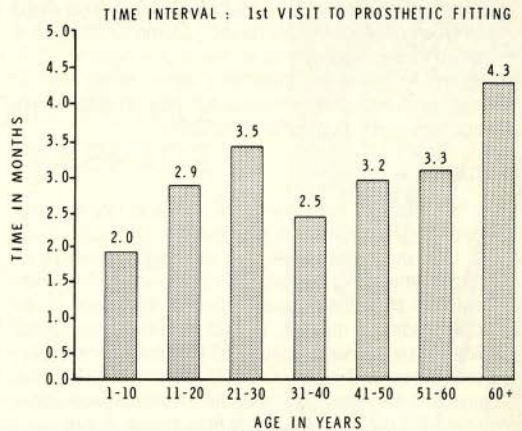


FIGURE 7

The average time interval between the receipt of the prosthesis and independent ambulation was .6 months, or approximately two weeks. (Figure 8)

This was difficult area from which to obtain satisfactory data because of the number of variables. It has been the experience of our Clinic that a young B/K amputee can be gait trained in a week or less and a young A/K amputee takes approximately two weeks for gait training. Our average times are about double this due to the usual stump and health problems one encounters in the overall amputee population.

Perhaps the most valuable figure is the average rehabilitation time, which is the time between the first visit to the Amputee Clinic and successful ambulation on a prosthesis. (Figure 9)

TIME INTERVAL : PROSTHETIC FITTING TO AMBULATION

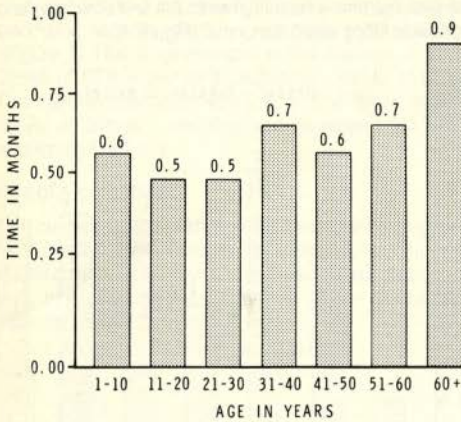


FIGURE 8

In our series, the average time for receipt of prosthesis and gait training was 3.7 months. These figures compare favourably with those recorded in the literature. In Hanf's series he makes the point that the quicker the patient is referred to the rehab program and gets his limb, the greater chance he or she has of becoming a Class A result.¹ His earliest referred group was within three months of amputation, but his average time for rehabilitation was somewhere between 3 and 6 months. Kerstein's series had a figure of 7 months from the time of amputation before successful rehabilitation on the limb took place.⁶ Stump problems and pulmonary disease accounted for many prolonged times. In his series, he refers to Chapman's series which had an average rehab time of 4½ months and Warren *et al.* whose average time was 6 months for rehabilitation.

DISCUSSION

On first analysis, the 94% overall success rate is rather overwhelming, as is the 86% success rate for the older age group. One would like to feel they accurately represent the results of a small clinic meticulously run. However, these high percentages of success could reflect a weakness in our Clinic assessment method, in that potentially successful candidates are missed because of an overly conservative selection process. The authors do not feel this to be the case because it is the responsibility of the attending physician to determine if a patient is medically fit to master the use of a prosthesis. A figure of 20% medically unsuitable candidates is reasonable in a series wherein the average age is 56 years.

Another partial explanation of the high success rate might be the questionnaire approach used to gather information from 1966 to 1970. Patients may have answered this with a bias, feeling that they wished to be "helpful" to the physician. They may have felt financially threatened by the questionnaire, feeling that they might be in some way jeopardized if they were not using the prosthesis. Possibly they were confused by the questionnaire, although all they had to do was indicate the length of time they used the leg for ambulation by the check-off method.

