An improvised endotrainer for low resource settings

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Original Article

Abstract

Background: Training in minimal access surgery has always been difficult in developing countries with limited resources, paucity of animal laboratories, unaffordability / unaffordable conventional endotrainer and limited number of trained endoscopic surgeons to help the trainee.
Objective: To design an endotrainer for use in resource- poor settings with the aim of domestication of laparoscopic surgery.
Materials and Methods: A fabricated endotrainer box with a camera, a bulb for adequate illumination powered by electricity connected to a television was designed at affordable price to improvise for the conventional endotrainer for low resource settings.
Results: The fabricated endotrainer model was found to be an effective training tool for improving psychomotor skills and dexterity of movement, especially for suturing in difficult areas. This is comparable to the sophisticated virtual reality simulator. Also, it is far less expensive compared to the expensive virtual reality simulator, thus affordable.
Conclusion: It is concluded that this model should be employed by other low resource setting to improve the skills of surgeons in endoscopy surgery and facilitate the training of new hands.

Key words; Endotrainer, Minimal access surgery, low resource setting.

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Un engin improvisé endotrainer pour faible paramètres de ressource

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L'article d'origine

Résumé

Contexte: Formation en minimal access surgery a toujours été difficile dans les pays en développement disposant de ressources limitées, le manque de laboratoires animale, inaccessibilité / inabordables endotrainer classiques et d'un nombre limité de formés endoscopique chirurgiens à aider le stagiaire.
Objectif:concevoir un endotrainer pour utilisation en ressource- pauvres paramètres avec l'objectif de la domestication de la chirurgie cœlioscopique.
Matériels et méthodes: fabriquer une endotrainer boîte avec une caméra, une ampoule pour un éclairement alimentés par de l'électricité raccordé à un téléviseur a été conçu à un prix abordable à improviser pour le endotrainer classiques pour les pays qui ont peu de ressources.
Résultats: Les fabriquer soi-même endotrainer modèle a été trouvé pour être efficace un outil de formation pour améliorer leurs compétences psychomotrices et la dextérité du mouvement et surtout de suture dans des zones difficiles. Ceci est comparable à la sophistiquée simulateur de réalité virtuelle. Aussi, il est beaucoup moins coûteux, comparé à la coûteuse simulateur de réalité virtuelle, donc abordable.
Conclusion: il est conclu que ce modèle devrait être employée par d'autres ressources faible réglage pour améliorer les compétences des chirurgiens en chirurgie endoscopique et faciliter la formation de nouvelles mains.

Mots clés; Endotrainer, Minimal Access Surgery, faible paramètre de ressource.

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INTRODUCTION

Laparoscopy surgery, also referred to as key hole surgery or minimal access surgery is a modern surgical technique in which operations in the abdomen are performed through small incisions (usually 0.5–1.5 cm) as opposed to the larger incisions needed in laparotomy (1). This surgical approach has been used since a century but in the last two decades there has been an explosion in this field. As new technology comes up day by day its indications and applications are also increasing (1).

The advantages of laparoscopy in comparison to open abdominal surgery include reduced surgical trauma, haemorrhage, less pain, fewer post-operative pulmonary complications, and shorter recovery times. The disadvantages include longer surgical times and higher equipment costs and extended training especially in developing nations (2). Adequate training and caution are key points in laparoscopic surgery.

Recognizing the growing role of laparoscopy in modern surgery, residency programs have incorporated it into training pograms. Various devices ranging from simple box trainers, animal models to sophisticated virtual reality trainers are used to aid in this education of laparoscopic skills. Virtual reality system is an advanced and effective training method, however it is yet to be adopted due to its cost and the advanced technology required for it (3). However formal training in this technique is limited in low resource setting primarily due to high cost of virtual reality simulator and limited numbers of trained endosurgeons (3). We designed an endotrainer for low resource setting to improve the skills of surgeons in the art of endosurgery.

Materials and Methods

The endotrainer we have designed is a rectangular box with the dimensions of 35cm x 28cm x18cm. These dimensions are developed, such that, they nearly correspond to the normal adult peritoneal cavity. This space is adequate for the placement of instruments and training objects. A fabricated rectangular endotrainer box was made up of grade A interior plywood with a Color Weather proof IR Closed Circuit Television Camera (C CT V (EC-WC6009). It has an in-built light source and a 20 Watt conventional *energy saving white bulb* for adequate illumination; powered by electricity and connected to a television via Audio/Video (A/V) cable. This was designed as an improvision for virtual reality simulator endotrainer which is expensive for developing nations.

