LEARNING PROCESS OF LAPAROSCOPIC TRANSABDOMINAL PRE-PERITONEAL (TAPP) REPAIR OF GROIN HERNIA USING 3D ENDOVISION SYSTEM.

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Introduction

Even after being internationally recommended, uptake for laparoendoscopic hernia surgeries is still low. The reasons quoted include the 2D environment of laparoendoscopic surgery and long learning curve. We aim to assess the impact of 3D Endovision system in learning curve of a surgical trainee and its transferability to the 2D environment.

Methods

This was a prospective observational study done at a tertiary care academic center during the period between September, 2022 and March 2023. A senior surgical resident (MCh trainee) who had not done any laparoscopic inguinal hernia surgeries, but have undergone more than 100 hours of training in Endo trainer and reviewed 20 operative videos and assisted 17 cases of TAPP repair, did 25 cases of TAPP repairs, with first 20 cases in 3D and last 5 cases in 2D Endovision system. Before undertaking the study, the trainee underwent stereovision test using Randot© stereotest (Stereo Optical, Chicago, Illinois, USA). All the cases in the trial were performed under the direct supervision of an expert surgeon (faculty) in the field of laparoscopic hernia repairs. The supervising faculty provided technical help deemed necessary and took over the procedure from the trainee if there were any technical difficulties or there was non-progression of the procedure. This study was cleared by the Institutional Ethics Committee and was registered in the Clinical Trial Registry of India.

After obtaining written and informed consent, patients with unilateral, uncomplicated inguinal hernias, who were being prepared for elective surgery, were recruited for the study. Patients with age more than 60 and less than 18 years, those who had not consented to the study, those with bilateral hernias, irreducible or obstructed hernia, recurrent hernia, patients with a history of lower abdominal surgeries and patients with ASA score III or more, were excluded from the study.

Operative Procedure and Equipment

General anesthesia with standard agents was used for all cases. Patient was placed supine with both hands tucked to the side of the body. All patients in the study were catheterized, though it is not our general protocol for laparoscopic inguinal hernia surgeries. Surgeon and camera assistant stood on the side opposite to the hernia. The monitor was placed at the foot end of the patient. Pneumoperitoneum was established using closed technique through an umbilical incision. 12mm Endopath XCEL™ port (Ethicon Endo-Surgery LLC, Guaynabo, USA) was placed in the umbilical region for telescope. Both working trocars (5mm, Endopath XCEL™) were placed under vision in the pararectal line at the level of umbilicus on either side. Patient was then placed in a Trendelenburg position, turned 15° towards the surgeon.

Procedure was carried out in a standard fashion. Polypropylene heavy mesh was used to cover the entire myopectineal orifice. At least 2 absorbable a were used to fix the mesh and peritoneal incision was closed with barbed 2-0 polydioxanone suture (V-Loc 180/Covidien, Mansfield, MA). All videos were recorded in 2D HD format for further evaluation.

In 3D Endovision system, Karl Storz system (Karl Storz Endoscopy, Tuttlingen, Germany) with TIPCAM telescope and monitor (LCD monitor, 32-inch Model number- EJ-NDA32EK2) were used. The Endovision system used in 2D HD was Stryker Laparoscopy System (Stryker Endoscopy, San Jose, USA) and 26 inch monitor (Vision pro 26-inch LED display, Model number-BPM150524511).

The primary endpoint of the study was the total operating time and time for dissection, mesh placement and peritoneal closure. The total operating time was the time from the skin incision made for insertion of the Veress needle to the closure of the skin after completion of the procedure. The dissection time was the time between peritoneal incision and the beginning of mesh insertion. The mesh placement time was the duration between insertion of the mesh to the insertion of the needle for peritoneal closure. The peritoneal closure time is the duration between insertion of the needle for peritoneal closure to the division of suture after completion of peritoneal closure. All durations were expressed in minutes.
Secondary endpoints were skill transferability from 3D to the 2D HD Endovision system in terms of the operating time and instrument path length. Comparisons with an expert cohort was done of the operating time and its components of the trainee to that of a historical cohort of experts, based on a previously published experience of TAPP hernia repair using a 3D Endovision system(15). The recorded 2D videos of the procedure were assessed to identify the instrument path length in terms of pixels using Kinovea© (GNU GENERAL PUBLIC LICENSE Version 2, June 1991 Copyright 1989, 1991 Free Software Foundation, Inc.). This system provides an acceptable level of accuracy in angular and linear measurements obtained via digitization of x- and y-axis coordinates. The faculty take over time, including the number of times and duration of the faculty takes over as operating surgeon, was recorded in each phase. Any untoward events that occurred during surgery and after surgery is recorded in a proforma.

