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VIDEO-BASED SELF-LEARNING MODEL OF LAPAROSCOPIC CHOLECYSTECTOMY

Hepatobiliary Surgery

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ABSTRACT

Surgery has been traditionally taught by the Halstedian model of "see one, do one, teach one." Laparoscopic training requires adaptation technology and hence different training modules have been developed that range from bench top models, Mentor and Mentee, simulators to Augmented and Virtual Reality and even cadavers. However, to enhance operative skills, the use of only one module may not be effective. Hence, we have made a simple video-based learning module for the learning of one of the most commonly done laparoscopic surgeries worldwide. We had 20 surgical residents who enrolled in this study. All of them had observed 30 laparoscopic cholecystectomies in their first year, assisted 30 as camera surgeons in their second year and performed 15 as third-year residents assisted by their Mentors which were recorded. These recorded videos were observed by themselves and also by the teachers independently. The Mentors and Mentees were given a 10-point agenda graded over a scale of 5, where they were asked improvisation points if the scale was less than 3. A joint meeting was organized so that Mentors can clarify salient points. They mainly focused on learning of 10 basic steps of laparoscopic cholecystectomy which included port placement, dissection of the calot's triangle and creating the critical view of safety, tackling the cystic artery and the duct, Dissection of the gall bladder from its bed, retrieval of the gall bladder and port closure, duration of surgery, blood loss, unnecessary steps, Intra-operative mishaps, conversion from laparoscopic surgery to open surgery. All these 20 surgical residents were given to perform 15 laparoscopic cholecystectomies after reviewing these videos and the same 10 points were given to scale them. After the study, we found that 60% of the residents showed statistical improvement in port placement. Most of the residents showed significant improvement in the time required to create the critical view of safety while dissecting the calot's triangle. 82% of students showed improvement in the procedure of clip application. 85% of the students showed statistical improvement in the duration of surgery. 62% of students showed a marked reduction of unnecessary steps. There was no statistical difference in blood loss in both groups, though lesser in the latter group. There was no significant advantage in decreasing intraoperative gall bladder perforation in either group. Hence, The Video-based self-assessment with the mentor is an effective tool in training junior laparoscopic surgeons and to improvise their operative skills in LC.

KEYWORDS

Video-Based, Safe lap cholecystectomy, Learning Module, Self-Learning

INTRODUCTION

Surgery has been traditionally taught by the Halstedian model of "see one, do one, teach one." [1] This can be applied in our setting as we have a large number of cases coming to us. Minimally invasive surgery requires skill more than open surgery. It is based on the hand-eye coordination of the surgeon and the learning curve is very steep. Different training modules have been developed ranging from bench top models, and different simulators to Augmented and Virtual Reality systems. [2]Cadavers have also been used for training purposes. All of them require a large number of resources ranging from human resources to financial resources.

In a developing country, financial resources are the limiting factor when we have a large number of human resources.

However, to enhance operative skills, the use of only one module may not be effective. For developing countries, these are expensive and may not be available in most teaching institutes. Hence, we propose a model that combines mentoring along with assessment-operated videos to improve the operative skills during the learning curve.

Learning curves are a widely used diagnostic tool in machine learning. During training, plots of the measured performance can be created to show learning curves.

Reviewing the learning curves of models during training can be used to diagnose problems with learning. [3]

Hence, we have made a simple video-based learning module for the learning of one of the most commonly done laparoscopic surgeries worldwide. This can be used for residency training programs which have a large number of residents and an even larger number of residents.[4]

OBJECTIVES:

1. To see the feasibility and fidelity of a video-based learning module in a real-world situation.
2. To validate the new video-based model against the traditional modules established for learning laparoscopic cholecystectomy.

Study Design :

Method of the Study: Prospective Study

Sample Size: 20 Surgical Residents (All of them enrolled in the training of general surgery program)

Study duration: May 2019 to April 2022 (3 Years)

Study Place: Tertiary health care centre in Mumbai.

Methodology:

20 surgical residents were enrolled in this study from their first year of residency training till their final year.

These 20 residents were selected by a random selection method. The institution in which this study was performed, on average, performs 2 laparoscopic cholecystectomies per day.