Four holes (5mm each) through which the hand-held laparoscopic instruments are introduced are made in the cover of the box and covered with white rectangular foam to prevent escape of light from within the box which might reduce illumination. The inside of the box simulates an insufflated abdominal cavity and is lined with foam. At the center, there are two 10cm rectangular foams of 0.5cm in thickness, held side by side and firmly apposed with a gap of 0.5cm and fixed over a white foam covering the floor of the box using Evo-stik gum. This constitutes the working area.

A television stand that houses the 17 inches television and a trainer box desk (where the endotrainer is placed) are designed specifically for this purpose taken cognizance of the height of the endotrainer and screen position at eye level to ease manipulation. Also, a Light-Emitting Diodes (LEDs) 32" television which displays edited/unedited videos of laparoscopic surgeries is placed in between the television for demonstration.

Instrument and training

The instruments for endotrainer are similar to those in use for live surgery only that they are made of plastic handle except for needle holder. These include Maryland, babcock, scissors and needle holder. The training pattern in the use of endotrainer is similar to conventional laparoscopic training. Hand-eye coordination, dissection, and suturing exercises are carried out. The hand-eye co-ordination exercises included transfer of objects between instruments and transfer between petri dish placed within the trainer. The technique of dissection is by cutting round a circle and suturing is practiced using the inner foams.

Discussion

The introduction of laparoscopic surgery in the 1901s brought with it new challenges for the Surgeon (4). Previously, Surgeons looked directly at the target organ through an abdominal wall incision. Now they had to adapt to a new technique in which they had to look at a monitor displaying the intra abdominal scene. As there were no structured instructional courses available, it took time to adapt to this method of surgery. They needed to acquire excellent hand–eye coordination. Surgeons learning on patients may be a dangerous venture (5). Simulation is the imitation or modeling of a real-life situation for training or instruction. Since the first simplistic endoscopic simulators were described in 1969 (6) and the early 1970s (7, 8), these instruments have evolved greatly over time and now include complex computerized devices.

In the developed world, the finer points for the improvement of the safety of patients undergoing laparoscopic surgery were debated and guidelines were set. Unfortunately, in developing countries there are no such guidelines and there are only a limited number of trained endosurgeons. The local surgical fraternity was not convinced about the safety of laparoscopic surgery most especially in the developing countries and so a training policy had to be developed which would help to develop hand-eye coordination (3).

Market driven public demand has created unprecedented challenges in training and certification within this field. A revolution has occurred in surgical education in the developed world, as a result of availability of virtual reality simulators for the training and assessment of technical skills. This innovation is due to combination of simulators, curriculum-based training, validation of objective assessment and policy (criterion-based bench marks) to deliver high-level proficiency-based training (9). However, the reverse is the case in the developing world where domestication of laparoscopic surgeries is being hampered by the limited resources to procure simulators and lack of trained endoscopic surgeons to help the trainees.

The basic principles of mechanical stimulators have not changed during the last decade; however, it has been constantly upgraded over years (10). The average cost of a standard endotrainer ranges between five thousand to eight thousand five hundred dollars. Due to poor funding of health services this is not within the reach of most developing countries. Therefore, there is need to design an affordable endotrainer in order to initiate and sustain the practice of laparoscopic surgery in these regions. The cost incurred in putting up this model is less than one-sixth (seven fifty dollars) of virtual reality simulators, thus suitable for low-resource setting like ours.

This model operates using the same principles as standard virtual reality simulators except for some modifications (Fig. 1.). Various tasks as in standard endotrainer like stacking of cube of sugar, cylindrical and dough nut shaped beads on each other, cutting with the aid of endo-scissors round a circle and endo knotting and endo suturing training are being conducted by previously trained endosurgeons (Fig.2, 3, 4, 5, 6). The results are comparable to conventional endotrainer. This is similar to findings of Powers et al and Munz et al in India and United Kingdom respectively (11, 12).

This model is a cost effective training tool for improving psychomotor skills and dexterity of movement, especially for suturing in difficult areas as commonly encountered in minimal access surgical practice. It is therefore recommended to other low resource setting for training and to improve the skills of surgeons who are new to the art of endosurgery.

