SKILLS TRANSFER AFTER PROFICIENCY-BASED BENCH MODEL SIMULATION TRAINING IN SAPHENOFEMORAL JUNCTION DISSECTION

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Abstract

Introduction: Bench model simulation training in open vascular surgery has been shown to improve the technical skills of surgical residents, either in a laboratory or in a simulated operating room (OR). The purpose of this study was to explore whether basic surgical skills acquired using proficiency-based bench model simulation training in open saphenofemoral junction (SFJ) dissection translate to real world performance.

Methods: Twelve junior surgical residents, with no past experience in varicose vein surgery, received didactic training in the technique of SFJ dissection. Thereafter, trainees were randomised, with six receiving further training on a synthetic bench model simulator up to proficiency level. All twelve trainees then performed one SFJ dissection in an OR within five days of completing didactic only vs. didactic plus simulation training. Trainee performance was assessed by one attending consultant blinded to the trainees’ training status, using previously validated procedure-specific and global rating scales.

Results: Overall, simulation-trained trainees scored higher than the controls on the procedure-specific rating scale (30.3 ± 2.1 vs. 18 ± 2.2 $P < 0.001$) and the global rating scale (28.3 ± 1.9 vs. 18.5 ± 4 $P < 0.001$). In addition, simulation-trained trainees scored higher in all of the 7 individual measures of the procedure-specific rating scale, and in 6 of the 7 measures of the global rating scale.

Conclusions: Basic surgical skills, acquired using proficiency-based bench model simulation training in SFJ dissection, do translate to real world performance. Structured bench model simulation training in SFJ dissection should be incorporated into surgical training programmes.

Introduction

Surgical skills’ training is traditionally carried out in the operating room (OR), where trainees are coached by a senior surgeon acting as assistant for part or all of an operative procedure. In the context of cost containment and recent changes in healthcare, the current form of OR training has been characterised as expensive, time-consuming and inefficient in the provision of surgical education [1, 2]. Moreover, with increased patients’ expectations and limited healthcare resources, ethical and legal concerns for patients’ safety have increased the challenge in using the OR to train surgical residents. In the face of these challenges, surgical educators have innovated and developed novel methodologies, simulation tools and assessment techniques to optimise learning and the acquisition of surgical expertise while minimising associated costs.

Simulation-based surgical training offers an opportunity, both to trainees and trainers, to learn and teach surgical skills outside the operating room in a pseudo-realistic environment without risks to patient safety [4]. To date, several studies have demonstrated that different bench model simulators in vascular surgery are effective as assessment tools in distinguishing between surgeons of differing levels of expertise either in a laboratory [5, 6, 7, 8, 9, 10] or in a simulated OR [11, 12, 13]. There are few reports in the literature on the use of bench model simulators in the training of basic vascular surgery technical skills [14, 15]. In addition, most studies restricted either the number of sessions, or the duration, rather than using proficiency in the simulated environment as the end point of training. Proficiency-based progression training enhances motivation and learning, thus maximising skill acquisition and retention [16, 17] and reducing the risks to patient safety during the latter part of the trainees’ learning curve. For these reasons, proficiency-based training is currently being embraced as the preferred method of training [18].

Another important aspect in simulation training is to explore whether simulation-acquired skills translate to real world performance. Although this has been described in the literature in different surgical procedures such as in colonoscopy/sigmoidoscopy [19], laparoscopic cholecystectomy [20] and the endovascular management of peripheral vascular disease [21], no studies have explored the transfer of simulation-acquired skills in open vascular surgery. In this study, we designed a randomised, controlled, prospective study to determine whether surgical skills acquired using proficiency-based bench model simulation training in open saphenofemoral junction (SFJ) dissection translate to real world performance.

Materials and Methods

Twelve basic surgical trainees (equivalent to PGY 1 and 2), with no prior exposure to varicose vein surgery, were invited to the simulation laboratory in the Royal College of Surgeons in Ireland (RCSI) individually. After informed consent, each trainee received didactic teaching in the basic surgical skills required to perform SFJ dissection. Didactic teaching involved a computer slideshow presentation and videos on the essential steps to perform SFJ dissection. Videos consisted of recordings of the hands of a vascular surgeon consultant (ST) performing SFJ dissection on a plastic bench model simulator (Lims & Things, Bristol, UK) and on a real patient. Each trainee was instructed on choosing and manipulating different instruments, and the use of diathermy and suture material. Didactic teaching was delivered by a research fellow in surgical simulation training (HH) on a one-to-one basis for a duration of one hour. A previous study identified seven operative components for SFJ dissection [8]. Didactic teaching was based on the same seven domains, with a slight modification in two domains: the use of Ligaclip instead of knot tying when dividing the tributaries, and transfixion of the SFJ in place of flush ligation (see Table 1).
dissection. The OSATS consists of seven items which reflect the overall basic surgical skills performance, and is not specific to the procedure performed. Each item was rated between 1 and 5 when using the ICEPS and the OSATS rating scales, with 1 representing a poor performance, 3 (an average score) representing a competent performance, and 5 representing an excellent performance. Rating was based on the ability to perform the individual steps efficiently from a technical and a result aspect. The minimum score that could be given using the ICEPS scale or the OSATS scale was 5 and the maximum was 35. Performance of the two groups of trainees was studied and compared.

