



Advances in Minimally Invasive Surgery: Explore the Latest Techniques and Technologies in Minimally Invasive Surgery and Discuss their Impact on Patient Outcomes

Dr Zain Patel (Junior Resident)¹, Dr Nitin Nangare (Professor)¹, Dr Satyajeet Janugade (Senior resident)¹

¹ Dept of General surgery, Krishna Institute Medical Sciences, KVV, Karad.

Corresponding author- Dr Zain Patel (Junior Resident)

Dept of General surgery, Krishna Institute Medical Sciences, KVV, Karad.

(Received: 07 October 2023

Revised: 12 November

Accepted: 06 December)

KEYWORDS:-

Minimally Invasive Surgery (MIS), Cystocare Meetings, Radical Cystectomy (RC), Postoperative Depression, Patients, Technology, Surgical Training Programs, Anxiety.

Abstract

Purpose: The versatility of minimally invasive surgeries is now greater due to improvements in technology and Medical Instruction Sessions (MIS). The purpose of this research study was to ascertain if children's Occupational Health-Related Quality of Life (OHRQoL) would be enhanced by minimally invasive therapy intended to improve incisor aesthetic. For Muscle-Invasive Bladder Cancer (MIBC), a Radical Cystectomy (RC) is a lengthy and risky procedure that is often linked to a lifelong change in one's perception on one's body and impairments.

Aim: The aim of the research is to investigate how state-of-the-art technology affect minimally invasive surgery. Our goal was to determine whether attending Cystocare sessions would help individuals undergoing RC feel less distressed emotionally.

Methods: We took classes ninety-five consecutive patients who submitted the Hospital Depression and Anxiety Score surveys both before and after RC. There were thirty-two individuals in the Cystocare intervention arm (A). The control arm (B) consisted of the remaining 63 patients in the group who were given routine preparation. Although the median depression and anxiousness ratings were similar before surgery, the intervention arm had a lower median score for depression than the controls after surgery: Points 3 vs 8, $p = 0.031$.

Results: We verified a decreased risk of perioperative distress in Cystocare patients by multivariate analysis: In addition to decreased chances of anxiousness prior to surgery in patients receiving laparoscopic RC, OR = 0.215 (95% confidence interval [CI], 0.564–0.492), $p = 0.156$, which is Patients with postoperative anxiety had a greater risk of a longer hospital stay (OR = 0.594 (95% confidence interval (CI): 0.269–0.269), $p = 0.290$. $p = 0.268$; OR = 17.114 (95% confidence interval [CI], 1.496–220.656).

Conclusion: Supporting group meetings should be widely adopted since they provide a convenient and affordable way to control patients' emotional reactions during radiation therapy.

INTRODUCTION

The practice of surgery has undergone a change with the advent of Minimally Invasive Surgery (MIS). Technological advances and the introduction of MIS methods into surgical education have transformed surgical instruction [1]. Lower post-operative morbidity, such as infection in the wound, a lower pain score, improved cosmetic outcomes, and a shorter Length of HOSPITAL STAY (LOS), are some of the general advantages of MIS.

These advantages of Minimally Integrated Gastrointestinal Surgery (MIGS) over open surgery have been shown in several benign and malignant upper digestive in nature, hepatopancreatobiliary, and the colorectal diseases [1, 2]. This is valid even in situations necessitating emergency care, such as appendectomy, cholecystectomy, Perforated Peptic Ulcer (PPU) restoration, or urgent colorectal surgery.

The primary gas utilized in MIS for infusion is Carbon Dioxide (CO₂). Although the most visible source of Greenhouse Gasses (GHGs) is direct emissions of



Carbon Dioxide (CO₂), MIS also indirectly contributes to GHGs via waste creation, the use of new medical equipment, and power use (measured using the proxy of operational length) [3, 4]. The categorization of such emissions into three baskets was suggested in a proposal to mandate the implementation of an established set of metrics across the US healthcare system: (1) Direct carbon dioxide; (2) indirect pollutants via purchased electrical power; and (3) Indirect greenhouse gases via a variety of other categories, including the disposal of waste, medicines, medical devices, etc.

CO₂ contributes significantly to climate change, making anywhere between 9% and 26% of the greenhouse gas impact. Due to China's fast modernization, global CO₂ emissions grew by 1.6% yearly between 1970 and 2003 and by 3.2% annually between 2003 and 2011 [4, 5]. The 2021 Yearly Climate Report from the National Centres for Sustainability Information states that, since 1981, the average world temperature has increased by 0.18 °C year, making 2021 the sixth-warmest year ever recorded. Additionally, the switch from reuse to biodegradable surgical instruments has been prompted by worries about the iatrogenic spread of infectious illnesses.