Our rehabilitation time of 3.7 months also appears to be acceptable, but could be further improved by quicker

AVERAGE REHABILITATION TIME

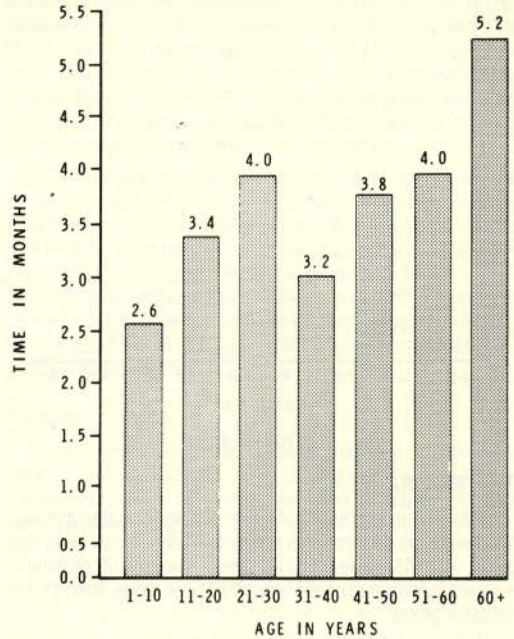


FIGURE 9

prosthetic supply. This is a regional problem based on a manpower shortage of prosthetists, coupled with shipping delays for components from the U.S. However, modular prosthetic parts are now being stocked locally and this should improve matters.

When calculated over the last five years, the average time to supply a B/K prosthesis was nearly identical with that for an A/K prosthesis. One hopes for a much improved delivery time using the modular components, with an almost immediate fit for the B/K amputee.

A word should be said regarding the increasing role of Social Service in our Amputee Clinic. Table I indicates a breakdown of social services given to amputees requiring assistance with regard to financing of new prostheses, funds for repairs and payment of board in Halifax while receiving gait training. One can see the steady upward trend in numbers of patients requiring this, and appreciate the increasing load borne by the Department of Rehabilitation and Social Services.

TABLE I

Year	No. Patients	Prosthesis	Repairs & Adaptations	Board
1967	15	13	—	4
1968	16	16	4	2
1969	37	36	10	12
1970	32	35	9	11
1971	40	36	17	18
1972	23	25	8	14
1973	25	25	14	7
1974	29	31	15	19
1975	38	39	21	23

Whatever the technical errors of our study, our success rates and rehabilitation times are acceptable when compared with other review series. Earlier post-surgical referral might shorten the total rehabilitation time, as would quicker prosthetic supply.

The point that patients over 60 years of age can be successful prosthetic candidates has been made. In Glatley's series, it was found that 30% of amputees were older than 65 years of age in a total of 29 states in the U.S.⁴ He makes the point and the plea that old age is not by itself a contraindication for prosthetic fitting. Hanf also makes the point that in his experience, motivation is the largest factor in determining success, and age per se, is not a single determinant.¹ The authors would agree with this and feel their good results are, in part, due to selection on the basis of medical fitness and motivation.

Funding for prostheses is becoming increasingly difficult where the patient is unable to bear the financial responsibility. The authors feel that the current thrust of funding, favouring only those patients who might have a vocational goal, is inappropriate.

Rural Nova Scotia is a difficult area to travel in a wheelchair. Outdoor "plumbing" with its limited access, upstairs bedrooms and unpaved roads are more easily negotiated on a prosthesis than in a wheelchair. True, they

could be managed on crutches, but in our experience, patients who can manage crutches usually can manage an artificial limb. Why not afford them the dignity and satisfaction provided by a prosthesis?

