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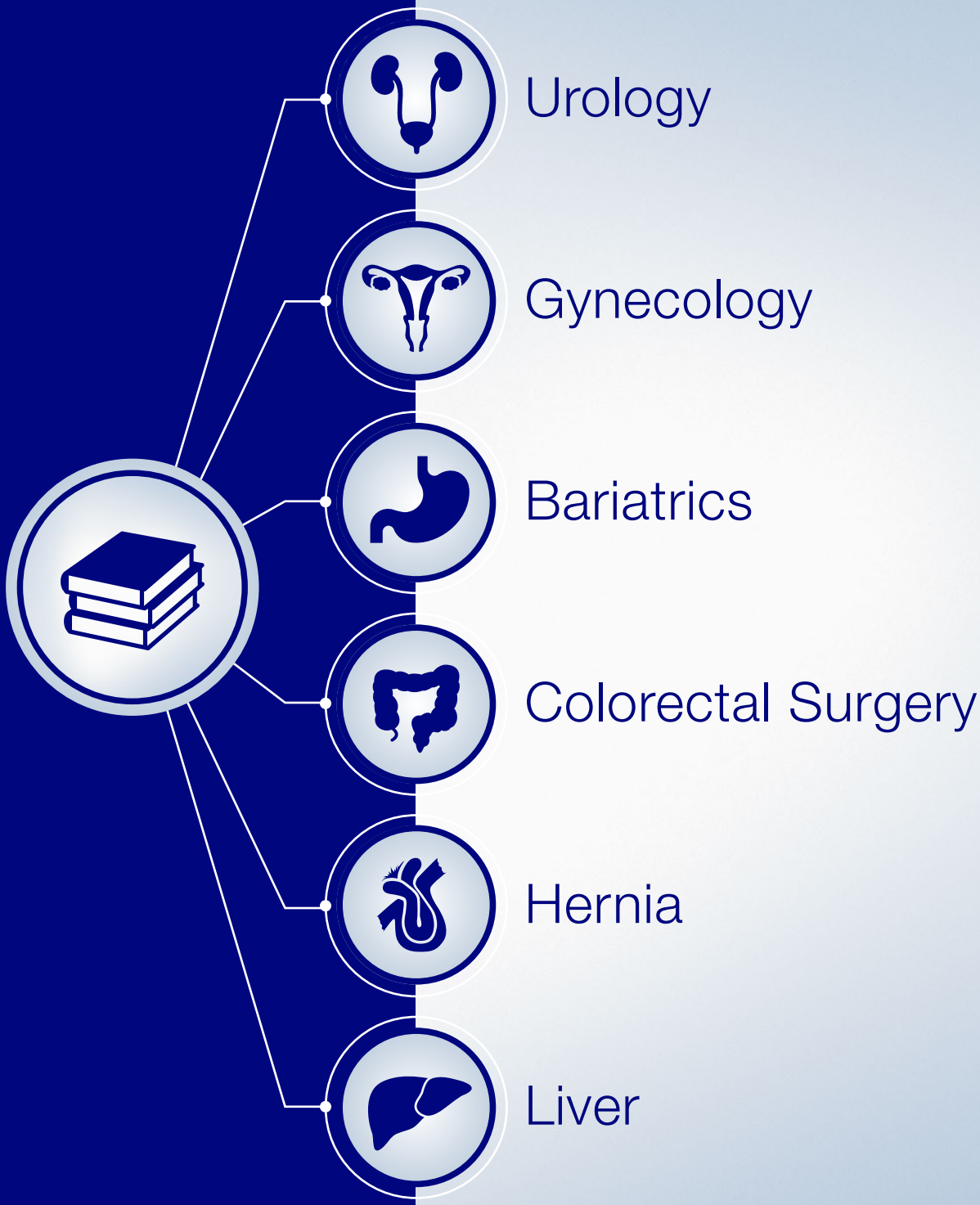
3D Endoscopy

Study Summary Overview



3D Endoscopy

Disclaimer

This study summary gives an overview of the studies already published which compare the use of 3D technology and 2D technology in laparoscopic operations. Included are various colorectal and bariatric surgery procedures as well as gynecological and urological surgery procedures. Liver and hernia procedures are also considered.

Each study is summarized on a single page and is presented with its results and key findings in addition to general information like the author, title and study design.

In turn, the titles and authors of the studies in a specialist area are presented on an overview page, enabling the reader to quickly obtain an overview of the available evidence. This overview page additionally features four indicators that show whether a study includes results regarding operating time, patient outcome, surgeon confidence and the learning curve. These indicators are designed to help the reader gain an initial overview of the aspects covered by a study and are provided irrespective of whether the results are positive or negative.

The keywords quoted cannot be found directly in the original texts and are derived in part from the study results. In the studies, the operating time calculated may be the entire operating time needed or the time determined for individual operation steps. The patient outcome is founded on factors such as a shorter hospital stay, less bleeding and quicker continence recovery. Surgeon confidence is determined on the basis of factors like speedier surgery, fewer stitches and knots, and subjective reports. The learning curve is represented in particular by a shorter operating time in the case of inexperienced surgeons.

The original study texts can be accessed via the usual channels. If you have any questions, please do not hesitate to contact your designated sales representative.