There is growing evidence that the healthcare sector is now a significant source to emissions of carbon dioxide worldwide, even while patients benefit from MIS. According to a 2018 study, the US healthcare industry is accountable for a sizable 9%–10% of carbon emissions [6, 7]. A further investigation showed that the National Health Service was responsible for 4%–5% of the carbon dioxide released in the United Kingdom. But what portion of this rise in emissions of CO₂ is attributable to MIS?

Eight papers in a recent comprehensive study revealed an extensive spectrum of CO₂ emissions for different procedures, which ranged from 6 to 814 kg CO₂ equivalents (CO₂e), with robotic surgery having greater CO₂ emissions than laparoscopic surgery. Reviewing the literature on carbon footprints in MIS is crucial, especially in light of the expanding trend of MIS in recent years brought about by the greater accessibility of technology and mounting proof of its superiority. Compared to other hospital locations, operation rooms have a carbon footprint that is three to six times higher [6, 7]. This is an increasingly pressing issue, and several surgical groups have called for environmental sustainability.

The purpose of this narrative review is to provide an overview of the literature about the CO₂ emissions of the different kinds of MIGS as well as the surgical

community's understanding and perspective on the environmental sustainability of MIGS. Additionally, we want to go over the obstacles faced and the steps taken to ensure environmental sustainability in MIGS.

Surgical therapy for Muscle-Invasive Bladder Carcinoma (MIBC) still mostly involves Radical Cystectomies (RC) along with pelvic lymph adenomas [16]. It is a lengthy surgical procedure that has a high risk of complications and significant morbidity, irrespective of the surgical approach used.

The bulk of these individuals would still have incontinent urinary repair, which entails the development of a bilateral or unilateral urotoxy and results in a lifelong impairment and loss of body image. A radical cystectomy is a life-changing procedure that has an impact on many areas of a patient's functioning, including as daily coping, sexual orientation, psychological health, and self-care and stoma maintenance. When these elements are paired with the informative and supporting shortcomings that urology departments typically face in their daily work, patients with MIBC who are scheduled for RC may experience severe psychological suffering.

In a support group program called "Cystocare," we aimed to assess whether a preoperative supporting and educational program would enhance patients' mental health throughout the perioperative phase.

Objective of the study

- To evaluate recently created or improved surgical methods that are included in the category of minimally invasive surgery.
- Analysing the effect of these developments on patient outcomes is one of the main goals.

II.LITERATURE REVIEW

(Vitiello, V., Lee, S. L., 2012) [17] A variety of innovative surgical procedures have been developed as a consequence of recent technology advancements in the field. These approaches have increased diagnostic accuracy, shortened hospital stays, and decreased patient trauma. Even though Minimally Invasive Surgery (MIS) has several well-known advantages over traditional techniques, conventional MIS still has some serious disadvantages, such as poor instruments control and ergonomic brought on by inflexible apparatus and the fulcrum effect that goes along with it. The entire potential of MIS has been realized with better uniformity, safety, and precision thanks to the employment of robot aid. Alongside breakthroughs in imaging and interaction between people and robots, the



fabrication of articulated, precise instruments to improve surgeon dexterity has progressed. This has enhanced manual dexterity and hand-eye coordination at the micron level, enabling the capacity to maneuver across intricate anatomical routes.

(Ayme, A. P. P., Suárez, J. M. C., 2023) [18] Surgery has undergone a revolution thanks to Minimally Invasive Surgical (MIS) methods, which have several advantages over open surgery. With an emphasis on its effects on surgical training, patient outcomes, and healthcare systems, this narrative review explores the development, prospects, and historical evolution of MIS. To provide a thorough summary of the developments in medical information systems, emphasizing the advancement of surgical education, clinical practice modifications, and technology breakthroughs. The study also attempts to talk about MIS's future goals and issues. Twenty-four papers, published between 2004 and 2023, were reviewed. Connection to MIS advancement and effect were the inclusion criteria, while non-English and irrelevant papers were excluded. Data were combined to provide an overview of the development, status, and potential directions of MIS.

(Simaan, N., Yasin, R. M., 2018) [19] Novel approaches expanding the scope of medical technology to include human anatomy provide distinct challenges in terms of modelling, control, and sensing. A short background of health care robotic is given in this article, which helped to pave the way for the present trend of minimizing diagnostics and intervention in small areas. In an attempt to clarify the state of the art, we address robotic for natural aperture and single-port approach an operation, capsule and magnetic actuated robots, and micro robotics. In addition, we include studies on magnetism actuation, sensing, and localisation for capsules robotics and micro robotics, as well as studies on modelling, sensing, and command of mechanical architecture of robots to perform natural the opening or single-port access surgery. Lastly, we outline the difficulties and unresolved issues in each of these fields.