To deny an older citizen independent ambulation on the basis of cost effectiveness would appear to be a travesty of the philosophy of good medical care. □

References

1. **Hanf Liselotte C et al:** A Follow-up Survey of Predominantly Older Amputees, *Geriatrics* **21**, 166-173, 1966.
2. **Kerstein Morris D et al:** Amputations of the Lower Extremity; A Study of 194 Cases, *Archives of Physical Medicine and Rehabilitation*, **55** (10), 454-459, 1974.
3. **Olejniczak Stanley et al:** Summary of Leg Amputations and Prosthetic Replacement, *Michigan Medicine* **66**, 723-726, 1967.
4. **Glatly H W:** A Statistical Study of 12,000 New Amputees, *Southern Medical Journal* **57**: 1373-1378, 1974.
5. **Kay H W and Newman J D:** Relative Incidences of New Amputations; Statistical Comparisons of 6,000 New Amputees, *Orthotics and Prosthetics*, **29**, (2) 3-16, 1975.
6. **Kerstein Morris D et al:** What Influence Does Age Have on Rehabilitation of Amputees? *Geriatrics*, **30** (12), Page 67-71, 1975.

THERE ARE NEW PARAMETERS FOR DEPENDABILITY IN RADIO PAGING IN METRO — ULTRA HIGH FREQUENCY TELEPAGE

Radio paging is for dependable people, people ready to be counted on whether it's life or death, an industrial emergency or just a customer in need of re-assurance. Now, there's a radio paging system in Metro that's equally dependable.

Telepage, because it is an ultra high frequency system, gives you all these pluses: penetration of massive modern structures . . . coverage of the Metro circle . . . as far away as Bedford, Sackville or Burnside . . . choice of tone signals, light signal and voice transmission (no need to find a telephone before you start action on

the problem) . . . minimal interference because U.H.F. bands in Metro are uncrowded . . . a vest pocket, 5.1 oz. high quality receiver.

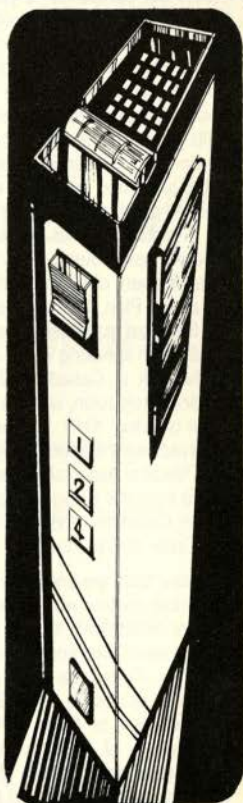
Telepage operates from the same offices as Telephone Answering Services and Cortell's dependable 24-hour answering service — the combination gives professionals the most effective communications service in Metro.

For a demonstration or more information about **Telepage's** unique capability, call: 422-1451 or 422-6427.

RUSS BAILEY ENTERPRISES LTD.



TELEPAGE



An Appreciation

DR. ARTHUR DILL KELLY

Arthur Kelly died — as he would have wished — still actively working for his medical friends and colleagues. Only a month before, he published in a November issue of the Canadian Medical Association Journal an account of his "Golden Years of Retirement". In his own inimitable way he outlined his daily routine, his travels, his interests, but perhaps most meaningfully, "the *modus operandi*" of the Kelly household sharing with Gladys the tasks there just as they had shared the task of directing the Canadian Medical Association for so many years. He expressed his happiness at having a desk provided for him at the Ontario Medical Association House and counselled on the importance of "a man having a place to go at 8:30 in the morning". I am sure the O.M.A. never got such good value as they did by having Arthur Kelly sit around the place, always ready to share his wisdom and give his support in the recurring crises of a medical association. At his desk he plunged into the activities of a medical elder statesman writing of past memories and his visions of the future, and giving encouragement and condolences to the people he had served so well through the years — the doctors of Canada, their wives and families, and above all their patients.