First Year Residents :

All 20 of them had observed 30 laparoscopic cholecystectomies in their first year. Amongst these initial 30 surgeries, they had also learnt retraction of the gall bladder.

In these surgeries, the operating surgeon was the mentor of each of these students. The surgeon explained every step of the procedure in detail. They recorded videos of all the 30 surgeries and at the end of the year analyzed them over 10 days. Scoring of the steps of the surgery was explained later.

Second Year Residents:

As the same residents became second-year residents they assisted 30 Laparoscopic cholecystectomies as camera surgeons.

Before they started showing the camera, basic concepts of camera holding were explained along with the technical details.

The same process of recording their camera showing skills along with the operating skills of their mentors was done and they were discussed at the end.

Angulation of the camera held prime importance in easy dissection for the surgeon. Better the camera showing skills, faster the surgery.

Third-year Residents :
On going to the third and final year of their training program, they performed 15 laparoscopic cholecystectomies assisted by their mentors. While the residents performed these surgeries themselves, points recorded from their previous year's experience were reviewed by them. If there was any difficulty in performing the surgery, mentors guided them or took over the surgery if required.

The residents observed these recorded videos themselves and their teachers did the same independently after the whole session was over.

The Mentors and Mentees were given a 10-point agenda graded on a scale of 5. (1 being the worst and 5 being the best).

10-point Agenda:
They mainly focused on learning of 10 basic steps of laparoscopic cholecystectomy.

1. Port placement[5]
a. Camera port and Working ports
- It included 3 port and 4 port surgeries.
- It also included the time required for the insertion of each port
- No opti-ports were used

b. Manipulation and Elevation angle
2. Dissection of Calot's triangle and create a critical view of safety
- Anomalies in the anatomy of the cystic duct, cystic artery and hepatic artery were noted.
- Frozen Calot's if present.

3. Tackling the cystic artery and the cystic duct
- Clipping, ligation or staplers could be used.
- Any cholecysto-duodenal fistula noted.

4. Dissection of the gall-bladder from its bed
- Includes details of the instrument and energy source used.

5. Retrieval of the gall-bladder and Port closure
- Use of retrieval bag
- Closure of sheath
- Closure of skin
- Retrieval from the epigastric port or umbilical port.
- Suture materials used were noted.

6. Duration of surgery
7. Blood loss.
8. Unnecessary steps
9. Intra-operative mishaps
- Perforation of the Gall bladder
- Bile duct injuries
- Bowel perforation
10. Conversion from laparoscopy to open surgery.

From this 10-point agenda, each was scored from 1 to 5. Less than 3 meant a really poor score so if any agenda had a scoring of less than 3, the mentors gave tips for improvement in that particular aspect. A joint meeting was organized so that Mentors could get further clarity.

After this exercise was over, all these 20 surgical residents were given to perform another 15 laparoscopic cholecystectomies.

The same 10-point agenda was used to grade the skills of the operating surgeon. Now the scoring was done on each point after the incorporation of the model.Hence a comparison was done amongst the 10 points before and after the incorporation of the model.

RESULTS:
Agenda 1: Port Placement
60 % of the residents showed statistical improvement in the port placement which was assessed by the formation of the manipulation and elevation angles after they had marked the site for port placement. (p=0.04).

Only one resident was successful in doing a 3 port cholecystectomy which was his last surgery after the incorporation of the model.

Agenda 2: Dissection Of Calot's Triangle And Create A Critical View Of Safety
Most of the residents showed significant improvement in the time required to create a critical view of safety while dissecting the calot's triangle.

1% of the residents were unable to dissect to the point of critical view of safety till the last surgery post incorporation of the model.

Amongst all the patients who were posted for the surgery, One patient had an anomalous cystic artery which came from the common hepatic artery and 5 patients had a short and wide cystic duct. No other anatomic abnormalities were seen.

Agenda 3: Tackling The Cystic Artery And The Cystic Duct
All the surgeons used clips to ligate the cystic duct and cystic artery except one of the residents sutured the cystic duct as it was wide in the second half of the study.