Statistical Analysis
The results generated from both assessment tools (ICEPS and OSATS) were entered into a database and subsequently analysed using the SPSS 18 software supplier. Based on the nature of the data (the results showed a parametric distribution), an independent sample t test was performed to test for statistically significant differences. All values were represented as mean ± SD and mean differences were considered significant for a P value of less than 0.05. A Pearson correlation analysis was used to measure the correlation between the procedure-specific and the global rating scales.

The Royal College of Surgeons in Ireland ethics committee and the Adelaide and Meath Hospital ethics committee approved the study protocol in advance.

Results
Trainees’ background information: Twelve trainees were enrolled in the study. Eight were male, and four were female. Trainees’ age ranged between 26 and 29. All trainees had completed a one-year internship and are surgeons in training in the first two years of a surgical training programme. No trainees had prior exposure to varicose vein surgery.

Acquiring proficiency: All simulation-trained trainees reached predetermined proficiency targets at a median of 6.3 hours (ranging from 5 to 7 hours) and a median of 5.2 procedures (ranging from 4 to 6 procedures).

ICEPS Procedure-specific rating scale: Overall, simulation-trained trainees scored higher than the controls on the seven-item ICEPS procedure-specific rating scale (30.3 ± 2.1 vs. 18 ± 2.2 P < 0.001). Moreover, simulation-trained trainees scored higher in all of the seven individual measures of the ICEPS rating scale. Table 2 shows the mean value of trainees’ scores in the two groups (simulation group and control group) for each item in the OSATS global rating scale (NS = not significant).

Table 3: The mean value of trainees’ scores in the simulation group and the control group for each item in the OSATS global rating scale (NS = not significant)

<table>
<thead>
<tr>
<th>Task description</th>
<th>Simulation group mean ± SD</th>
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<tbody>
<tr>
<td>1. Incision</td>
<td>4.8 ± 2.1</td>
<td>3.1 ± 1.9</td>
<td>0.001</td>
</tr>
<tr>
<td>2. Dissection</td>
<td>4.2 ± 2.1</td>
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<td>&lt; 0.001</td>
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Table 2: The mean value of trainees’ scores in the simulation group and the control group for each item in the ICEPS procedure-specific rating scale

All twelve trainees then performed one SFJ dissection in an OR within five days of completing didactic only or didactic plus simulation training. To attempt to standardise the live operating assessment conditions for each of the trainees, only patients undergoing day surgery were considered for the study. Moreover, all clinical cases were primary varicose veins with no complications such as phlebitis, lipodermatosclerosis, or ulceration. Before their procedures, each patient was provided with an information leaflet and signed a consent form. A vascular surgeon consultant (ST) assisted and ascertained each trainee performing the procedure. The same consultant, who was blinded to the training status of the surgical trainees, assessed the twelve trainees using the Imperial College Evaluation of Procedure-Specific Skill (ICEPS) procedure-specific rating scale (see Table 2) [8, 12] and the Objective Structured Assessment of Technical Skill (OSATS) global rating scale (see Table 3) [22, 23]. Both rating scales have been previously validated. The ICEPS consists of the seven domains specific for SFJ sfj dissection. The OSATS consists of seven items which reflect the overall basic surgical skills performance, and is not specific to the procedure performed. Each item was rated between 1 and 5 when using the ICEPS and the OSATS rating scales, with 1 representing a poor performance, 3 (an average score) representing a competent performance, and 5 representing an excellent performance. Rating was based on the ability to perform the individual steps efficiently from a technical and a result aspect. The minimum score that could be given using the ICEPS scale or the OSATS scale was 5 and the maximum was 35. Performance of the two groups of trainees was studied and compared.

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OSATS Global rating scale: Overall, simulation-trained trainees scored higher than the controls on the seven-item global rating scale (28.3 ± 1.9 vs. 18.5 ± 4 P < 0.001). Moreover, simulation-trained trainees scored higher in 6 of the 7 individual measures of the OSATS rating scale. Table 3 shows the mean value of trainees’ scores in the two groups (simulation group and control group) for each item in the global rating scale.

Correlation between the ICEPS and the OSATS rating scales: There was a positive correlation between the ICEPS procedure-specific rating scale and the OSATS global rating scale (r = 0.92, P < 0.001).

Discussion

The traditional form of surgical skills training and recent changes in healthcare have created challenges in keeping up the standards in skills training of future surgeons. The structured development of simulation training might help tackle these challenges. In this study, we have shown that proficiency-based simulation training in SFJ dissection translates to real world performance. The ultimate test of simulation is the improvement of performance in an OR situation. This has been described in a few surgical procedures such as in endoscopy [19], laparoscopic cholecystectomy [20] and the endovascular management of peripheral vascular disease [21]. In the endovascular study, simulation training was limited to two hours, lesions treated were different among trainees as they included a variety of iliac, femoral and popliteal stenoses or occlusions and the procedure checklist used was not validated. Although the use of simulators in open vascular surgery have been explored in the training and assessment of surgical residents for more than a decade [6,9-18], most studies restricted either the duration or the number of sessions rather than using proficiency as the end point of training. In addition, the transfer of simulation-acquired skills in open vascular surgery has not been described.