Art Kelly served for 12 years as the General Secretary of the Canadian Medical Association, after 10 years of apprenticeship under that master craftsman, T. C. Routley. He brought to this job a sound medical training, administrative skills developed during the war years when he rose to the post of Deputy Director of Medical Services for Canada and skills of diplomacy and tact, of courtesy and charm, backed by an encyclopedic knowledge of the ways of politics and politicians when they dealt with the medical profession. The finished product was a great secretary of the Canadian Medical Association (and we have had several). He was our greatest asset during the difficult years which led to the establishment of our present Hospital and Medical Services Insurance Plan. The fact that we have in this country probably the most successful system of medical care delivery in the English speaking world, a system giving high quality care to the sick of Canada and providing a moderately happy medical profession, is in no small measure the accomplishment of Arthur Kelly. For these and other achievements, he received many honors justly awarded — all that the Canadian Medical Association could bestow on him, honorary degrees from the University of Western Ontario, University of British Columbia, and from Dalhousie University, and finally the Order of Canada.

These facts are known to all, but there is a small group of Canadian doctors who have had the good fortune to have a special relationship to Arthur Kelly which resulted in a very special admiration and respect for his skills and a real love for the man. These are the past presidents of the Canadian Medical Association, who had the good fortune to serve during the years of Arthur Kelly's general secretaryship. The very nature of the Organisation resulted in almost daily intimate contact with him. My wife and I count as one of our greatest blessings that fact that Art's last year of office overlapped with our Presidential term. This was a year to test the



merit of a man — a year climaxed by the sudden and unexpected announcement by Prime Minister Lester B. Pearson that his government would immediately proceed with the introduction of the Universal Medical Service Insurance plan in this country. You may well believe the C.M.A. President was besieged by everyone — newspaper reporters, radio hot lines, TV commentators, and the general public — to discuss the issues in a way that would be honest and informative to the public and represent the views of Canadian medicine. We were mere amateurs, but Arthur Kelly was always there providing witty and intelligent comment and making the President believe that it was all his own — while Gladys did the same for that equally important person, the President's wife. These duties the Kellys gladly took on — but they went further and acted as counsellors, and psychotherapists for the presidential party in their moments of difficulty. They quickly knew of our concerns and sensitivities and were always at hand to change the subject or bring about a diversion when some eager reporter threatened to probe too deeply. Travelling across Canada with this intelligent and sophisticated couple, with these warm friends, was an experience which we fortunate ones will cherish the rest of our lives. And so we — the past presidents, the officers, the executive members, the members of council, and Arthur Kelly's friends, which includes the total membership of the C.M.A. in his day — do cherish his memory and say again he was a great secretary and a great man. The sick of Canada, as well as those that care for him, have it better because Arthur Kelly worked and lived with us. We all mourn his loss and say to Gladys, "Our deepest sympathy to you. We share your grief — we loved him, too." □

R.O.J.

Correspondence

To the Editor:

I was delighted to read M. Isobel MacLeod's comments on my report on "Hyperalimantation in a Regional Hospital", August 1976 edition of *The Nova Scotia Medical Bulletin*. I was particularly pleased to see her distinguish between teaching hospitals in Halifax and regional hospitals.

Hyperalimantation, or more correctly, Parenteral Nutrition is a method for successfully helping a patient suffering from starvation. In all our hospitals there are patients showing some degree of starvation requiring nutritional support. It is imperative that hospital staff in small or large, regional or teaching hospitals should be familiar with and capable of successfully offering Parenteral Nutrition to these patients.

The object of my report was to illustrate how a small regional hospital could accomplish this. We are aware that, unfortunately, Parenteral Nutrition is not offered in many hospitals. Among the reasons given for not accomplishing this exceptionally helpful and often lifesaving programme is the lack of facilities at these hospitals. This reflects the mystique shrouding hyperalimantation. Our statement "There are no major requirements for the preparation of hyperalimantation solutions" was directed towards dispelling this mystique and to encourage hospital staff to embark on a Parenteral Nutrition programme.

We are aware of the potential of nutrient solutions to become infected although we have not seen it in our hospitals. We welcome your correspondent's emphasis on the role of the pharmacist in Parenteral Nutrition programmes. Shortage of space precluded our listing warnings not to use Parenteral Nutrition Lines for anything other than administration of nutrients and electrolytes and other don'ts mentioned by M. I. MacLeod.