3D Endoscopy

Key Indicators

Urology

Aykan et al. (2014)
Perioperative, Pathologic, and Early Continence Outcomes Comparing Three-Dimensional and Two-Dimensional Display Systems for Laparoscopic Radical Prostatectomy — A Retrospective, Single-Surgeon Study

Bove et al. (2015)
3D vs 2D Laparoscopic Radical Prostatectomy in Organ-Confined Prostate Cancer: Comparison of Operative Data and Pentafecta Rates: A Single Cohort Study

Kinoshita et al. (2015)
High-Definition Resolution Three-Dimensional Imaging Systems in Laparoscopic Radical Prostatectomy: Randomized Comparative Study with High-Definition Resolution Two-Dimensional Systems

Komatsuda et al. (2016)
Technical Improvement Using a Three-Dimensional Video System for Laparoscopic Partial Nephrectomy

Benelli et al. (2018)
3D versus 2D Laparoscopic Radical Prostatectomy for Organ Confined Prostate Cancer: Our Experience

Arezzo et al. (2019)
The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

Bertolo et al. (2019)
Current Status of 3D Laparoscopy in Urology: An ESUT Systematic Review and Cumulative Analysis

3D Endoscopy

Key Indicators

Gynaecology

Fanfani et al. (2016)
How Technology Can Impact Surgeon Performance: A Randomized Trial Comparing 3-Dimensional versus 2-Dimensional Laparoscopy in Gynecology Oncology

Yazawa et al. (2018)
Surgical Outcomes of Total Laparoscopic Hysterectomy with 2-Dimensional versus 3-Dimensional Laparoscopic Surgical Systems

Arezzo et al. (2019)
The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

3D Endoscopy

Key Indicators

Bariatrics

Padin et al. (2017)
Impact of Three-Dimensional Laparoscopy in a Bariatric Surgery Program: Influence in the Learning Curve

Kanaji et al. (2017)
Comparison of Two- and Three-Dimensional Display for Performance of Laparoscopic Total Gastrectomy for Gastric Cancer

Arezzo et al. (2019)
The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

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Key Indicators

Colorectal Surgery

Arezzo et al. (2019)

The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

Bracale et al. (2020)

Does a 3D Laparoscopic Approach Improve Surgical Outcome of Mininvasive Right Colectomy? A Retrospective Case-Control Study

3D Endoscopy

Key Indicators

Hernia

Leon et al. (2017)

3D Vision Provides Shorter Operative Time and More Accurate Intraoperative Surgical Performance in Laparoscopic Hiatal Hernia Repair Compared with 2D Vision

Arezzo et al. (2019)

The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

3D Endoscopy

Key Indicators

Liver

Velayutham et al. (2016)
3D Visualization Reduces Operating Time when Compared to High-Definition 2D in Laparoscopic Liver Resection: A Case-Matched Study

Kawai et al. (2018)
3D Vision and Maintenance of Stable Pneumoperitoneum: A New Step in the Development of Laparoscopic Right Hepatectomy

Arezzo et al. (2019)
The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

Journal of Endourology (2014)

Study Summary

Perioperative, Pathologic, and Early Continence Outcomes Comparing Three-Dimensional and Two-Dimensional Display Systems for Laparoscopic Radical Prostatectomy — A Retrospective, Single-Surgeon Study

Serdar Aykan, MD[1], Paras Singhal, MD[2], Daniel P. Nguyen, MD[3], Akin Yigit, MD[4], Murat Tuken, MD[1], Emrah Yakut, MD[1], Aykut Colakerol, MD[1], Suhejb Sulejman, MD[1], Atilla Semercioz, MD[1]

[1]Department of Urology, Bagcilar Training and Research Hospital, Istanbul, Turkey, [2]Department of Urology, Weill Cornell Medical College, New York, New York, [3]Department of Urology, Berne University Hospital, Berne, Switzerland, [4]Department of Urology, Erzincan University School of Medicine, Erzincan, Turkey

Conclusion:
Laparoscopic radical prostatectomy using 3D vision is associated with shorter operation times, less blood loss and higher early continence rates compared to 2D vision.

Objective:
· To compare a 3D laparoscopic system to a 2D display system for the investigation of perioperative, pathological and early continence results of laparoscopic radical prostatectomy (RP).

Design:
· Retrospective cohort study.

Indication:
· Patients with clinically localized prostate cancer that underwent laparoscopic RP.
· The study was conducted by a surgeon who had performed more than 600 laparoscopic procedures, including about 100 laparoscopic RPs.

Patients:
· A total of 29 patients underwent laparoscopic RP with a 3D display system and 66 patients underwent laparoscopic RP with a 2D display system (October 2009 to December 2012).
· Baseline characteristics, perioperative and pathological variables, and continence data were reviewed retrospectively from a prospectively maintained database three months after surgery.

Results:
· The mean total operative time was significantly shorter for the 3D group with 131 minutes (SD ± 18 min) compared to 190 minutes (SD ± 31 min) for the 2D group ($p < 0.001$).
· The average time to perform urethrovesical anastomosis was 28 minutes (SD ± 6 min) for the 3D group compared to 87 (SD ± 17 min) for the 2D group ($p < 0.001$).
· Blood loss was significantly lower for the 3D group at 102 ml (SD ± 17 ml) versus 138 ml (SD ± 32ml) for the 2D group ($p < 0.001$).
· A statistically significantly higher number of patients in the 3D group had early recovery of continence compared with patients in the 2D group (14/28 (50%) of patients in the 3D group vs 16/64 (25%) of patients in the 2D group, $p = 0.02$).

Key Findings:
· The 3D imaging system is significantly associated with shorter operative times, reduced blood loss and higher early continence rates.

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BMC Urology (2015)

Study Summary

3D vs 2D Laparoscopic Radical Prostatectomy in Organ-Confined Prostate Cancer: Comparison of Operative Data and Pentafecta Rates: A Single Cohort Study

Pierluigi Bove, Valerio Iacovelli, Francesco Celestino, Francesco De Carlo, Giuseppe Vespasiani, Enrico Finazzi Agrò

Department of Urology, Tor Vergata University of Rome, Rome, Italy

Conclusion:

The 3D technology increases the possibility of achieving better intraoperative results.

Objective:

· To compare perioperative data between 2D and 3D laparoscopic radical prostatectomy (LRP) and the current role of 3D LRP in urology.

Design:

· Randomized clinical trial.

Indication:

· Patients with clinical T1c prostate tumor belonging to the low/intermediate D'Amico risk group were included in the study from October 2012 to July 2013.

· All patients underwent a laparoscopic extraperitoneal radical prostatectomy (LERP) by a single experienced surgeon.

Patients:

· Patients were randomly divided into two groups: 2D LERP (43 patients) operated with a 2D HD camera and 3D LERP (43 patients) operated with a fourth-generation 3D HD viewing system.

Results:

· A significantly shorter operative time was detected with 3D LERP in comparison to 2D LERP (241 vs. 162 min, p = 0.01).

