A PROSPECTIVE COMPARISON OF THE COSTS OF REUSABLE AND LIMITED-REUSE LAPAROSCOPIC INSTRUMENTS

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OBJECTIVE: To compare the cost and performance of 2 types of laparoscopic instrumentation: reusable laparoscopic hook cautery instruments and curved scissors, or limited-reuse laparoscopic hook cautery instruments and curved scissors.

DESIGN: A randomized trial.

SETTING: The operating room of a tertiary care hospital.

METHOD: All general surgeons performing laparoscopic procedures at the hospital were randomized to be supplied with either reusable or limited-reuse hook cautery and curved scissors. Instrument use was recorded, together with principal outcome measures.

OUTCOME MEASURES: Life expectancy of the instruments, the number of cases for which they were used, the number, nature and cost of repairs, their purchase cost and surgeon satisfaction.

RESULTS: Reusable hook cautery instruments were less expensive than their limited-reuse counterparts. Excellent surgeon satisfaction was reported with the use of this type of instrument. The limited-reuse curved scissors arm of the study was terminated early because of a breach in study protocol.

CONCLUSIONS: Reusable hook cautery instruments were better than their limited-reuse counterparts. Rigorous attempts to compare the cost of laparoscopic instruments may be limited by their rapid evolution in design and the availability of many types of instruments on the market.

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Accepted for publication Oct. 30, 1997

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Operating rooms have high operating budgets and, in recent years, have acquired a variety of expensive, technologically advanced equipment. For these reasons, surgery has become a prime focus for cost accountability in many health institutions. Laparoscopic surgery is at the centre of this attention; thus, scientific evaluations of purchase cost, durability, maintenance and repair costs are needed.

When selecting laparoscopic instruments, hospital staff can choose between disposable or reusable instruments. Disposable instruments offer guaranteed sterility without the associated reprocessing costs of reusable instruments. However, this is balanced by a need for increased storage space, waste disposal requirements and the problems associated with handling large quantities of supplies.1 2

The reuse of disposable instruments has been proposed as a means of reducing costs without affecting quality of care.3 4 However, this practice has raised concerns regarding effective cleaning and reprocessing.5 A compromise between disposable and reusable instruments is limited-reuse instruments. Their purchase cost is similar to that of disposable instruments, yet their design facilitates reprocessing, thus alleviating concerns about patient safety. Their durability, however, is limited, and instruments must be discarded when they become worn out.

The purpose of this study was to compare prospectively the cost and performance of reusable and limited-reuse laparoscopic hook cautery instruments and curved scissors in the operating room of a tertiary care hospital. This report will also demonstrate the difficulties encountered in performing a prospective evaluation of surgical instruments in a clinical setting.

Current laparoscopic instruments have been designed to make them more durable, easier to clean and less expensive than previous reusable instruments. However, wear and tear still limit the life expectancy of curved scissors and hook cautery instruments. These 2 instruments were selected for study because the repair costs and short lifespan of the reusable forms are expected to significantly reduce their cost benefits. Limited-reuse models of these instruments are available and may be a viable alternative.

The study was conducted at Foothills Hospital in Calgary that, at the time of the study, had 639 adult acute care beds, of which 76 were designated for general surgery. A complete range of surgical services was offered. Laparoscopic surgical instrumentation was shared between general surgeons and thoracic surgeons; gynecologists had their own instruments and did not participate in the study.

METHODS

Two types of instruments were evaluated: curved scissors and hook cautery. These instruments, normally part of the standard general surgical laparoscopy set, were replaced by study instruments on a case-by-case basis according to a randomization protocol. The only hook cautery instruments and curved scissors available to the surgeons were the study instruments. Sterilized instruments were kept in a designated area of the operating room stores and were clearly identified as study instruments. Each instrument was inscribed with a unique identification number so it could be tracked.

Two sets of envelopes, one labelled “hook cautery” and the other labelled “curved scissors” were numbered from 1 to 500. Each envelope contained a study sheet that indicated whether a reusable or limited-reuse instrument was to be used. So, if a hook cautery instrument or curved scissors was required for a general surgical or thoracic endoscopic case, operating room personnel would open an envelope located next to the instruments in the operating room stores. According to the instructions on the study sheet, a limited-reuse or reusable instrument would be picked up for use, and additional data would be recorded on the study sheet at the time of surgery.

If a specific instrument type was not available, an alternative instrument would be used. A separate, non-randomized data collection sheet was used to record the necessary information, including the reason that randomization was not possible. Occasionally, instruments needed to be resterilized without having been used due to defective packaging or because the wrong instrument was opened or the instrument needed repairs. In these instances, data were also collected to record the reprocessing of the instrument. In this study, the number of uses of an instrument corresponded to the number of times it was reprocessed. If an instrument malfunctioned during use, a second instrument of the same type was used and a data sheet was completed for each instrument.

