ABSTRACT

A system is described which allows data entry on burned patients. A random-access file is set up which contains not only patient name, chart number, and basic information about the injury, but also the information necessary to describe accurately the distribution of the injury over the surface of the body. The file is updated on a weekly basis as the patient undergoes surgical debridement, grafting, and spontaneous healing. A subprogram computes total body surface area still "open" or unhealed. This can be used as a weekly index of the patient's progress toward recovery, and plotted against time using APPLEPLOT. In addition, a graphics routine written in GBASIC plots standard Lund and Browder picture charts which can be followed serially, or outputted to a printer for a permanent weekly record in the patient's chart. The program is being used in a small, active burn unit to facilitate the recording of changes in patient status and to gather data which may be of predictive value.

INTRODUCTION

The Lund and Browder chart is accepted as the standard means of recording initial extent of injury when a burn patient is first evaluated. This diagram divides the body up into 33 anatomic subunits and assigns a relative percentage body surface area to each subunit. It provides an easy and convenient way to estimate total body surface area involved in a major burn wound. The standard Lund and Browder chart not only allows computations of body surface area to each subunit, but gives approximations for children by age (infant, 1 year, 5 years, 10 years, 15 years and adult). Total body surface area is of predictive value in estimating mortality, length of hospitalization, and fluid and caloric requirements.

As a patient with a major body burn progresses through a long and complicated hospitalization, multiple operative procedures such as debridement and skin grafting change the body surface area involvement. When one is assessing the progress of such a patient several weeks into his hospitalization, there are no presently accepted guidelines to determine whether or not progress is adequate. When charts are reviewed later, either for teaching or research purposes, it is often impossible to reconstruct exactly how closure was achieved in an individual case. Photographs provide accurate records of changes in the burn wound, but do not yield quantitative measurements directly. We sought a simple way of not only recording changes in the burn wound over time, but also computing the total amount still unhealed. This could then be used to predict caloric requirements, plan future operative procedures, and see whether an individual patient is achieving optimum burn wound closure.

In order to track the progress of our patients, we decided to look at closure of the burn wound on a weekly basis throughout hospitalization using a microcomputer to record data, generate standard Lund and Browder charts, and display changes which occurred with the passage of time.

HARDWARE

We are using an Apple-II Plus with a Z-80 microprocessor, (running the CP/M 60K v 2.2 operating system), a Videx 80-column card, and 64k of RAM. Dual 5 1/4" floppy disc drives are used; the program disc is placed in one drive, and the data storage disc is placed in the second drive. We are presently using a high-resolution green monochrome monitor (Amdek 300G). The system was chosen on the basis of relatively low cost and the wide range of software available. There are a large number of Apple II users in the medical school community, and an active User's Group. CP/M was chosen as a more standard operating system and because of its more efficient random access file capabilities. It allows use of more sophisticated word processors, database programs, statistics programs and communication software than are available under Apple DOS. CP/M also allows an easier upward migration to the 16-bit machines. The computer is used in the Department of Surgery for Burn Unit data and for routine word processing, data storage, and instruction of residents and students. It is also used as a remote terminal to access the Marshall University VAX-11/780 computer. Output is to an EPSON MX-100 printer, using a Grappler II and graphics interface.
SOFTWARE

GBASIC was chosen because of our familiarity and long experience with programming in the BASIC language. The program is broken up into a series of programs which are chained together. Initial access to the program is through a simple menu program. Selection of the appropriate item on the menu allows a user to enter data on a new patient, update data on an old patient, display or print a Lund and Browder chart, or edit records by chaining to the appropriate program. The initial data entry routine computes total body surface area burned and computes estimated fluid requirements for the next 24 hours. Every time data are entered, the body surface area of the burn wound is re-computed, displayed and stored. Data entry is via a simple menu-driven routine. Correction for partial involvement of large surface areas is done by allowing a nurse or physician to input an estimate of the percentage of an area which is still open. Particularly after grafting, coverage of an area may be very spotty. Partial involvement of large areas such as the anterior trunk (13% on the Lund and Browder chart) can be easily entered so that calculation of total surface area involved is more accurate.