· Imaging via 3D resulted in reduced time in comparison with 2D in the technically demanding task of anastomosis (32 vs. 24 min, p = 0.03).

· Significant improvement in quality of life in the first month in the 3D group (average value 90.45) compared to the 2D LERP group (average value 81.8) (p = 0.01).

· Positive quality of life results also in the third (93.3 vs. 83.6, p = 0.01) and twelfth (95.4 vs. 88.1, p = 0.03) month in the 3D group compared to the 2D group.

Key Findings:

· Improvement of intraoperative blood loss and postoperative restoration of continence with consideration of oncological safety.

· Laparoscopy performed under 3D imaging is superior to 2D laparoscopy in radical prostatectomy.

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Surgical Endoscopy (2015)

Study Summary

High-Definition Resolution Three-Dimensional Imaging Systems in Laparoscopic Radical Prostatectomy: Randomized Comparative Study with High-Definition Resolution Two-Dimensional Systems

Hidefumi Kinoshita[1], Ken Nakagawa[2], Yukio Usui[3], Masatsugu Iwamura[4], Akihiro Ito[5], Akira Miyajima[2], Akio Hoshi[3], Yoichi Arai[5], Shiro Baba[4], Tadashi Matsuda[1]

[1]Department Urology and Andrology, Kansai Medical University, 2-5-1 Shin-machi, Hirakata 573-1010, Japan, [2]Department of Urology, Keio University School of Medicine, Tokyo, Japan, [3]Department of Urology, Tokai University Hospital, Isehara, Japan, [4]Department of Urology, Kitasato University School of Medicine, Sagamihara, Japan, [5]Department of Urology, Tohoku University Graduate School of Medicine, Sendai, Japan

Conclusion:
The 3D imaging system in laparoscopic radical prostatectomy increased surgical feasibility and reduced surgeon effort without causing significant fatigue.

Objective:

· To determine if laparoscopic radical prostatectomy (LRP) under 3D HD resolution imaging is superior to LRP under 2D HD resolution imaging in terms of perioperative outcome, feasibility and fatigue.

Design:

· Randomized study trial, multicenter, controlled.

Indication:

· Patients with histologically confirmed prostate adenocarcinoma with local disease (clinical tumor stage T1c-2c, N0, M0 disease) who opted for laparoscopic radical prostatectomy.

· Patients with a WHO performance status of 0 and an age of less than 75 years.

Patients:

· A total of 116 patients were randomly assigned to a 2D or 3D group.

· Surgeons (three surgeons had performed more than 200 operations, while six surgeons had completed fewer than 200) were divided into two subgroups according to the number of operations.

· All surgeons performed LRP via a retroperitoneal approach and vesicourethral anastomosis (VUA) via an unbroken suture.

Results:

· The number of VUA sutures was significantly less with the 3D imaging system, with 11.5 sutures versus 10.4 sutures with the 3D system ($p = 0.04$, Mann-Whitney test).

· VUA time was not significantly shorter in the 3D group (26.7 min, mean value) than in the 2D group (30.1 min, mean value).

· Number of operations where the VUA time was below the median was greater in the 3D group ($p = 0.04$).

· Feasibility, which was evaluated during the LRP, significantly was better when using the 3D imaging system.

Key Findings:

· The subjective evaluation by the surgeons showed that the 3D imaging was better and did not increase fatigue.

· A 3D imaging system can lead to a higher quality of precision performance.

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Asian Pacific Journal of Cancer Prevention (2016)

Study Summary

Technical Improvement Using a Three-Dimensional Video System for Laparoscopic Partial Nephrectomy

Akari Komatsuda, Kazuhiro Matsumoto, Akira Miyajima, Gou Kaneko, Ryuichi Mizuno, Eiji Kikuchi, Mototsugu Oya

Department of Urology, Keio University School of Medicine, Tokyo, Japan

Conclusion:

The 3D video system makes it possible to shorten the warm ischemic time in laparoscopic partial nephrectomy and can thus help to improve the procedure.

Objective:

· To overcome the difficulty of resection of the tumor and closure of the renal parenchyma within a limited warm ischemia time (WIT), a 3D video system with laparoscopic partial nephrectomy was evaluated in its usefulness.

Design:

· Retrospective comparative cohort study.

Indication:

· Between November 2009 and June 2014, a laparoscopic partial nephrectomy (LPN) was performed in 31 patients.

· Indication for LPN was clinical T1 renal cell carcinoma (RCC).

· The surgeon decided if the clinical T1a RCC is suitable for open partial nephrectomy (OPN), LPN or laparoscopic radical nephrectomy (LRN).

Patients:

· A total of 31 patients underwent LPN: In 20 patients a conventional 2D video system was used (between November 2009 and June 2013), in 11 a 3D video system (between June 2013 and June 2014).

· LPN was performed by a surgeon.

Results:

· There were no significant differences in operative time (158 vs. 175 min, $p = 0.34$), pneumoperitoneum time (118 vs. 136 min, $p = 0.32$), cutting time (5.6 vs. 6.3 min, $p = 0.49$) or estimated blood loss (37 vs. 23 ml, $p = 0.33$).

· WIT was significantly shorter in 3D LPN (16.1 min) than in 2D LPN (21.2 min, $p = 0.02$).

· Suture time was significantly shorter in 3D LPN than in 2D LPN (9.1 min vs. 15.2 min, $p = 0.008$).

· Frequency of needle change was significantly lower in 3D LPN than in 2D LPN (7.8 vs. 3.9 times, $p < 0.01$).

· 3D video systems could contribute to the spread of safe and minimally invasive surgery in RCC.

Key Findings:

· 3D video systems can contribute to safe minimally invasive surgery for RCC.

· 3D video systems can provide good surgical results and have a potentially significant cost advantage.

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Journal of Clinical Urology (2018)

Study Summary

3D versus 2D Laparoscopic Radical Prostatectomy for Organ Confined Prostate Cancer: Our Experience

Andrea Benelli, Virginia Varca, Marco Rosso, Francesca Peraldo, Andrea Gregori
Department of Urology, G. Salvini Hospital, Italy

Conclusion:
With 3D HD vision the achieved operative, functional and oncological results are significantly better in comparison with a 2D HD vision.