Each time a study instrument was picked up, its unique identification number and colour code were recorded on the study sheet. The following data were also collected: date, surgeon, surgical procedure and, if the instrument was actually used, the surgeon’s rating of the instrument’s performance on a 5-point rating scale (1 = poor, instrument malfunctioned; 5 = excellent performance). All data sheets were returned to the primary investigator for data compilation.

If a surgeon believed an instrument required repair or needed to be discarded, this was reported to an inves-
tigator who then removed the instrument. Data were not reviewed until data collection was completed, rendering the investigators and all participating surgeons blind to the number of times each instrument was used.

Outcome measures included the number of times each instrument was used, the number of times each was reprocessed, the name of the surgeon performing the procedure, the type of procedure and the satisfaction of the surgeon with the instrument’s performance. Also, the purchase cost of the instrument was recorded (purchase costs remained stable throughout the study period). Repair costs were recorded prospectively. Reprocessing costs were not considered in this analysis, since both types of instrument required reprocessing before each use. Both reusable and limited-reuse instruments were delivered from the manufacturer and needed to be sterilized before their first use. All costs in this study were calculated in Canadian dollars.

Results

Curved scissors

The curved scissors trial ran for 8 months, from April to December 1995. During this time 143 uses were recorded: 76 of reusable scissors and 67 of limited-reuse scissors. Nine data sheets were discarded from the analysis because they were incomplete. However, the curved scissors arm of the study was discontinued when all the limited-reuse curved scissors were inadvertently discarded by an operating room employee who mistook them for disposable instruments. Three pairs of reusable curved scissors were used 22, 27 and 27 times each. One pair required sharpening after being used 15 times and the other 2 pairs after being used 20 times. Five pairs of limited-reuse curved scissors were used a minimum of 11 and a maximum of 18 times (mean 13). No difference was noted in the surgeon satisfaction ratings between the reusable and limited-reuse curved scissors, nor was there a change in the satisfaction rating over the number of uses.

Instrument costs were $130 each for the limited-reuse curved scissors (Stryker Endoscopy, Santa Clara, Calif.) and $1200 each for the reusable curved scissors (Access, Pilling Weck Inc., Research Triangle Park, NC). The reusable scissors were sharpened at a cost of $15 each. The mean cost per use of the limited-reuse curved scissors was $10 ($130/13) and that of the reusable curved scissors was $48.60 ($1200 + $15)/25. The cost-per-use estimate of the reusable curved scissors was expected to decrease with continued use.

Hook cautery instruments

The hook cautery instrument trial ran for 15 months, from April 1995 to July 1996. At the beginning of the trial, 3 reusable and 3 limited-reuse hook cautery instruments were introduced. A fourth reusable instrument was introduced in June 1995. As limited-reuse instruments failed they were replaced with similar instruments. A total of 12 limited-reuse instruments were purchased, and at the end of the trial, 3 limited-reuse and the original 4 reusable hook cautery instruments were still in use.

Hook cautery instrument use was randomized for 494 surgical procedures. From these, 391 completed data sheets were collected, 15 of which were discarded from the analysis because they were incomplete (data collection rate of 76%). Of the remaining 376 recorded uses of hook cautery instruments, 201 were for reusable hook cautery instruments and 175 for limited-reuse instruments. Repeat use of the 4 reusable instruments ranged from 47 to 55, with a mean of 50 uses per instrument.

By the end of the trial, the insulation of 1 of the reusable hook cautery instruments was noted to be damaged and required repair. The 3 other reusable hook cautery instruments, 2 of which had been reinsulated during the course of the study, were in good working condition. The number of uses of reusable hook cautery instruments, therefore, does not represent the maximum number of uses for this type of instrument.

Reusable hook cautery instruments were purchased for $225 each (Elmed Inc., Addison, Ill.). Three instruments required insulation repair during the study at a cost of $45 per repair. The average cost per use for reusable hook cautery instruments was $5.15 ([4 × $225 + 3 × $45]/201). Since these instruments continued to be used beyond the current study, this amount was expected to decrease with time.

The limited-reuse instruments were resterilized between 10 and 33 times (mean 17) before being removed from circulation because of malfunction. This excluded 3 limited-reuse hooks which were still in use at the end of the trial. The reason for malfunction and instrument removal was insulation failure in all cases. No adverse patient outcomes were recorded.