We feel Parenteral Nutrition is not more than enriched I.V. therapy which we have practised for years and requiring the same care and attention in prescribing, dispensing and administration. We accept new drugs and adopt new techniques and equipment and control procedures whenever possible. We would feel very disturbed if we could not prepare sterile solutions without a laminar flow hood.

After reading her excellent letter we have reviewed our procedures to try to identify possible weaknesses. We pay particular attention to technique and its application through all stages of the programme. Because technique is largely a product of learning and dedication rather than equipment we were encouraged by the understanding and application of our staff and their determination reinforced by success to continue Parenteral Nutrition with "no major requirements".

M. A. Naqvi, M.D., F.R.C.S.(D.) F.A.C.S.
Suite 407
Sydney Civic Centre,
Sydney N.S.,
B1P 1A7

□

OF SPECIAL INTEREST TO THE MEDICAL PROFESSION

The symbol  is a sign of service to many people involved directly and indirectly with the medical profession. [®]

We strive to provide the best possible service at the most reasonable rates.

Our **Telephone Answering Service** is especially designed for the medical profession-**ask us how?**

Our **Pocket Radio Paging Service** (Tone & Voice) is especially designed for the medical profession-**ask us how?**

Our **Mobile Radio Service** is **NOT** specially designed for the medical profession-**ask us why?**

We'd like to show how you can benefit by joining the many hundreds in the medical profession already using our services.

Call Rick Norman anytime.



ANSWERING SERVICE LIMITED

453-2640

Halifax

693-2601

Saint John

382-3348

Moncton

NEW SOCIETY SERVICE FOR MEMBERS

JAMES R. JONES, M.D.

Orthopedic Surgeon

1440 Swampside St.
Gottingen, N.S.

Phone 999-4230

For _____ Age (if under 16) _____

Address _____ Date _____ 19__

Label as to contents YES NO

Safety closure YES NO

No Repeat Repeat X at _____ intervals

Signature _____

Physician's License No. _____

This form endorsed by The Medical, Pharmaceutical and Dental Societies of Nova Scotia

For _____ Age (if under 16) _____

Address _____ Date _____ 19__

Label as to contents YES NO

Safety closure YES NO

No Repeat Repeat X at _____ intervals

Signature _____

Physician's License No. _____

This form endorsed by The Medical, Pharmaceutical and Dental Societies of Nova Scotia

NEW LOW COST PRESCRIPTION FORMS STAND BY YOU AND YOUR PATIENTS

Please allow not less than 28 days for delivery of order.

UNIFORM PRESCRIPTION FORMS have been endorsed by The Nova Scotia Medical Society and the Nova Scotia Pharmaceutical Society. These forms provide space for all pertinent information and include safety features which inhibit alteration and even counterfeiting.

AVAILABLE NOW to Society members and Nova Scotia hospitals, the forms will be custom printed to include the required individual, group or hospital name(s), address and phone number(s).

TO ORDER carefully fill in the blank form in the top right hand corner with the necessary information as per the accompanying sample copy. Your name, quantity ordered and billing address should go on the form in the bottom right hand corner.

NOTE — Actual prescription forms are printed black on yellow background.

***LOW COST FORMS** in pads of 100 each:
2,500 @ \$10.50 per thousand — \$26.25
5,000 @ \$ 8.77 per thousand — \$43.85
10,000 @ \$ 7.07 per thousand — \$70.70

*Prices include all taxes, shipping and associated charges

QUANTITY ORDERED

2,500 5,000 10,000
OVER 10,000 _____ forms. (Please
advise me of costs)

NAME

ADDRESS

PHONE

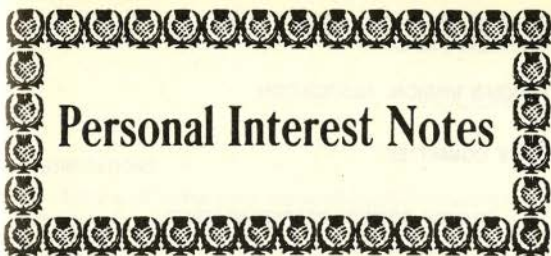
CHEQUE/MONEY ORDER ENCLOSED

PLEASE BILL ME

HAVE YOU FILLED IN THE BLANK FORM
CORRECTLY?