Objective:

· The aim of the study was to compare operative, functional and oncological results of 3D and 2D laparoscopic radical prostatectomy (LRP).

Design:

· Multicenter randomized controlled study.

Indication:

· Patients with the histological diagnosis of a clinical T1 prostate carcinoma who belonged to the low to medium D'Amico risk group were included.

Patients:

· The patients undergoing LRP were randomly allocated to a 2D HD camera (50 patients) or a 3D HD camera (52 patients).

· All procedures were performed by the same experienced surgeon (more than 500 laparoscopic prostatectomies performed) using the same LRP surgical technique.

Results:

· Mean total operative time of 143 ± 17 minutes (range) in the 2D group and 118 ± 15 minutes (range) in the 3D group – was significantly shorter in the 3D group ($p = 0.02$).

· Mean anastomosis time of 31 ± 12 minutes (range) in the 2D group and 23 ± 12 minutes (range) in the 3D group – was significantly shorter in the 3D group ($p = 0.03$).

· Length of hospitalization was reduced (7.8 vs. 6.1 days, $p = 0.16$) in the 3D cohort, however not statistically significantly.

· The pentafecta rate at 3 months was 46% in the 2D group and 50% in the 3D group, after 12 months it was 60% in the 2D group and 67.3% in the 3D group, respectively – the value results were significantly better in the 3D group ($p = 0.03$).

Key Findings:

· The surgical procedures were faster with 3D and the long-term achieved pentafecta was superior.

· 3D imaging is superior to 2D imaging in detecting various fine structures and does not increase fatigue.

· The 12-month pentafecta rate shows significantly better long-term oncological and functional results with 3D imaging.

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Surgical Endoscopy (2019)

Study Summary

The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

Alberto Arezzo[1], Nereo Vettoretto[2], Nader K. Francis[3], Nathan J. Curtis[3,4], Daniele Amparore[5], Manuel Barberio[6], Luigi Boni[7]

[1]Department of Surgical Sciences, University of Torino, Corso Dogliotti 14, 10126 Torino, Italy, [2]Montichiari Surgery, ASST Spedali Civili Brescia, Montichiari, Italy, [3]Department of General Surgery, Yeovil District Hospital NHS Foundation Trust, Higher Kingston, Yeovil, UK, [4]Department of Surgery and Cancer, St Mary's Hospital, Imperial College London, London, UK, [5]Division of Urology, ESUT Research Group, San Luigi Gonzaga Hospital, Orbassano, Torino, Italy, [6]IRCAD, Research Institute Against Digestive Cancer, Strasbourg, France, [7]Department of Surgery, Fondazione IRCCS Cà Granda, Policlinico Hospital, University of Milan, Milan, Italy

Conclusion:
The use of 3D vision in laparoscopy is recommended to reduce surgery time.

Objective:

· Systematic reviews of the PubMed and Embase libraries were conducted to provide evidence of the potential benefits of 3D imaging systems for clinical practice and patient outcomes.

Design:

· Systematic review.

Number of Studies Included:

· Review included 18 studies in total: seven randomized controlled studies, 11 cohort studies.

· Four deal with cholecystectomy, three colorectal operations, two gastrectomies, two hernia repairs, six gynecological operations and one radical prostatectomy.

Indication:

· Inclusion criteria of the study were comparative observational studies on 3D technology (RCTs, prospective and retrospective).

· All searches were carried out on 22 September 2017 in both PubMed and Embase electronic libraries, with no restriction on year of publication or language.

Results:

· 3D significantly shortened the operation time (mean difference 11 min (8% [95% CI 20.29-1.72], I2 96%).

· A significant reduction of complications was observed when using 3D systems (RR 0.75 [95 CI% 0.60-0.94], I2 0%), especially in cases with laparoscopic sutures (RR 0.57 [95% CI 0.35-0.90], I2 0%).

· In 69 box trainer or simulator studies, 64% of participants concluded that they worked significantly faster and 62% that they made fewer mistakes when using 3D.

Key Findings:

· 3D vision improves results for young trainees who perform standardized box trainer tasks.

· The use of 3D imaging systems improves the completion time and error rate of laparoscopic box trainer tasks.

· 3D laparoscopy does not lead to a higher cognitive workload and may lead to a lower experienced cognitive workload, provided that the viewing configuration is optimal.

· 3D laparoscopy could be advantageous in terms of operating time for more complex procedures.

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Journal of Endourology (2018)

Study Summary

Current Status of 3D Laparoscopy in Urology: An ESUT Systematic Review and Cumulative Analysis

Riccardo Bertolo[1], Enrico Checcucci[2], Daniele Amparore[2], Riccardo Autorino[3], Alberto Breda[4], Miguel Ramirez-Backhaus[5], Prokar Dasgupta[6], Cristian Fiori[2], Jens Rassweiler[7], Evangelos Liatsikos[8], Francesco Porpiglia[2]

[1]Glickman Urological and Kidney Institute, Cleveland, OH, USA, [2]Urology Department, San Luigi Hospital, University of Turin, Turin, Italy, [3]Division of Urology, Virginia Commonwealth University, Richmond, VA, USA, [4]Uro-Oncology Division and Kidney Transplant Unit, Fundacio Puigvert, Barcelona, Spain, [5]Department of Urology, Fundación IVO, Valencia, Spain, [6]Division of Urology, King's College and Guy's Hospital, King's Health Partners, London, UK, [7]Department of Urology, Klinikum Heilbronn, Heilbronn, Germany, [8] Urology Department, University of Patras, Patras, Greece

Conclusion:
This systematic review indicates that 3D laparoscopy is advantageous over 2D laparoscopy in terms of operating time, blood loss and length of stay in major urologic procedures.

Objective:
· The aim of this meta-analysis was to compare 3D and 2D laparoscopic approaches for urological procedures with perioperative results in a subgroup analysis of studies reporting procedures requiring intracorporal sutures.

Design:
· Systematic review.