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Fig 1. Endotrainer Laboratory

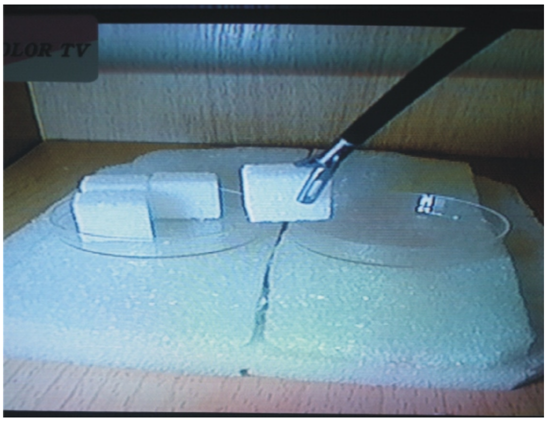

Fig 2. Hand precision (stacking of cube of sugar)

Fig 3. Hand precision (stacking of beads)

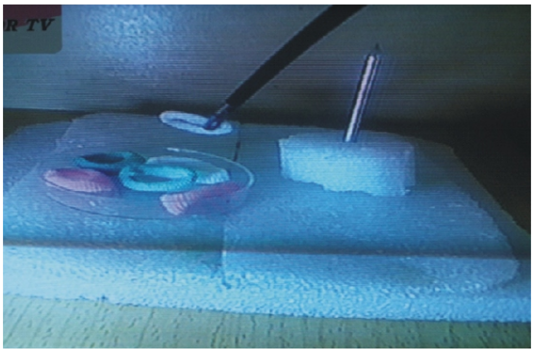

Fig 4. Hand precision (stacking of doughnut shaped beads)

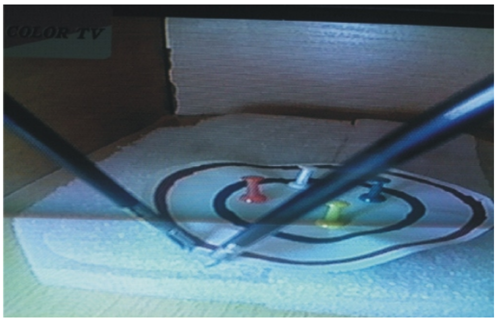

Fig 5. Dissection precision (cutting round a circle)

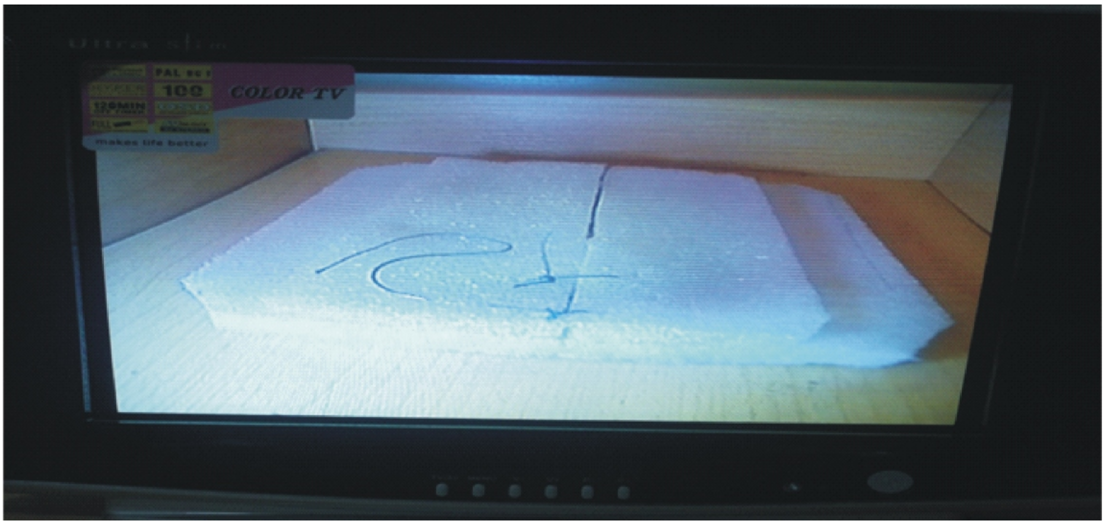

Fig. 6 Suturing precision (Endo-suturing and Knotting)