MAIL TO:

THE MEDICAL SOCIETY OF NOVA SCOTIA
SIR CHARLES TUPPER MEDICAL BUILDING, HALIFAX, N.S.



Personal Interest Notes

Dr. Harold W. Cook of the Faculty of Medicine, Dalhousie University has received \$18,000.+ grant from the Multiple Sclerosis Society to study fat metabolism in the brain and the deviations that occur in demyelinating diseases.

Professor D. M. Regan of the Department of Psychology has received \$36,000. from the Multiple Schlerosis Society to develop the diagnosis and study of the disease through the use of sensory tests. It is hoped that these tests could prove sensitive enough to give advanced notice of attacks and remissions in the course of multiple sclerosis.

The new formed Section of Otolaryngology of The Medical Society of Nova Scotia has appointed as officers — **Dr. K. E. Walling**, chairman; **Dr. M. N. Wali**, vice-chairman; and **Dr. G. M. Novotny**, secretary-treasurer.

Among the most recent successful candidates in the College of Family Physicians Certification examinations were **Drs. David H. Bars**, **Alexander J. Clark** and **Ian Slayter**, all graduates of Dalhousie Medical School in 1974. These three represent the latest of this group who are finishing their residency in the Division of Family Medicine, Dalhousie University. It is interesting to note that since this program was established in 1970, all residents who have written these examinations have passed.

Dr. Chester B. Stewart (B.Sc. '36, M.D.C.M. '38), Dean of Medicine at Dalhousie from 1954 to 1971 and Vice President, Health Sciences from 1971 - 1976 was appointed as special consultant to President Henry D. Hicks. He will examine in detail the costing of programs and the transfer of payments between and relating to the health science areas within the university.

During Dalhousie's Annual Refresher course, the class of 1971 managed to have a brief reunion. Class president, **Dr. Don Johnston** (Chatham, N.B.) and Secretary, **Dr. Vonda Hayes** (Amherst, N.S.) arranged a dinner which followed a reception hosted by the Dalhousie Alumni Association. □

NO SMOKING

Once again there is a tip-in which may easily be removed for use as a poster in your waiting room or office.

PHYSICIAN AVAILABLE

Family Physician Available from 1 May to 10 June for Halifax-Dartmouth or suburbs. 1971 Dalhousie Graduate, MDFP. Experience in hospital and office based practice, including obstetrics.

Please reply: Dr. R. Hutchings
P.O. Box 40
Labrador City
Newfoundland A2V 2K3
709-944-3888

or call:

When you're ready to set up practice, we're ready to help.

Bank of Montreal. We've been helping doctors and dentists longer than any other Canadian bank. We've got plans designed to meet your particular needs.

Operating funds, term loans and mortgages (business or personal). We can also arrange your car or equipment leasing.

We mean it when we say

Just look for the shingle.



The First Canadian Bank

Bank of Montreal



ADVERTISERS' INDEX

Air Page	71
Bank of Montreal	73
Gardiner Realty Ltd.	47
Isnor Motors Limited	57
Manufacturers Life Insurance Company, The	53
Manuage Galleries Limited	49
Maritime Telegraph and Telephone Co. Ltd.	I.F.C.
Medical Estate Planning Services	64
Medical Society Insurance Program	I.B.C.
Robins, A. H., Company of Canada Ltd	O.B.C.
Royal Trust	61
Russ Bailey Enterprises Ltd	69
Classified	53, 73