Indication:
· Included were studies in which patients underwent a laparoscopic 2D versus laparoscopic 3D approach to urological procedures.
· Search was performed on Embase and Medline.
· Studies were conducted according to the PRISMA criteria.

Patients:
· A total of eight studies, four retrospective cohort studies and four randomized controlled trials, enrolling 318 patients were included in the systematic review and meta-analysis.

Results:
· Cumulative analysis showed a mean difference in operating time of 10.90 min in favor of 3D laparoscopy (95% CI -14.82, -6.98 min), while the meta-analysis showed no difference (mean difference 3.32, 95% CI -2.12, 8.76 min).
· In terms of operating time, which was limited to radical prostatectomy only, the results were strongly in favor of 3D laparoscopy, with a mean difference of 35 minutes less (95% CI -41, -29).
· Retention time for quantitative synthesis was significantly shorter in 3D laparoscopy (-0.55 days, 95% CI -0.82, -0.29 days).
· Significant difference in blood loss (mean difference -21.55 cc, 95% CI -28.51, -14.59 cc).
· Procedures requiring intracorporal suture were significantly shorter in 3D laparoscopy.

Key Findings:
· Laparoscopy performed with 3D imaging results in a shorter operative time for urological procedures. Especially during a radical prostatectomy, surgeons benefit from the imaging system.
· The 3D laparoscopy tower is versatile and could be used for any type of laparoscopic procedure in various surgical specialties.

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Journal for Minimally Invasive Gynecology (2016)

Study Summary

How Technology Can Impact Surgeon Performance: A Randomized Trial Comparing 3-Dimensional versus 2-Dimensional Laparoscopy in Gynecology Oncology

Francesco Fanfani, MD, Cristiano Rossitto, MD, Stefano Restaino, MD, Alfredo Ercoli, MD, Vito Chiantera, MD, Giorgia Monterossi, MD, Giulia Barbati, MD and Giovanni Scambia, MD

Conclusion:
The 3D system could be advantageous for intraoperative and postoperative techniques.

Objective:

· To compare 2D with 3D laparoscopic hysterectomy and pelvic lymphadenectomy in patients with endometrial and cervical cancer.

Design:

· Randomized controlled trial.

Indication:

· Patients (female) with endometrial or cervical cancer who were candidates for a minimally invasive approach were recruited.

Patients:

· Investigation of hysterectomy and pelvic lymphadenectomy in patients with endometrial and cervical cancer.

· 29 patients (32.2%) were diagnosed with cervical cancer (21 early stage and 8 locally advanced) and 61 (67.8%) with endometrial cancer.

· 48 patients (53.3%) were randomly assigned to the 2D group and 42 (46.7%) to the 3D group.

Results:

· Surgery time for the entire procedure did not differ statistically significantly between the two groups (108 vs. 110 min; $p = 0.59$).

· No significant differences were observed between surgical time in hysterectomy ($p = 0.58$) or pelvic lymphadenectomy ($p = 0.83$).

· Blood loss during lymphadenectomy was significantly lower in the in 3D group (65 ml vs. 38 ml; $p = 0.03$).

· The operating time of a pelvic lymphadenectomy in patients with cervical cancer performed by “novice” surgeons was significantly lower in the 3D group ($p = 0.04$).

Key Findings:

· 3D imaging shortens the learning curve for less experienced surgeons.

· 3D imaging shortens operating times for more experienced surgeons and improves surgical precision for less experienced surgeons.

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Fukushima Journal of Medical Sciences (2018)

Study Summary

Surgical Outcomes of Total Laparoscopic Hysterectomy with 2-Dimensional versus 3-Dimensional Laparoscopic Surgical Systems

Hiroyuki Yazawa[1], Kaoru Takiguchi[2], Karin Imaizumi[1], Marina Wada[3] and Fumihiro Ito[1]

[1]Department of Obstetrics and Gynecology, Fukushima Red Cross Hospital, [2]Department of Obstetrics and Gynecology, Ohta Nishinouchi Hospital, [3]Department of Obstetrics and Gynecology, Fukushima Medical University

Conclusion:

The laparoscopic 3D system could be used safely and efficiently in total laparoscopic hysterectomy.

Objective:

· To compare the outcomes of total laparoscopic hysterectomy with 3D versus conventional 2D laparoscopy retrospectively.

Design:

· Retrospective comparative cohort study.

Indication:

· Patients indicated for total laparoscopic hysterectomy (TLH).

· Cases performed between November 2014 and December 2015 with the 3D laparoscopic system were compared to a 2D cohort that underwent surgery in the two years prior to the introduction of the new system.

Patients:

· 94 TLH procedures were performed: 47 with a 3D laparoscopy system (3D TLH) and 47 with the conventional 2D laparoscopy system (2D TLH).

Results:

· The 3D TLH group had a statistically significantly shorter mean surgery time (137 ± 20 min vs. 119 ± 20 min, $p < 0.05$).

· The 3D TLH group tended to have lower mean intraoperative blood loss than the 2D TLH group. The difference between the two groups is not statistically significant (193 ml vs. 161 ml).

· Surgeon and the assistant surgeons reported no symptoms such as dizziness, eye strain, nausea or headaches.

Key Findings:

· The 3D imaging system can enable safer and more precise surgery with depth awareness and improved resolution of the surgical field.

· The operating time for experienced surgeons is reduced and surgical precision is increased for less experienced surgeons.

· Blood loss could be reduced by the depth perception of the laparoscopic 3D system.

· The learning curve is reduced with the 3D system.

· The laparoscopic 3D system could be used safely and efficiently in TLH.

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[1]Department of Surgical Sciences, University of Torino, Corso Dogliotti 14, 10126 Torino, Italy, [2]Montichiari Surgery, ASST Spedali Civili Brescia, Montichiari, Italy, [3]Department of General Surgery, Yeovil District Hospital NHS Foundation Trust, Higher Kingston, Yeovil, UK, [4]Department of Surgery and Cancer, St Mary's Hospital, Imperial College London, London, UK, [5]Division of Urology, ESUT Research Group, San Luigi Gonzaga Hospital, Orbassano, Torino, Italy, [6]IRCAD, Research Institute Against Digestive Cancer, Strasbourg, France, [7]Department of Surgery, Fondazione IRCCS Cà Granda, Policlinico Hospital, University of Milan, Milan, Italy

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· Inclusion criteria of the study were comparative observational studies on 3D technology (RCTs, prospective and retrospective).