In the present study, we chose varicose vein surgery as it is routinely performed by most surgeons at all levels of expertise in general and vascular surgery. In addition, it contains the basic surgical skills needed to train and assess junior surgical trainees. The end point of simulation training was the acquisition of proficiency, rather than a fixed number of sessions or duration. Although the number of simulation-trained individuals was small, there was a considerable variation in the time/number of sessions required to reach proficiency. It is not known yet whether this difference in ability is innate or acquired, or a mixture of both. Furthermore, it is not known which psychomotor abilities correlate best with different surgical skills. As different duration and number of sessions was necessary for trainees to acquire proficiency, we strongly believe that simulation training should be aimed at acquiring proficiency without limitation in duration or sessions number. Simulation-trained trainees did have more contact time with the coach. However, we do not believe that time alone is likely to have had an such impact as the fact that this was spent with the simulation model.

Our study has a few limitations. First of all, the number of trainees involved in the study was small. This restricted the ability to study the differences in the technical skills performances among simulation trained individuals when performing the procedure on patients, to evaluate whether the variation in the capability to learn/perform technical skills persisted after proficiency-based simulation training. Secondly, each candidate performed only one clinical case. It would be interesting to evaluate skills retention for the six simulation trained individuals in our study. However, skill retention has been documented following proficiency-based progression training, with as high as 93% to 99% retention at five months for basic laparoscopic skills, and 90% to 95% retention at six months for laparoscopic suturing [16,17].

Simulation-based surgical training offers an opportunity both to trainees and trainers to learn and teach surgical skills outside the OR in a low risk, stress-less, safe environment. Moreover, simulation training shortens the learning curve in the clinical situation, thereby reducing risk to patients. However, there are limitations to this form of medical simulation learning technology. Simulation education is expensive. The cost of each bench model simulator used in this study was $460. In addition, simulation education requires dedicated facilities. However, any improvement in the operator surgical skills and procedure outcome after simulation training will have significant cost implications. While the cost associated with the use of simulation in surgical training can be calculated precisely, the cost of training inadequately can be hidden initially, but becomes evident later.

Conclusion

The results generated from this preliminary study show that basic surgical skills acquired using proficiency-based bench model simulation training in SFJ dissection translate to real world performance. Structured proficiency-based simulation training in SFJ dissection should be incorporated into surgical training programmes. Future studies should aim at developing structured and validated simulation training curriculums for different surgical procedures, studying the transferability between procedures and looking at skills retention.

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Am J Surg 2004 Sep;188(3):294-300

Technical skills examination for general surgical trainees
Br J Surg 2006 Sep;93(9):1139-46
COMMENTARY ONE:
Skills Transfer After Proficiency-Based Bench Model Simulation Training in Saphenofemoral Junction Dissection

Louis Fligelstone
Past Associate Dean & Head of Wales Training School of Surgery

This paper addresses some issues that we are all facing on a daily basis when training our future colleagues. How much risk is acceptable, and how much time do we have, what can we do more efficiently and safely? It is important to remember that PMETB training Domain 1 is patient safety. Undergraduate training, and specialties such as anaesthesia, have embraced simulation and structured assessment prior to allowing access to patients. Reduced training hours results in less time ‘at the coal face’, however, patient expectations are increasing, so balancing these connected, but conflicting, issues has to be addressed. The use of high quality, validated simulation could provide this. This study, although small in numbers, utilises a practical approach assessing skill transfer from bench to OR. The positive results are encouraging for the cohort studied. The design of the study is appropriate for the grade of surgeon:

- Patient selection (day case likely to have low BMI).
- Uncomplicated varicose veins.
- Ligaclip application for tributary and junction control.

Many training units would have difficulty reproducing this environment because treatment of uncomplicated varicose veins is becoming a rarity, combined with the advent of outpatient treatments including foam sclerotherapy, endovascular thermal ablation, and the cost implications of ligaclip usage versus traditional ligation.

The operation of SFJ ligation is a good general procedure, as it requires careful dissection, fine tissue handling, and aspects of small and larger vessel transection and control. Use of ligaclip has removed the assessment of one of the finer aspects of vessel control, namely ligation of vessels in a confined space, and choice between ligation in continuity then division, versus slipping tributaries, division followed by careful ligation. Perhaps the authors feel that these skills would be best assessed for more advanced trainees, rather than inexperienced trainees?

Cost issues: $460 for the bench model simulator is expensive, however, this is offset by not having additional time for elective cases in theatre (often costed at $750 - $1,000 per session). Although pragmatically logical, it is almost impossible to fund...