No. 15

THE CAMBRIDGE GLAUCOMA LETTER

published by THE CAMBRIDGE GLAUCOMA FOUNDATION, INC.

Angle Closure Glaucoma

1

The recognition of the mechanism of angle closure as a cause of intraocular tension elevation stands out as one of the great ophthalmological accomplishments in this century. The diagnosis of angle closure glaucoma, when correct, and its treatment, when successful, comprise one of the most satisfying professional experiences an ophthalmologist can have, for it provides an example of at least one disease process that is accessible to our understanding and amenable to our intervention. This, we say to ourselves, is a demonstration of the clarity with which ideally all disease should be understood, and the effectiveness with which all disease should be treated. But as soon as we state our claim thus confidently and flamboyantly, we realize that the problem is not so simple. Like other disease processes and their therapies, what we have come to refer to as the "textbook picture" of angle closure glaucoma is an idealization from which the actual case almost always differs in some small and sometimes not so small degree.

We begin by reviewing the pathophysiology of angle closure as it is usually described. The aqueous humor, we are taught, is secreted by the anterior processes of the ciliary body, flows through the zonules into the posterior chamber, negotiating its way between the posterior surface of the iris and the anterior surface of the lens until it passes through the pupil into the anterior chamber. Aqueous escapes from the eye through corneoscleral, and possibly in part also through the uveo-scleral meshwork in the anterior chamber angle. Mechanical occlusion of the angle, from whatever cause, may be associated with a gradual or sudden rise in the intraocular pressure.

As the aqueous humor flows on its path between the lens and the iris from the posterior to the anterior chamber, it encounters a flow resistance which may be sufficiently great to increase the posterior chamber pressure. Then, depending upon its elasticity, the iris will be pushed anteriorly by the pressure differential. If the anterior chamber angle is sufficiently narrow, this pressure-induced anterior displacement of the iris, associated sometimes with mechanical crowding at the periphery, may be sufficient to occlude the outflow channels and thereby to induce glaucoma.

The obstruction of aqueous flow from the posterior to the anterior chamber is called pupillary block, and pupillary block is clearly amenable to surgical relief by the simple expedient of making a hole in the iris, creating a shunt that by-passes the high resistance path through the pupil itself. This procedure was until recently performed in the operating room by surgical incision into the globe and excision of a triangular fragment of peripheral iris, the well-known peripheral iridectomy. It is now commonly accomplished with the argon laser by burning a small hole into the mid-periphery of the iris under topical anesthesia. That is how many cases of early angle closure glaucoma can readily be cured.

The relative ease and safety and effectiveness of this treatment for angle closure glaucoma has changed not only the prognosis that we attribute to the disease, but also the criteria by which we identify it. Consider, by way of contrast, diseases for which there is no therapy. For an untreatable disease, the making of a diagnosis becomes an end in itself. Various neurologic disorders come immediately to mind. Conversely, the more effective and the safer the available treatment, the less importance one is inclined to assign to a precise account of the pathological process. Our patients, in general, want very much to be treated. They have little understanding for the subtleties of diagnosis, and if they can be assured that the treatment works and doesn't hurt, they usually do not ask whether it is really necessary. Where therapy looms large, diagnosis is often neglected. There is logic in the argument that if therapy is effective and devoid of complications, the need for precise diagnosis diminishes. In terms of decision theory, the statistical costs of precise diagnosis may outweigh its benefits. An extreme example is the well established policy of immunizing entire populations without attempting in any way to determine the prior existence of immunity or the risk of exposure to the disease to be prevented. It is important to understand that there are diseases for which such indiscriminate therapy is appropriate. Whether or not angle closure glaucoma is one of them remains to be considered. The enthusiastic therapist, be he physician or surgeon, is likely to underestimate the true costs of treatment to the patient, and unless the cost-benefit analysis has been painstakingly thought through, the risk of indiscriminate treatment is almost always greater than the risk of neglect. That is why it seems worthwhile, in a future issue of the Glaucoma Letter, to review once again the prognosis for the patient with narrow angles, and to weigh as dispassionately as we are able the costs of prophylactic treatment against its benefits.

Ernst J. Meyer, M.D.

* * * * *

A Laboratory Computer System for Clinical Practice

1. An Historical Perspective

The invention of digital computing is comparable in some ways to the invention of printing from movable type. For thousands of years it must have been apparent that when the unbroken flow of spoken language is fragmented into words, a new dimension of conceptual meaning arises. The division of words into single letters, in turn, has made possible their dissemination beyond the spatial and temporal boundaries of uttered speech. But the ultimate exploitation of this reduction came with the invention of the printing press which installed the written instead of the spoken word as the paradigm of language. The principles of digital computing likewise had been anticipated at least since antiquity, with the recognition that human experience is uniquely susceptible to binary interpretation. It was the Greeks who discovered the analytic power of dialectic. The polarity of opposites was a pervasive theme in their philosophy. Light and darkness, life and death, being and not-being, each pole excludes the other, but the world is the complementary union of both. The fact that dialectic, in the form of binary mathematics, was an instrument suited not only to analyzing but also synthesizing experience, was a discovery which dates only to the nineteenth century, and it was the elaboration of electronic technology in the last three decades, specifically the invention of solid state devices and integrated circuits that has made possible the systematic (re)construction in terms of binary elements of a universe of logical experience, with virtually no limitation in sight.