82 % of students showed improvement in the procedure of clip application in terms of time consumption and complete inclusion of the lumens of both, the duct and the artery. (p=0.02)

Two studies involved frozen Calot's. Partial cholecystectomy was done for both procedures and a stapler was used for one of them. Both of them required active help from their mentors.

Agenda 4: Dissection Of The Gall-bladder From Its Bed
98 % of the surgeons used the laparoscopic hook aided with electrocautery while the other 2% of students used the assistance of scissors and Maryland with electrocautery.

63.4 % of the residents could manoeuvre this step better after incorporation of the model when it was judged in terms of going in the avascular sub-serosal plane.

Agenda 5: Retrieval Of The Gall-bladder And Port Closure
Before the incorporation of the model, 66% of the residents removed the gall bladder from the umbilical port while the rest removed it from the epigastric port.

After the incorporation of the model, 95 % of the residents were comfortable with removing the gall bladder from the umbilical port while 5% of them removed it from the epigastric port.

There was no statistical difference in the time and technique for port closure.

The umbilical port was closed with a port closure vicryl followed by skin staplers. While all the ports were closed directly by skin staplers.

Agenda 6: Duration Of Surgery
85% of the students showed statistical improvement in the duration of surgery ($p<0.05$)

Agenda 7: Blood Loss
After the model was applied there was no statistical difference in blood loss

Agenda 8: Unnecessary Steps
62% of students showed a marked reduction of unnecessary steps.

Agenda 9: Intra-operative Mishaps
There were no bile duct injuries and perforation of the bowel in pre and post-involvement of the module.

Pre incorporation of the module 2 % of the surgeries had a perforation of the gall bladder and stone spillage which reduced to none after the incorporation of the model.

Agenda 10: Conversion From Laparoscopy To Open Surgery.
Only one surgery had to be converted to open surgery due to excessive inflammation at the calot's triangle and inability to do dissection even by the mentor.

DISCUSSION :
When we say that laparoscopic surgery has a steep "learning curve"- It means that inexperienced surgeons have not only a longer operating time but also a higher complication rate. And this cannot be left to "trial and error" in routine clinical practices. The need of the hour is to

develop, define and introduce a model that is suitable for training a large number of surgeons for laparoscopic training that too utilises minimum time and financial resources. And the final aim is to shorten the "learning curve".[6]

Laparoscopic cholecystectomy refers to the removal of the gallbladder through small incisions in the abdomen. Over 5,00,000 minimally invasive cholecystectomies are performed annually, with the majority being removed through a laparoscopic approach. This is the procedure of choice for patients with asymptomatic, symptomatic, and most forms of complicated gallbladder disease

History of Laparoscopic Cholecystectomy: [7]

The first Laparoscopic cholecystectomy was done by Dr Muhe of Boblingen in Germany on September 12, 1985. He did it by using a side-viewing endoscope with pneumoperitoneum made with the help of a Veress Needle.

Indications Of Laparoscopic Cholecystectomy [8]

Diseases of Gall Bladder giving rise to any symptoms to the patient:

- Symptomatic Cholelithiasis
- Acute Cholecystitis
- Symptomatic Chronic Cholecystitis

Complicated gallbladder diseases

Contra-indications Of Laparoscopic Cholecystectomy [9]

Absolute Contraindications

- Invasive gallbladder carcinoma (diagnosed preoperatively)
- Uncorrected coagulopathy
- Inability to tolerate general anaesthesia or laparotomy

Safe technique:

- The safety of laparoscopic cholecystectomy requires correct identification of relevant anatomy.
- An intraoperative cholangiogram may reduce the rate or severity of the injury and improve injury recognition.[10]

(None of the surgeries performed in this study have required an intra-operative cholangiogram or ultrasonography.

Ergonomics:

Ergonomics is extremely essential. It must be learnt before performing the surgery. Studies have shown that correct ergonomics can reduce suturing time. Pressure-related chronic pain among surgeons is relieved by the use of ergonomically designed products. [11]

Once the ergonomics are taken into consideration port placement begins. Port placement is an art to be learnt in laparoscopic surgery.