Data analysis

The average of values or the mean value is calculated. Values by subtracting each variable is taken and was plotted as a cumulative sum (CUSUM, cumulative sum). This technique gives a graphical representation. There can be one or more inflection points where the graph descends or achieves a stable value. This was later validated by independent t test (Mann Whitney's test), to compare the cohort before and after the inflection point which brings out the statistical probability of significant change. If there were more than one inflection point, we took the inflection point that has a more stable efferent limb.

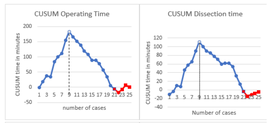
Values were also compared in blocks using independent t test or Man Whitney's test. For the purpose of the study, we divided the data into group of fives. 1st to 5th case was taken as first block (3D block 1) and consequent five cases as second, third, and fourth blocks. Last five cases of 2D Endovision system were considered as 2D block.

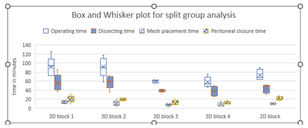
Visual graphs and CUSUM technique were used to compare faculty take over time and trainee's with published expert cohort values. Instead of putting average as the subtracting value, expert cohort value was used. If the trainee was reaching the average of expert, then his CUSUM chart will be similar to the chart which reaches 0 in the end. If the trainee plateaus and the CUSUM value doesn't approach zero, then the expertise of the trainee have not reached up to the expert cohort value. Bland-Altman graph compared the difference of the trainee's time with the expert's time and infers whether there was an agreement when compared with the gold standard (i.e, historical expert cohort values). Fischer's exact test was done to assess the distribution of comorbidities and complications. Graphical comparison was made between the faculty take over time and trainee time using area graphs in each phases of the operating time.

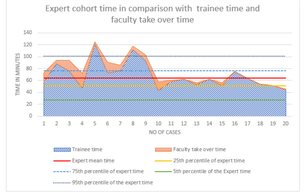
The analysis of the instrument path characteristics were made in terms of pixels. Path lengths in the settings of the suturing process and peritoneal incision were assessed. Dominant hand movement was assessed by using the tracker in Kinovea© 0.9.5 software which gave raw data. Path length was later calculated using Microsoft Excel formulas and macros to assess the values in pixels per frame. Pixel data was used to plot graphs and assess the CUSUM and split group block techniques.

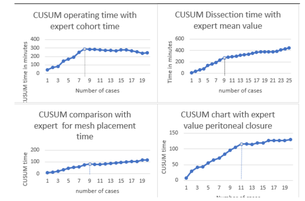
Results

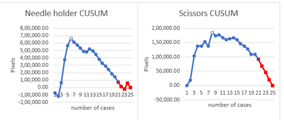
block average and distribution were not significantly different from the fourth block of 3D Endovision cases and significantly lower than the first block of 3D Endovision systems in all phases except peritoneal closure. signifying skill transferability.
Trainee reached within the IQR of expert cohort after inflection and there was moderate agreement according to Bland Altmann graphs.
Faculty takeover time came down after 2nd block again to increase when the 2D Endovision system is used. Pathlength of needle holder and scissors showed earlier inflection point (5th and 6th case) and good skill transferability to 2D Endovision in terms of pathlength.
Post-operative complications till the 3-month follow-up period showed a decreasing trend.











Conclusions

The learning curve is expedited using the 3D Endovision system
but skill transferability was less in the case of complex procedures like peritoneal suturing.
Faculty takeover time it decreased in third block
. Trainee results were comparable to the expert cohort
. Video-based assessment is a good adjunct for objective assessment of the learning curve.

References

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