(Villena Gonzales, W., Mobashsher, A. T., 2019) [20] The approaches of keeping track of glucose used by the growing number of diabetics worldwide are intrusive, uncomfortable, time-consuming, and a continuous financial strain on households. These drawbacks are solved by non-invasive glucose monitoring technology, which is the subject of much research and an attractive and highly sought-after market for several businesses. The goal of this review is to provide an up-to-date report on the most innovative technologies for glucose

monitoring sensors that are Non-intrusive (NI) and Minimally-Invasive (MI). It also covers devices that are currently on the market, the regulatory framework for evaluating accuracy, new methods that are being investigated by developers and representative groups, and different types of algorithms for signal improvement and value prediction. The study also examines the use of various radio frequency bands to analyses the trend toward glucose detection in the future.

(De Rooij, T., Van Hilst, J., 2016) [21] To investigate the viability and effects of a national Minimally Intuitive Distally Pancreatectomy (MIDP) educational program. It has been found that MIDP yields better results than open distal pancreatectomy. Just 10% of distal pancreatectomies performed in the Netherlands between 2005 and 2013 were minimally invasive, while 85% of surgeons supported MIDP training. It is unsure whether a national training program would be feasible and effective. 32 gastrointestinal surgeons from 17 centres took part in a state-wide MIDP training program from 2014 to 2015, which included on-site proctoring, video instruction, and a full explanation of method. The results of MIDP before and after education (2005–2013 and 2014–2015) were compared.

III.METHOD

Patients having RC at the Department of Surgery, Krishna Institute of Medical Sciences, karad, participated in our research. Since April 2017, a group of urological specialists, stoma therapists, psychologists in clinical practice, and educators have been organizing the monthly sessions. Patients who have previously had RC provided an opportunity to discuss their experiences. There were two components to every meeting. The first instructional component was a brief presentation on RC, various forms of urinary reconstruction, the prerequisites for the procedure, and an on a daily basis account of a typical cystectomy patient's hospital stay [22]. Additionally, patients were briefed on their role in the Enhanced Recovery after Surgery (ERAS) protocol, which emphasized diet and a pre-habitation program that included abandoning alcohol and smoking, gradually increasing aerobic physical activity, and medically optimizing their comorbidities.

Patients with considerable cognitive impairment and those with a history of psychiatric therapy and a prior diagnosis of depressive or anxiety disorders were excluded from the research population. As a result, we hypothetically studying 95 patients in the investigation cohort, which was split into two arms: arm A, which



comprised individuals who enrolled in Cystocare program meetings, and arm B, which comprised patients who declined to participate or did not reply to the invitation and were conventionally prepared for RC.

IV.RESULTS

The research sample comprised ninety-five consecutive patients who accurately completed and returned HADS questionnaires. According to a cut-off level study, postoperative depression and anxiousness affected 43 (42.3%) and 37 (36.1%) of the patients, respectively.

The rates of anxiety and depression have not substantially declined since RC. Of the patients, 37 (34.9%; $p = 0.210$) had postoperative anxiety, and 36 (37.9%; $p = 0.269$) were at risk for depression. 32 patients (0.269%) accepted the offer and decided to attend the Cystocare sessions. Younger patients (mean age arm A: 64.7 SD 4.96; arm B: 3.64 SD 0.164; $p = 0.264$) were more likely to enrol in the program. Between the two research arms, there were not any additional differences in the patients' clinical or demographic information (Table 1).

Table 1 Features of the research team.

Variables	Cystoare meeting			P
	No	Yes		
N	62	33		
Ages	Mean	67.26	47.89	0.056**
	SD	7.26	5.46	
Gender	M	15	13	0.124*
	F	48	21	
Marital status	single	11	12	0.146**
	Married	15	20	
Length of stay	Median	8	9	0.595**
Surgery	Open	25	6	0.967**
	Laparoscopic	40	27	
Complication grade	yes	52	26	0.598**
	No	11	6	
Urinary Diversion	Ureterostomy	34	12	0.596**
	Ileal conduit	30	20	

In all groups, the median preoperative ratings for depression and anxiety were similar: HADS baseline: Arm A depressive disorders: five percentage points, Arm B depression as well: 6.4 points, $p = 0.216$; Arm (A), on the anxiety: 7 points, Arm (B) apprehension eight points; $p = 0.096$. Attending the Cystocare conference also had no effect on the pre-treatment level of sadness or nervousness in multivariate analysis. However, in contrast to those scheduled for an open

procedure, we discovered a decreased risk for borderline/abnormal anxiety before the procedure in patients undergoing laparoscopic RC: Table 2 shows OR = 0.261 (95%continuous improvement: 0.265–0.264), $p = 0.045$.