· All searches were carried out on 22 September 2017 in both PubMed and Embase electronic libraries, with no restriction on year of publication or language.

Results:

· 3D significantly shortened the operation time (mean difference 11 min (8% [95% CI 20.29-1.72], I2 96%).

· A significant reduction of complications was observed when using 3D systems (RR 0.75 [95 CI% 0.60-0.94], I2 0%), especially in cases with laparoscopic sutures (RR 0.57 [95% CI 0.35-0.90], I2 0%).

· In 69 box trainer or simulator studies, 64% of participants concluded that they worked significantly faster and 62% that they made fewer mistakes when using 3D.

Key Findings:

· 3D vision improves results for young trainees who perform standardized box trainer tasks.

· The use of 3D imaging systems improves the completion time and error rate of laparoscopic box trainer tasks.

· 3D laparoscopy does not lead to a higher cognitive workload and may lead to a lower experienced cognitive workload, provided that the viewing configuration is optimal.

· 3D laparoscopy could be advantageous in terms of operating time for more complex procedures.

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Obesity Surgery (2017)

Study Summary

Impact of Three-Dimensional Laparoscopy in a Bariatric Surgery Program: Influence in the Learning Curve

Esther Mariño Padin[1], Raquel Sánchez Santos[1,2], Sonia González Fernández[3], Antonia Brox Jimenez[3], Sergio Estevez Fernández[3], Ester Carrera Dacosta[3], Agata Rial Duran[3], Maria Artime Rial[3], Ivan Dominguez Sanchez[3]

[1]Servicio de Cirugía General y Digestiva, Complejo Hospitalario Universitario de Pontevedra Instituto de Investigación, Sanitaria Galicia Sur, [2]Jefe de Servicio de Cirugía General y Digestiva, Complejo Hospitalario de Pontevedra, Carretera de Mourente, [3]Servicio de Cirugía General y Digestiva Complejo Hospitalario Universitario de Pontevedra, Pontevedra, Spain

Conclusion:
The use of 3D laparoscopy in bariatric surgery, regardless of the surgeon's experience, helps to reduce operating time and hospital stay and improve the safety of the operation.

Objective:
· To compare the introduction of a 3D laparoscopy system to a 2D system in patients that underwent bariatric surgery (gastric bypass or sleeve gastrectomy) on perioperative and postoperative parameters.

Design:
· Comparative retrospective cohort study (2D: 2013-2015; 3D: 2015-2016).
· Surgery was performed by four surgeons: One experienced surgeon (> 250 bariatric procedures) and three novice surgeons (< 50 bariatric procedures).

Indication:
· Consecutive patients indicated for bariatric surgery (sleeve gastrectomy (SG) or gastric bypass (GB).

Patients:
· The study included 312 consecutive patients undergoing bariatric surgery; 56.9% of patients were operated on via GB and 43.1% via SG.
· There were 104 procedures with 3D laparoscopy (3D cohort) and 208 procedures with high-resolution 2D laparoscopy (2D cohort).

Results:
· Operative time and hospital stay were significantly lower in the 3D group overall as well as in the two procedures types (SG: 124.7 ± 51.97 min vs.100.22 ± 41.22 min, p = 0.007 and GB: 209.08 ± 71.51 min vs. 175.7 ± 47.19 min, p = 0.001).
· Significantly fewer complications occurred in the 3D cohort in comparison to the 2D cohort (10.2 vs. 1.8%, p = 0.034) when performed by novice surgeons.
· There were no cases of postoperative mortality in patients in the study in either group.

Key Findings:
· The use of 3D laparoscopy shortens the duration of surgery and hospital stay.
· Improved intervention is achieved through depth perception.
· The depth perception increases the safety of the procedure with fewer complications in the 3D cohort and also results in a significantly reduced hospital stay.

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J Langenbeck's Archives of Surgery (2017)

Study Summary

Comparison of Two- and Three-Dimensional Display for Performance of Laparoscopic Total Gastrectomy for Gastric Cancer

Shingo Kanaji[1], Satoshi Suzuki[1], Hitoshi Harada[1], Masayasu Nishi[1], Masashi Yamamoto[1], Takeru Matsuda[1], Taro Oshikiri[1], Tetsu Nakamura[1], Yasuhiro Fujino[2], Masahiro Tominaga[2], Yoshihiro Kakeji[1]

[1]Division of Gastrointestinal Surgery, Department of Surgery, Graduate School of Medicine, Kobe University, [2]Department of Gastroenterological Surgery, Hyogo Cancer Center, Hyogo, Japan

Conclusion:

The 3D display is useful in difficult situations requiring tangential view and suture reconstruction in confined spaces.

Objective:

· Analysis of the effects of 3D technology on surgical performance during laparoscopic total gastrectomy (LTG) for gastric cancer.

Design:

· Retrospective comparative cohort study.

Indication:

· Patients who had undergone LTG for gastric cancer were enrolled between 2012 and 2016.

· The usage of the 3D system was chosen based on the availability of the system.

Patients:

· Successive LTG surgeries with esophagojejunostomy were performed using the overlap method.

· Patients were divided into two groups: 15 were placed in the 3D group and 15 in the 2D group.

Results:

· The utilization of the 3D system led to a significant reduction of pure laparoscopic time (182.7 vs. 154.2 min, $p = 0.02$).

· Reduced operating time during lymphadenectomy in the 3D group (scene 6, 17.5 vs. 13.5 min, $p = 0.003$, and scene 7, 18.4 vs. 12.4 min, $p = 0.02$).

· Significantly shorter operating time in the 3D group for esophageal jejunostomy (scene 11, 39.4 vs. 30.3 min, $p = 0.008$).