There is no longer any doubt that the invention of digital computing will have a most far-reaching impact on our intellectual life as long as our highly industrialized society survives. Fascinated, awed, and sometimes frightened, we watch the computer transform the areas that it invades. Already it has changed the operations of governments, of banks and insurance companies, of airlines and newspapers, not to speak of the manufacturing and marketing of virtually all mass-produced and mass-consumed products. That the computer has had no comparable effects on the clinical practice of medicine is at one and the same time a source of perplexity and relief. We wonder why this should be the case, and we ask ourselves, whether we are the better or the worse off on account of it. Does the application of data-processing techniques to medical practice hold promise of radically improving the quality of what we do for our patients? Perhaps in the end computer technology will find no other application to medicine than to deprive the physician of his autonomy and transfer the control over his work that he has hitherto exercised to a nameless and unaccountable bureaucracy. Whatever the case, it seems appropriate to review what we understand about computers and computing, to try to distinguish reality from illusion, to prepare ourselves as best we can to benefit from this amazing technology, or at the least, to protect ourselves from being swept away by change.

To many patients, and even to some physicians, the digital computer remains a mystery, and its utilization in medical practice, a species of sorcery. The complexity of the new technology, the rapidity with which it has been introduced, and the pervasiveness of its effects, have seemed to place it beyond the intellectual reach of many otherwise knowledgeable persons, who regard it as an impenetrable labyrinth which entraps the foolhardy who presume to venture there. That, however, is too pessimistic an assessment of our intellectual capacities. The power and effectiveness of modern medicine derive almost entirely from the circumstance that it has succeeded in assimilating the discoveries and insights of many other disciplines, we call them basic sciences, knowledge of which has long been considered prerequisite to entering our profession. It would be incongruous indeed if digital computation, now that it has grown to such great practical significance, should not also become incorporated into the body of knowledge that makes the practice of medicine rational and effective. Logically, computational mathematics is fundamental to clinical medicine no less than are biochemistry or biostatistics. Why should it have a lesser place in the medical curriculum? To learn to understand it, is one of the more pressing challenges that confronts the profession. In this article and in those that follow, I shall try to make a small contribution to fostering that understanding by describing a practical approach which makes computing accessible to the practicing physician not only for the management of his business, but also for the creation and analysis of medical records and thus for the statistical elucidation of medical practice itself.

It is good, in the beginning, to dispose of any prejudice to the effect that learning to use the computer is mysterious and at the same time to be wary of the advertised promises that it is easy. The elements of digital computing are utterly simple; the electronic devices and the logical structures into which they are aggregated are extraordinarily complex. The execution of the most obscure algorithm is invariably susceptible to reduction into binary elements. This dialectic between complexity and simplicity is the source of the power of digital computing; it is also the key to its interpretation. Consider as an example, far fetched on first consideration, but actually highly apposite, the task of delivering a letter to a specified address in this large country. For one who is illiterate, the task is impossible. For him who is able to read, who understands the geographical division of the country into states, of states into municipalities, of municipalities into streets, and streets into houses, each of which is numbered, the millions of potential locations are reduced, if the address is unique, ultimately to a single mail box. Understanding the complexity of our social geography does not make that geography simple, but to him who is able to rationalize the meaning of an address, millions of such addresses become potentially accessible. The analogy may be carried further. One need not know the geography of Des Moines in order to deliver a letter in New Haven. The methods of orienting oneself, however, are the same. Similarly, one does not need to be familiar with every computer structure ever devised; one does not even need to know a single one exhaustively. But one does need to understand how a formula can be written to specify a given process for the computer to execute, and one does need to understand how the artificial conventions of computer language impress the constraints of the formula upon a passive network of inert electronic circuits.