Data on each of the 33 areas of the standard Lund and Browder chart is stored as a 5-byte string. The first 2 bytes contain a two-digit code which discriminate between healthy, unburned or fully healed skin (00), first-degree burn (01), second-degree burn (02), third-degree burn (03), and grafted with good take (04). Other codes could be devised and used here. The next 3 bytes contain the percentage of that area which is still open. Thus, a fully healed area would be 000. An area which was totally open would be 100, and one which was 50% healed would be coded 050. This factor is used when the total percent open is computed. Strings are concatenated to obtain a manageable number of variables to place in the buffer for record I/O.

A single record for a patient on a particular date requires 256 bytes; compared to storing a complete graphics screen image which would require 8k of disc storage space, storing the data for a patient this way also allows other computations such as total body surface involvement, and the detailed subtotals of percentage area that are second-degree or third-degree.

The display program first generates a graphic outline of the Lund and Browder chart from a series of HPLOT statements, and then inputs data from the individual patient's file. The original string variables are generated by decoding the concatenated strings with substring functions. These variables supply the parameters to pass to subroutines which generate the completed Lund and Browder chart, filled in with parallel lines where the wound is still open. The routine for filling in parts of the outline also uses HPLOT statements. Figure 1 shows a sample computer-generated Lund and Browder chart for a patient with a 38% body surface area second-degree burn. APPLEPLOT is used under Apple DOS 3.2 to generate graphs, which can also be printed on the dot matrix printer.

Figure 1. Lund and Browder Chart for Patient with Second-Degree Burn over 38% Body Surface Area

Variables (A% and B%) are used as local reference points in the HPLOT statements to allow the same subroutine to generate both front and back (by simple translation) and to allow repositioning of charts on the screen (for example, to display two charts for two different dates simultaneously side-by-side).

Data are read into the program from the individual patient's file. The original string variables are generated by decoding the concatenated strings with substring functions. These variables supply the parameters to pass to subroutines which generate the completed Lund and Browder chart, filled in with parallel lines where the wound is still open. The routine for filling in parts of the outline also uses HPLOT statements. Figure 1 shows a sample computer-generated Lund and Browder chart for a patient with a 38% body surface area second-degree burn. APPLEPLOT is used under Apple DOS 3.2 to generate graphs, which can also be printed on the dot matrix printer.
RESULTS

We have used the program to compute closure curves for 10 patients who were treated for major burns in our unit from January 1982 through January 1983. Review of charts for the past year confirmed our initial impression that it is difficult to tell exactly how closure of the wound was achieved. Closure curves were generated for a total of 8 survivors. The composite graph is shown in figure 2. The two non-survivors had the curves shown in figure 3. It is clear that many factors such as age and intercurrent disease may affect the rate at which closure of the burn wound can be attained; however, the demonstration that a particular patient is not "on schedule" is of help in planning accelerated clinical strategy.

DISCUSSION

A simple method for documenting and following the progress of a burned patient using an Apple II computer is presented. In contrast to the traditional initial Lund and Browder chart, our system, supplemented by weekly photographs, allows precise records to be kept in a standardized format, with easy data retrieval and graphics display. The data storage technique used saves disc space, using only 256 bytes per patient on a given date compared with 8k bytes to store an entire graphics screen image.

Several complex indices of burn injury severity have been devised. However, the use of percent-body-surface involvement still has important prognostic value, particularly when adjustment is made for the age of the patient. It is easy to compute, and forms an easy parameter to follow on a weekly basis. The rate at which burn wound closure is attained may be even more significant. A computerized system such as ours allows easy data entry to be made on a periodic basis, and facilitates later analysis of trends in patient care in the Burn Unit. Other information, such as nutritional indices, can be added if desired.

Rapid closure of the burn wound by excision and grafting is recognized as an ideal means to decrease morbidity and mortality, decrease caloric and metabolic demands upon the patient, and shorten overall hospitalization. The parameters that most groups have reported are either total length of hospitalization or total time to complete closure of the wound. While these are accurate endpoints, total length of hospitalization may be complicated by other factors and neither measurement helps the clinician to decide how fast an individual patient is progressing. Rough yardsticks such as "allow one day of hospitalization per percent burn" and "the patient should be undergoing some sort of surgical procedure, debulking or grafting, each week" are useful but imprecise. The ideal of rapid closure is frequently difficult to achieve. In our burn unit, many of the patients are elderly and have other medical problems.

Accurate recording of changes as the wound heals or is grafted facilitate planning subsequent operative strategy. Review of serial Lund and
Browder charts allows analysis of results and critique of mistakes. It also provides an excellent means for training students and residents in the surgical approach to burn wound closure.

REFERENCES