· Tissue exposure was significantly lower in the 3D group during scene 6, from the dissection of the right gastric artery to the dissection of the left gastric artery (LGA), and scene 7, from the dissection of the LGA to the end of the lymphadenectomy around

the splenic artery (scene 6, $n = 4.0$ vs. 3.0, $p = 0.006$, and scene 7, $n = 4.0$ vs. 3.0, $p = 0.01$).

Key Findings:

· The utilization of a 3D laparoscopic system reduces the operative time for a gastrectomy, potentially by improving laparoscopic skills during difficult situations (including suturing, lymphadenectomy), independent of the level of experience of the laparoscopic surgeon.

· The use of 3D imaging leads to an improvement in surgical skills when performing difficult techniques.

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Surgical Endoscopy (2019)

Study Summary

The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

Alberto Arezzo[1], Nereo Vettoretto[2], Nader K. Francis[3], Nathan J. Curtis[3,4], Daniele Amparore[5], Manuel Barberio[6], Luigi Boni[7]

[1]Department of Surgical Sciences, University of Torino, Corso Dogliotti 14, 10126 Torino, Italy, [2]Montichiari Surgery, ASST Spedali Civili Brescia, Montichiari, Italy, [3]Department of General Surgery, Yeovil District Hospital NHS Foundation Trust, Higher Kingston, Yeovil, UK, [4]Department of Surgery and Cancer, St Mary's Hospital, Imperial College London, London, UK, [5]Division of Urology, ESUT Research Group, San Luigi Gonzaga Hospital, Orbassano, Torino, Italy, [6]IRCAD, Research Institute Against Digestive Cancer, Strasbourg, France, [7]Department of Surgery, Fondazione IRCCS Cà Granda, Policlinico Hospital, University of Milan, Milan, Italy

Conclusion:
The use of 3D vision in laparoscopy is recommended to reduce surgery time.

Objective:

· Systematic reviews of the PubMed and Embase libraries were conducted to provide evidence of the potential benefits of 3D imaging systems for clinical practice and patient outcomes.

Design:

· Systematic review.

Number of Studies Included:

· Review included 18 studies in total: seven randomized controlled studies, 11 cohort studies.

· Four deal with cholecystectomy, three colorectal operations, two gastrectomies, two hernia repairs, six gynecological operations and one radical prostatectomy.

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· Inclusion criteria of the study were comparative observational studies on 3D technology (RCTs, prospective and retrospective).

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· 3D significantly shortened the operation time (mean difference 11 min (8% [95% CI 20.29-1.72], I2 96%).

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Italian Society of Surgery (2020)

Study Summary

Does a 3D Laparoscopic Approach Improve Surgical Outcome of Mininvasive Right Colectomy? A Retrospective Case-Control Study

Umberto Bracale[1], Giovanni Merola[1], Antonia Rizzuto[2], Emanuele Pontecorvi[1], Vania Silvestri[1], Giusto Pignata[3], Felice Pirozzi[4], Diego Cuccurullo5, Antonio Sciuto[4], Francesco Corcione[1]

[1]Department of General Surgery and Specialities, School of Medicine Federico II of Naples, Via Pansini 5, 7th Building, Naples, Italy, [2]Medical and Surgical Science, University "Magna Graecia" of Catanzaro Medical School, Catanzaro, Italy, [3]Department of General Surgery II, Spedali Civili of Brescia, Brescia, Italy, [4]Department of General Surgery, Santa Maria delle Grazie Hospital, Pozzuoli, Naples, Italy, [5]Department of General Surgery, Ospedali dei Colli Monaldi Hospital, Naples, Italy

Conclusion:

3D vision appears to improve the performance of the totally laparoscopic approach for right hemicolectomy (TLRC) by reducing the time of surgery and facilitating intracorporeal anastomosis.

Objective:

· The aim of the study is to investigate whether 3D vision during TLRC offers advantages in surgical performance over 2D vision.

Design:

· Multicenter study.

· A case-adapted analysis was performed using the Mantel-Haenszel method.

· The procedures were performed by five highly qualified laparoscopic colorectal surgeons who, prior to their inclusion in the study, had gone through a learning curve of more than 100 laparoscopic colectomies and were fully trained in advanced laparoscopic procedures.

Indication:

· Consecutive patients undergoing elective TLRC for cancer at three Italian surgical centers using 2D or 3D technology between January 2013 and December 2018 were retrieved from a computerized database.

Patients:

· A total of 106 patients were analyzed, with 53 patients in each group.

Results:

· The average surgery time for 3D TLRC was significantly shorter than for 2D TLRC (153.2 ± 52.4 vs. 131 ± 51 min, p = 0.02).

· The time to perform an intracorporeal ileocolic anastomosis was significantly shorter in the 3D group (21.7 ± 6.2 vs. 19.2 ± 5.9 min, p = 0.03).

· No difference was observed in the median number of harvested nodes (21 ± 7 vs. 23 ± 11, p = 0.48).

Key Findings:

· 3D vision seems to improve the performance of fully laparoscopic colectomy.

· Reduces the operating time.

· Simplifies the performance of intracorporeal anastomosis.

· None of the surgeons in the 3D group complained of dizziness or headaches during the procedure.

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Surgical Innovations (2017)

Study Summary

3D Vision Provides Shorter Operative Time and More Accurate Intraoperative Surgical Performance in Laparoscopic Hiatal Hernia Repair Compared with 2D Vision

Piera Leon, MD[1], Roberta Rivellini, MD[2], Fabiola Giudici, BMath[1], Antonio Sciuto, MD[3], Felice Pirozzi, MD[3], Francesco Corcione, Prof, MD[3]

[1]University of Trieste, Trieste, Italy, [2]University of Perugia, Perugia, Italy, [3]Monaldi Hospital, Naples, Italy

Conclusion:

The 3D vision reduces operative time in the repair of hiatal hernias, which could be a result of improved visualization in narrow spaces enabling more accurate surgery.

Objective:

· To evaluate a 3D laparoscopy system in comparison to conventional high-resolution 2D vision in the repair of hiatus hernia (HH).

Design:

· Prospective randomized controlled trial.

Indication:

· Patients with a hiatal hernia type I, II or III scheduled for elective surgery.