FIG. 1. Satisfaction ratings for a limited-reuse hook cautery instrument versus increasing number of uses.
The limited-reuse hook cautery instruments cost $88 each (Holmed Inc., South Easton, Mass.). The average cost per use for the limited-reuse hook cautery instruments was $5.18 ($88/17).

**Satisfaction ratings**

The mean satisfaction ratings were 3.9 for the reusable scissors and 3.8 for the limited-reuse ones. No difference in satisfaction rating was identified between surgeons or procedures. The ratings were stable over time and over the number of uses.

With regard to the hook cautery instruments, surgeons preferred the reusable ones (mean satisfaction rating of 4.4) over the limited-reuse ones (rating of 3.5). This difference was consistent between surgeons. Despite having no knowledge of the age of an instrument, surgeons’ satisfaction with the limited-reuse instruments decreased over time as these instruments became worn. Fig. 1 shows the ratings given to 1 of the limited-reuse instruments over time. The rating decreased as the number of uses increased. This phenomenon was not observed with the reusable instruments (Fig. 2). When the ratings of all the instruments of a given type were averaged for each consecutive use, we found that the ratings of the limited-reuse hook cautery instruments decreased with the number of uses but remained steady for the reusable type of instrument. Regression lines of satisfaction over number of uses for each instrument demonstrate this difference (Fig. 3). A similar analysis performed for the curved scissors did not reveal any differences between the reusable and limited-reuse types of instrument (Fig. 4).

**DISCUSSION**

Over the 15 months of the study, we determined that limited-reuse hook cautery instruments were used an average of 17 times each before being discarded. The reusable hook cautery instruments were used an average of 50 times each and were still in good working order at the end of the study. The cost per use of the reusable hook cautery was estimated to be $5.15 and that of the limited-reuse type, $5.18. This calculation took into consideration the repairs required for the reusable instruments. However, the cost per use of the reusable instruments is predicted to decline as their acquisition cost continues to be amortized with subsequent use.

From a financial standpoint, the reusable hook cautery instruments appear to be less expensive than their limited-reuse counterparts. The advantages of the reusable hook cautery instruments include more consistent surgeon satisfaction rating and fewer instrument failures. The latter is an important consideration, since thermal injury is usually a result of insulation failure and escape of current to adjacent organs. Taking into consideration instrument purchase, repair costs, safety and surgeon satisfaction, reusable hook cautery instruments were more cost effective than their limited-reuse counterparts.

Ideally, the study of the reusable hook cautery should have lasted until these instruments were no longer usable and had to be discarded. After 15 months of monitoring, these instruments remained in excellent working order and were expected to last for several more years. Based on the data collected in the course of the study, it was agreed that reusable hook cautery instruments would be more economical in the long run. As a result, data collection was discontinued.

Analysis of the curved scissors data was limited because of inadvertent early termination of this arm of the study; thus, no conclusions can be reached. This illustrates one of the difficulties encountered in attempting to scientifically evaluate the performance of a surgical instrument. In a busy operating room, instruments are handled by
many individuals, including nurses and work-room and sterilization employees who may often be located in different locales in the hospital. Ensuring familiarity with the instrumentation and study protocol can be difficult.

More recently, laparoscopic instruments with built-in electroshield features have become available. Previously available electroshields required a separate shield and cord on the instrument, which were cumbersome and considered nonviable by the general surgeons of this institution. The new design incorporates the cautery and electroshield electrical contacts in a single cord, and the instrument no longer requires a separate shield. This was seen as a major advance, and these instruments were selected over the study instrument to be part of the standard laparoscopy instrument tray.

Thus, it can be seen that rapid advances in instrument design make it difficult to conduct studies that require several years to complete satisfactorily, since the results may be obsolete by the time the study is completed.

To standardize the study methods, a limited number of instrument types were selected for evaluation in this study. This, unfortunately, fails to address the wide range of instruments available, such as one-piece instruments, take-apart instruments, and limited-reuse and disposable instruments. Simultaneous comparison of all these instruments is not possible in a single centre of the size used in this study. The scope of the study was therefore limited to a narrow subset of instruments, and the results cannot be extrapolated to any other types.

**CONCLUSIONS**

Purchase price, repair costs, durability, surgeon satisfaction and instrument performance were taken into account to evaluate scientifically the costs of 2 categories of laparoscopic instruments. The methodologic difficulties encountered in this study have demonstrated to us that rigorous comparisons of cost-effectiveness between instruments is likely to remain problematic. As laparoscopic instrument design in particular continues to progress rapidly, precise assessment of durability, repair and maintenance costs is not likely to be readily available.

Supported by a grant from the Centre for Advancement of Health, Foothills Hospital, Calgary, Alta.

**References**