Open technique for camera port insertion is usually preferred for laparoscopic surgery. After that one can go ahead with a 3 or 4-port surgery.

Knowing the anatomy is of utmost importance as only a few amongst thousands of cases will have anomalous anatomy and can put a surgeon in a grim situation.[12,13]

The key to a successful cholecystectomy is the ability to dissect the Calot's triangle and achieve a critical view of safety only after which a surgeon must clip the cystic duct and cystic artery.[14]

In our study special emphasis was made on gall bladder retrieval and port closure because one tends to take these lightly once the gall bladder is removed from its bed. Residents were taught the ideal way to remove the specimen from the umbilical port. There are multiple studies which show advantages of one over the other but as an institution protocol removal from the umbilical port was practised. [15]

Use of drains:[10]

Using a drain postoperatively after laparoscopic cholecystectomy is at the discretion of the operating surgeon. Recent studies, after multiple randomized controlled trials and meta-analysis, have found that the use of drain after elective laparoscopic cholecystectomy increases post-operative pain, and wound infection rates and delays hospital discharge.

In our study drains were used when there was excessive dissection, perforation of the gall bladder and any doubt of bile duct injury. But it did not hold any significance in the postoperative outcome.

The surgeon must not hesitate to convert to open surgery if laparoscopically, required dissection is not possible.

A balance has to be made by the operating surgeon between going ahead with a difficult dissection with laparoscopy and converting to open surgery which would simplify the procedure.[16]

Our scoring system:[17]

5 points were given to each agenda in the steps of the surgery. While giving points for the respective steps, a previously established model was kept in mind –GOALS(Global Operative Assessment of Laparoscopic Skills)[18]

GOALS is a validated assessment tool for grading overall technical proficiency for laparoscopic surgery. It does measure domains, such as fluidity of motion but does not define surgical or clinical judgement, e.g., autonomy. Each of the five domains shown below is scored on a Likert Scale between 1 – 5, a scoring anchor, with a total score range from 5 – 25.

Perception of depth

1 - Constantly overshooting target, wide swings and slow to correct
3 - Little overshooting or missing target, but was quick to correct
5 - Accurately directing instruments in the correct plane of the target

Bimanual Dexterity

1 - Uses one hand, ignoring non-dominant hand and poor coordination between hands
3 - Uses both hands, but does not optimize the interaction between the use of both the hands
5 - Expertly uses both hands in a complementary manner to have optimal exposure

Efficiency

1 – Uncertain and inefficient effort with many tentative movements. Continuously changing focus and persisting without progress
3 - Slow, but planned movements which are reasonably organized
5 - Confident, efficient and safe conduct.Maintains focus on the task until it is better performed by way of an alternative approach

Tissue Handling

1 - Rough movements, tears tissue, injures adjacent structures with poor grasper control and grasper frequently slips
3 - Handles tissue reasonably well with minor trauma to adjacent tissue
5 - Handles tissues well and applies appropriate traction with negligible injury to adjacent structures

So a detailed scoring pattern was used to generate better outcomes which lead to significant improvement in the scoring of the resident's post incorporation of the model.

Hence, this study comprises every detail of the surgery along with a teaching module where the operating surgeon himself will analyze his surgery, and make the required changes in the following surgery, thus enhancing his skills as a surgeon and delivering better patient outcomes.

CONCLUSION:

Video-based learning module combining self-assessment and mentoring is an effective tool for training junior laparoscopic surgeons, in a setting with ample human resources with less financial aid. It will improve their skills in Laparoscopic Cholecystectomy turning to better surgical outcomes, fewer complications, lesser surgical times and shorter hospital stays.