Patients:

· The patients were randomized into two groups: 17 were treated laparoscopically with a 2D HH repair, 19 were treated with the same operation with 3D vision.

Results:

· Significant reduction in surgery time in the laparoscopic 3D group (90.1 ± 19.9 min vs. 69.9 ± 21.5 min, p = 0.006).

· A tendency of reduction in surgery times in the 3D group during crura closure was noticed (8.9 ± 1.6 vs. 7.5 ± 1.0 min, p = 0.09).

· In a subgroup that underwent HH repair with mesh reinforcement a significant difference in surgery time was identified (2D: 109.3 ± 13.9 vs. 3D: 81.0 ± 22.1 min, p = 0.03).

· In the 3D group one episode of a short-gastric vascular hemorrhage occurred, in the 2D group three episodes (one bleeding during diaphragmatic column dissection and two during hernia sac dissection).

Key Findings:

· Reduction of operative time could be a result of easier vessel recognition, better spatial perception and a more accurate surgical performance.

· The 3D technology reduces the workload by simplifying movements in deep areas.

· Surgical performance gains speed and accuracy with fewer technical errors.

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Surgical Endoscopy (2019)

Study Summary

The Use of 3D Laparoscopic Imaging Systems in Surgery: EAES Consensus Development Conference 2018

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Conclusion:
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Objective:

· Systematic reviews of the PubMed and Embase libraries were conducted to provide evidence of the potential benefits of 3D imaging systems for clinical practice and patient outcomes.

Design:

· Systematic review.

Number of Studies Included:

· Review included 18 studies in total: seven randomized controlled studies, 11 cohort studies.

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Surgical Endoscopy (2016)

Study Summary

3D Visualization Reduces Operating Time when Compared to High-Definition 2D in Laparoscopic Liver Resection: A Case-Matched Study

Vimalraj Velayutham[1,2], David Fuks[1,2], Takeo Nomi[1,2], Yoshikuni Kawaguchi[1,2], Brice Gayet[1,2]

[1]Department of Digestive Diseases, Institut Mutualiste Montsouris, 42 Boulevard Jourdan, 75014 Paris, France, [2]Université Paris Descartes, Paris, France

Conclusion:

This study is the first to assess a positive impact of high-definition 3D visualization on operating time in laparoscopic liver resection in comparison to 3D visualization.

Objective:

· To analyze the effect of 3D visualization on operative performance during elective laparoscopic liver resection (LLR).

Design:

· Matched case-control study.

· The 2D and 3D treatments were performed by the same surgeon.

· Patients were prospectively enrolled with a 3D laparoscopy system between April and August 2014 and matched by gender, age, BMI, tumor size, degree of liver cirrhosis, ASA score, type of resection and tumor location from a retrospective cohort.

Indication:

· Patients with liver disease were included in this study.

Patients:

· 20 patients undergoing LLR with a 3D laparoscope (Olympus 3D HD Vision System), 3D group were compared to 40 patients who underwent LLR with a 2D laparoscope, 2D group between March 2010 and March 2014.

Results:

· Surgery time was significantly shorter in the 3D group compared to 2D (284 ± 71 min vs. 225 ± 109 min, p = 0.03).

· No significant difference in blood loss was identified between the two groups (252 ± 349 ml vs. 204 ± 226 ml, p = 0.29).

· The major complication rates for the 3D and 2D groups were 5.0% and 7.5%, respectively (p = 0.99).

Key Findings:

· 3D system is useful for performing complex laparoscopic minimally invasive surgery, with shortened learning curves and higher comfort for the surgeon.

· These benefits could enable the learner laparoscopic surgeon to quickly become an expert.

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Surgery Endoscopy (2018)

Study Summary

3D Vision and Maintenance of Stable Pneumoperitoneum: A New Step in the Development of Laparoscopic Right Hepatectomy

Takayuki Kawai[1], Claire Goumard[1], Florence Jeune[1], Shohei Komatsu[2], Olivier Soubrane[3], Olivier Scatton[1]

[1]Department of Hepatobiliary Surgery and Liver Transplantation, Pitié-Salpétrière Hospital, Sorbonne University, UMRS-938, Paris, France, [2]Department of Surgery, Graduate School of Medicine, Kobe University, Hyogo, Japan, [3]Department of Hepatobiliary Surgery and Liver Transplantation, Beaujon Hospital, University Paris VII Denis Diderot, Paris, France

Conclusion:

3D vision with maintenance of pneumoperitoneum facilitates hepatic vascular isolation/division, and may contribute to the development of laparoscopic right hepatectomy (LRH).

Objective:

· Investigation of the effectiveness and potential benefits of 3D vision with preservation of the pneumoperitoneum in LRH compared to 2D.

Design:

· Retrospective comparative cohort study.

· Two experienced surgeons performed LRH.

Indication:

· For the laparoscopic liver resection, consecutive patients were admitted who underwent hepatectomy (LRH) from May 2011 to June 2017.

Patients:

· The 2D group consisted of 45 patients that underwent LRH with a standard 2D laparoscope and a standard CO_2 insufflator (2D LRH group) between May 2011 and October 2014.

· The 3D group consisted of 30 patients that underwent LRH with a flexible 3D laparoscope and an optimized CO_2 insufflator (3D LRH group) between November 2014 and June 2017.

Results:

· Total surgery time was significantly shorter (390 ± 75 min in the 2D and 360 ± 56 min in the 3D LRH group, $p = 0.02$).

· The median duration of section 1, isolation and division of the right hepatic vessels, was significantly shorter in the 3D group (123 ± 31 min vs. 101 ± 26 min, $p = 0.003$).

· The median duration of section 2, liver parenchyma transection, was also shorter in the 3D group (151 ± 32 min vs. 138 ± 25 min, $p = 0.08$).

Key Findings:

· 3D vision significantly reduces the duration of right hepatic vessel dissection and the overall duration of surgery for LRH.

· Provides useful depth perception, which enables improved movement precision.

· Improves the surgeon's overall vision and requires less physical strain and mental effort.

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3D Endoscopy
Study Summary Overview

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