Our society covets the computer, as all other machines, for a means of fulfilling its fantasies of power. It puts the computer to weird and frivolous and oppressive employment, the mere enumeration of which might serve as an eloquent indictment of society's shortcomings. For the adolescent out to make his mark on the world, there are the computer games of the arcades where twenty five or fifty cents will buy a few minutes of deceptive suspense and spurious excitement. There are computer games for the home which teach pre-school children how much fun it is to push the button which sends the peace-keeping missiles of the virtuous to annihilate with their nuclear warheads the wicked ones on the other half of our earth. There are the personal computers with which those of us who could never keep a desk drawer in any semblance of order are told that we can organize our activities, and spreadsheets, which encourage the user to put the question "What if?" to the electronic oracle and thus to gaze into the future, even though he may not know what day of the week it is. And then of course there are the large computers, mainframes, as the industry calls them, with their cost of hundreds of thousands of dollars beyond the reach of even the most affluent physician with which the commercial and political authorities that govern us seek to control our lives and exact from us our contributions to their pyramids of power. To recognize the conventional uses of the machine for what they are is to free oneself of the constraints that custom might otherwise impose, and to create, within an environment which one cannot escape, the space and the occasion to use the computer for purposes of ones own. All that we lack is knowledge. It is knowledge which is the purchase price of freedom, and the first task, therefore, is to learn.

Who then shall be our teacher? It is the characteristic of our market-oriented culture that the boundary between education and advertisement has become blurred. The teacher has become promoter, (else he will perish, as the saying goes,) and the promoter has become our teacher. We learn about the computer from glossy advertisements that persuade us that computing is simple and pleasant. Our professor is a black-suited funny-man whose contrived awkwardness was devised by marketing experts to allay our feelings of helplessness and ignorance in the face of the new technology. He promises that wealth and prestige will be ours, if only we invest in the machine he is trying to sell. But if we take his advice, it is possible that the only thing we will reap will be frustration and disappointment. What we need to possess is not the machine, but the understanding, understanding not as an abstracted attitude, but understanding as a working instrument with which each one of us may appropriate to himself the benefits of digital computing.

We can become familiar with the organized structure of the computer much as we once learned the anatomy of the nervous system, the difference being that the computer's function is absolutely intelligible, while that of the nervous system is still largely a matter of speculation and fantasy. The vocabulary, the grammar, and the syntax of the computer's language can be assimilated by repetition and practice, much as one would learn a hitherto foreign

The Cambridge Glaucoma Letter
1679 Massachusetts Avenue
Cambridge, Mass. 02138

NON-PROFIT
ORGANIZATION
U.S. POSTAGE
PAID
BELMONT, MASS.
PERMIT NO. 58290

tongue. We ought not be discouraged by the fact that knowledge of so complex a technology is unavoidably a matter of degree. No one can learn it all, but that portion which one is able to assimilate is likely to be well worth the effort. The task of learning is made infinitely more difficult if we permit ourselves to be persuaded that it is unnecessary or even undesirable for us to know about these things, and that our ignorance about computing is a kind of virtue, evidence of our competence in more important matters. In the end it may not be necessary that we should write computer programs for our own use, but it is good that we should understand how it is done if only to be able to evaluate and modify programs that others will write for us.

* * * * *

The Cambridge Glaucoma Letter is published at unpredictable intervals by the Cambridge Glaucoma Foundation, Inc. If you wish to receive the Glaucoma Letter, it is free of charge, and if your address label bears a request date, such as "RQD 12-1-80", prior to 1982, or none at all, please write to us, or complete the coupon below and mail it to

The Cambridge Glaucoma Letter
1679 Massachusetts Avenue
Cambridge, Mass. 02138
(Telephone: 617-868-9307)

I would like to continue to receive the Cambridge Glaucoma Letter.

______________________________ name

______________________________ street

______________________________ city, state, ZIP

Once we are able to express ourselves in the computer's language much as we express ourselves in a paragraph of English prose, our view of the computer will change. It will lose its aura of mystery and magic. We will recognize it as an intellectual work of art of the highest order. It will present itself as a remarkable gift both to the artist and to the scientist latent in each of us. Our world is a laboratory, where to live is to learn by trial and error. To assist us in this most important of projects, the computer will prove to be a laboratory instrument without peer.

In subsequent issues of the Glaucoma Letter, we shall review some of the elements of computing technology. We shall describe the operating system published by Bell Laboratories under the trademark "Unix", the most versatile such system with which we are familiar, and offer some suggestions about programming in the C language. We shall describe the advantages of learning to use Unix on a large time-sharing system, and the advantages in turn of maintaining ones own Unix system for managing ones practice and keeping ones medical records, and of making repairs oneself both to the software and the hardware that one uses. Meanwhile, readers who wish individual help with Unix or C, or who would like to participate in a Unix programming workshop, are invited to write or to telephone.

* * * * *

On July 1, 1983, the Cambridge Glaucoma Foundation was accorded tax exempt status as a public charity under Section 501(c)(3) of the U.S. Internal Revenue Code, for a period of 30 months. At the end of this period we must provide evidence that we have public as distinct from private support. Readers who would like to help us demonstrate to the Internal Revenue Service that the Foundation has public support may do so by mailing us a contribution of one dollar. Larger sums, though of course welcome, are probably unnecessary for this purpose.