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No conflict of interest

REFERENCES

1. Shafiei SB, Hussein AA, Guru KA. Cognitive learning and its future in urology: surgical skills teaching and assessment. Curr Opin Urol. 2017 Jul;27(4):342–7.
2. Steigerwald SN, Park J, Hardy KM, Gillman L, Vergis AS. The Fundamentals of Laparoscopic Surgery and LapVR evaluation metrics may not correlate with operative performance in a novice cohort. Med Educ Online. 2015 Jan 1;20(1):30024.
3. Brownlee J. How to use Learning Curves to Diagnose Machine Learning Model Performance [Internet]. Machine Learning Mastery. 2019 [cited 2020 Apr 1]. Available from: https://machinelearningmastery.com/learning-curves-for-diagnosing-machine-learning-model-performance/
4. Pariani D, Fontana S, Zetti G, Cortese F. Laparoscopic Cholecystectomy Performed by Residents: A Retrospective Study on 569 Patients [Internet]. Surgery Research and Practice. 2014 [cited 2020 Apr 1]. Available from: https://www.hindawi.

com/journals/srp/2014/912143/
5. What is the technique for placing ports and instruments in laparoscopic cholecystectomy? [Internet]. [cited 2020 Apr 1]. Available from: https://www.medscape.com/answers/1582292-70762/what-is-the-technique-for-placing-ports-and-instruments-in-laparoscopic-cholecystectomy
6. Köckerling F, Pass M, Brunner P, Hafermalz M, Grund S, Sauer J, et al. Simulation-Based Training – Evaluation of the Course Concept "Laparoscopic Surgery Curriculum" by the Participants. Front Surg [Internet]. 2016 [cited 2020 Apr 1];3. Available from: https://www.frontiersin.org/articles/10.3389/fsurg.2016.00047/full
7. Laparoscopic Cholecystectomy - A SAGES Wiki Article [Internet]. SAGES. [cited 2020 Apr 3]. Available from: https://www.sages.org/wiki/laparoscopic-cholecystectomy/
8. Laparoscopic Cholecystectomy: Background, Indications, Contraindications [Internet]. [cited 2020 Apr 3]. Available from: https://emedicine.medscape.com/article/1582292-overview
9. What are the contraindications to laparoscopic cholecystectomy? [Internet]. [cited 2020 Apr 3]. Available from: https://www.medscape.com/answers/171886-20494/what-are-the-contraindications-to-laparoscopic-cholecystectomy
10. Guidelines for the Clinical Application of Laparoscopic Biliary Tract Surgery - A SAGES Publication [Internet]. SAGES. [cited 2020 Apr 3]. Available from: https://www.sages.org/publications/guidelines/guidelines-for-the-clinical-application-of-laparoscopic-biliary-tract-surgery/
11. Supe AN, Kulkarni GV, Supe PA. Ergonomics in laparoscopic surgery. J Minimal Access Surg. 2010;6(2):31–6.
12. Anatomical variations of the cystic duct.OA Anatomy [Internet]. [cited 2020 Apr 1]. Available from: http://www.oapublishinglondon.com/article/1280
13. Ding Y-M, Wang B, Wang W-X, Wang P, Yan J-S. New classification of the anatomic variations of cystic artery during laparoscopic cholecystectomy. World J Gastroenterol WJG. 2007 Nov 14;13(42):5629–34.
14. Chua ME, Mendoza J, See M, Esmena E, Aguila D, Silangcruz JM, et al. A critical review of recent clinical practice guidelines on the diagnosis and treatment of non-neurogenic male lower urinary tract symptoms. Can Urol Assoc J. 2015; 9(7–8): E463–70.
15. Hajibandeh S, Hajibandeh S, Clark MC, Barratt OA, Taktak S, Subar D, et al. Retrieval of Gallbladder Via Umbilical Versus Epigastric Port Site During Laparoscopic Cholecystectomy: A Systematic Review and Meta-Analysis. Surg Laparosc Endosc Percutan Tech. 2019 Oct;29(5):321–7.
16. Sakpal SV, Bindra SS, Chamberlain RS. Laparoscopic Cholecystectomy Conversion Rates Two Decades Later. JSLS. 2010;14(4):476–83.
17. Vassiliou MC, Feldman LS, Andrew CG, Bergman S, Leffondré K, Stanbridge D, et al. A global assessment tool for evaluation of intraoperative laparoscopic skills. Am J Surg. 2005 Jul 1;190(1):107–13.
18. GOALS [Internet]. C-SATS. [cited 2020 Apr 3]. Available from: https://www. csats.com/goals