"Latex Glove" Laparoscopic Pyeloplasty Model
A Novel Method for Simulated Training

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Purpose: To present a 'latex glove' laparoscopic pyeloplasty (LPP) training model and determine its construct validity for its effective use in resident training.

Materials and Methods: The 'latex glove' model was used to perform LPP by five operators with variable level of experience, ranging from an experienced (> 20 independent LPPs) to minimal operative experience (year 5 medical student). The palm of the glove was considered the renal pelvis with finger of the glove as the proximal ureter. A knot at the junction of the two was considered as ureteropelvic junction obstruction. A basic lap trainer was used to simulate the LPP. Operation time was noted in minutes and quality of continuous suturing was determined for each operator, using a previously described nonvalidated scoring system by a blinded reviewer.

Results: The operation time varied from 47 to 160 minutes for the most to the least experienced operator, and the difference was statistically significant ($P = .043$), while the quality of suturing score ranged from 1 to 6 for the most to the least experienced operator, respectively ($P = .038$). The operation time and quality of suturing were negatively correlated with the level of experience (-0.962 and -0.987, respectively), which were statistically significant ($P = .009$ and $P = .002$, respectively).

Conclusion: This novel training model has proven its validity, as a cost-effective and readily available option for LPP training.

Keywords: laparoscopy, urologic surgical procedures, reconstructive surgical procedures, ureteral obstruction, hydronephrosis

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INTRODUCTION

Introduction of minimally invasive methods has revolutionized not only surgery in general, but also the abdominal and pelvic urological procedures. Pyeloplasty is one such procedure, for which minimally invasive approach is gaining popularity, especially laparoscopic pyeloplasty, as its results are comparable with the open technique.[1] However, the problems associated with long learning curve and complexity of the reconstruction make it difficult in not only readily adopting, but also in training of the residents for this procedure. These problems are overcome with the use of various simulators or models to improve resident training.[2] Due to the high costs and lack of availability of sophisticated simulators, it becomes difficult for trainees in less developed countries to develop their skills. On the other hand, animal-based models are otherwise associated with ethical and cost issues.[3]

For a simulation to be valid, it has to be close to reality, correlate with the performance in a real case, and

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be able to discriminate between individuals with different degrees of experience. It is important to validate a model or simulator before it could be incorporated into urology residency training program. McDougall described various types of validity and emphasized the need for validation before its use.[4] Construct validity is one such type, in which a simulator is able to differentiate between experienced and beginner operators; thus, proving its ability to improve skills of novice to expert levels. In the current study, we present a LPP training model, made out of a simple latex glove, which is readily available and affordable for use by all urological trainees. We also determined its construct validity for its effective use in resident training.

MATERIALS AND METHODS

We used an ordinary latex glove and placed it in the laparoscopic training box. The knot in the finger simulated the ureteropelvic junction obstruction and palm of the glove as dilated renal pelvis (Figure 1).

Figure 1. "Latex glove" laparoscopic pyeloplasty model

An Anderson-Hynes dismembered pyeloplasty was laparoscopically performed, using continuous suturing technique. Initially, the glove is suspended in the simulator box. Using normal laparoscopic scissors, the "strictured" part of the ureteropelvic junction is cut and anastomosis is made between the cut part of the "ureter" (finger of the glove) with the remaining "pelvis" (palm of the glove). The first knot is placed at the edge and continuous suturing is performed in the anterior and posterior layers, placing a final knot in the end, following completion of the two layers.

To determine the construct validity of the model, the procedure was performed by five operators. The operators were divided from the most experienced, with more than 20 LPPs to the least experienced, with no experience of laparoscopic procedure, having basic knowledge of suturing and knot tying skills (Table). Total duration of procedure in minutes and quality of suturing score were recorded for each operator, by a blinded mentor using a standardized nonvalidated form described by Laguna and colleague.[5]

The recorded parameters were; distance between the sutures (< 2 mm, < 2 mm in one suture, and > 2 mm in more than one suture), tissue tear (no, once, and more than once), quality of knot tying (good, bad, and not applicable), and lesion of the posterior wall (no or inclusion).

Statistical analysis was done using SPSS software (the Statistical Package for the Social Sciences, Version 16.0, SPSS Inc, Chicago, Illinois, USA). One-way ANOVA was used to detect differences in suturing time among the operators. According to this method, higher the score, poorer was the quality of suturing. To further confirm the

Study variables

Operators (Level of experience)	Operator 1 (> 20 LPP)	Operator 2 (> 100 Endo)	Operator 3 (> 20 Lap CC)	Operator 4 (> 20 Endo)	Operator 5 (MS)	*P*
Duration of Procedure, min	47	74	92	142	160	.043
Quality of Suturing Score	1	2	3	6	6	.038

LPP indicates laparoscopic pyeloplasties; ENDO, endourological procedures; Lap CC, laparoscopic cholecystectomies; and MS, medical student minimal hands on operative experience.

Figure 2. Graphical presentation of time taken to complete task by operators with variable levels of experience

influence of level of experience on the operation time and quality of suturing score, we determined the Pearson correlation coefficient too.

RESULTS

Forty-seven minutes for duration of procedure was recorded for the most experienced operator, which increased to 160 minutes, with decreasing level of experience, for the least experienced operator (Figure 2). Similarly, the quality of suturing score increased from 1 to 6 for the most to the least experienced operator, respectively (Table). The differences in time and quality of suturing score were statistically significant ($P = .043$ and $P = .038$, respectively).

On determination of Pearson correlation coefficient, the duration of procedure and quality of suturing score were negatively correlated with the level of experience (-0.962 and -0.987, respectively) with statistical significance ($P = .009$ and $P = .001$, respectively).

DISCUSSION

Since introduction in 1993 by Schuessler and his colleagues,[6] LPP proved its success in terms of better outcomes comparable to open technique in the operative management of ureteropelvic junction obstruction.[1] However, the laparoscopic technique, which comprises of major reconstruction and intracorporeal suturing, has been reported to be related with steeper learning curve,[7] which poses difficulty in 'on patient' resident training; hence, emphasizing the importance of dry and wet laboratories, before reaching the operating table for the trainees.

Construct validity is one of the most valuable and mandatory assessments, as it can differentiate the experienced from the inexperienced surgeon based on the performance score. Content validity is the assessment of the appropriateness of the simulator as a teaching modality, and involves formal evaluation by experts' knowledge about the device. Before a surgical simulator can be used to assess competency, it must be vigorously and objectively evaluated to determine both its scientific reliability and validity.

Benefits of simulation have been proven in laparoscopic training,[8] and various models of both live and dead animals have been reported in literature for LPP training.[9-12] These models have also been validated in studies; however, no inanimate model has been reported in literature to our knowledge.

Apart from the type or availability of the models, an important factor of validity stands a significant ground, before considering a simulation as a valid learning tool for residents. McDougall described four types of validities, namely face, content, construct, and criterion validity.[4] Others reported models using chicken skin, chicken crop, and live porcine model; all determined construct type A validity, which assesses the ability of a simulation in improving the performance of an inexperienced operator over time.[9-11] In the live porcine model by Teber and colleagues, the authors determined the validity of a specific suturing technique of pyeloplasty and then performed the same in a real time scenario on a patient; thus, determining its predictive validity.[12]

In this 'latex glove' model, we determined the construct validity type B, which enables the simulator or model to distinguish between an experienced and inexperienced individual, who later improves on his skills or operative timings by repeated practice, demonstrating the construct type A validity. Similar type of validity has been reported in another animal model, for simulation of vesicourethral anastomosis in radical prostatectomy by Laguna and associates.[5]

Although Ramachandran used the chicken crop model, which could be considered as a cheap and

readily available alternate, the study was unable to give a statistical significance to type A construct validity.[10] We particularly determined this model because of its cost-effectiveness and ready availability, and proved its construct validity as well.

In future, we would like to determine the concurrent validity of this model, by comparing it with a standard simulation, ie, chicken skin or crop model, to improve its novelty and acceptability for development of LPP skills of the residents in training in this part of the world.

CONCLUSION

This 'latex glove' pyeloplasty model has proven its construct validity as a simulator for laparoscopic skills development. We believe that its validity will further improve its novelty as a cost-effective and readily available option for LPP training.

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CONFLICT OF INTEREST

None declared.

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