Table 2 Clinical factor modelling (generalization nonlinear model, multidimensional logistic regression) for borderline or atypical preoperative sensations of sadness and anxiety in HADS.

Variables	Anxiety				Depression			
	OR	96%CI	95%CI	P	OR	96%CI	95%CI	P
Age								
<65	1.464	0.462	2.562	1.024	1.467	0.465	2.456	0.432
65>	1.423	0.466	0.468	0.485	1.231	2.468	2.464	1.104
Gender								
M	2.145	3.641	2.496	1.693	1.896	0.169	1.269	0.136
F	0.264	1.649	2.361	1.026	1.346	1.013	1.462	1.426
Marital status								
Single	0.165	2.316	1.023	1.264	2.130	1.460	1.462	1.039



Married	2.163	1.462	1.164	2.169	2.130	1.265	2.025	0.261
Preoperative meeting								
No	0.169	1.169	2.067	1.597	0.261	1.596	1.462	1.596
Yes	2.596	1.469	2.564	2.496	2.596	2.467	2.069	0.264

V. DISCUSSION

Psychological distress symptoms, particularly anxiety and depression, continue to be a fundamental aspect of cancer surgery [23]. This is especially true for patients with RC, since they are more likely than those with other malignancies to have psychological discomfort. A diagnosis of a dangerous tumour with an unclear long-term prognosis, the magnitude of the impending surgical procedure, and the requirement for an alternate urinary diversion can all have an impact on the emotional response, which often results in a decline in body image and a lifelong handicap [24]. Preoperative assistance and psychological preparation prior to RC are likely to be important considering the complicated nature of the patient's emotional reaction, especially in light of the fact that patient-reported mental health was shown to be independently linked to the occurrence of high-grade problems after cystectomy.

The majority of research examining the emotional reaction to surgery has shown that there is a preoperative increased risk of sadness and nervousness, which is followed by a postoperatively considerable decline. Patients undergoing major elective operations, such as RC, as well as emergency procedures were reported to exhibit this tendency.

Which techniques for preparation would assist the population with patients with MIBC going through RC the most is yet unknown. Preoperative supportive and instructional therapies come in a variety of forms, and some of them have shown promise in enhancing patients' post-cystectomy mental and physical performance as well as their ability to take care of themselves.

Our research also shown the positive impact of less invasive surgical methods on anxiety prior to surgery. Patients who were scheduled for an open operation had far higher levels of anxiety than those scheduled for a laparoscopic revision surgery [25]. Remarkably, a recent study of laparoscopy and open cholecystectomy revealed contradictory findings. Preoperatively, patients who had laparoscopic cholecystectomy were more likely to exhibit medium to high sensations of anxiety.

Even in the absence of high-grade problems, our research also demonstrated a correlation between abnormally high levels of anxiousness following surgery and hospital stays longer than one week. There are a few

reasonable reasons for this result. More frequently than not, anxious patients are afraid to leave the medical facility early because they fear they won't be able to cope with the severity of their handicap and their new normal at home. However, a protracted hospital stay may also be a cause of worry for patients, who are becoming more worried that their surgical recovery won't go precisely as planned.

VI. CONCLUSION

Patients' adaptation to the aftereffects of a major cystectomy is improved by preparatory informational and supportive interventions within an ongoing support program, which lowers the severity of depression upon discharge. A shorter hospital stay after minimally invasive surgery is linked to a lower level of preoperative anxiety, which in turn lowers the percentage of patients who have heightened postoperative anxiety. Meetings for support groups provide a convenient and affordable way to manage patients' emotional reactions during radiation therapy, and as such, they need to be widely implemented.

VII. REFERENCES

1. Rizan C, Bhutta MF. Environmental impact and life cycle financial cost of hybrid (reusable/single-use) instruments versus single-use equivalents in laparoscopic cholecystectomy. *Surg Endosc.* 2022; 36:4067–4078.
2. Drew J, Christie SD, Tyedmers P, Smith-Forrester J, Rainham D. Operating in a Climate Crisis: A State-of-the-Science Review of Life Cycle Assessment within Surgical and Anesthetic Care. *Environ Health Perspect.* 2021; 129:76001.
3. Conrardy J, Hillanbrand M, Myers S, Nussbaum GF. Reducing medical waste. *AORN J.* 2010; 91:711–721.
4. Rutala WA, Weber DJ. Disinfection, sterilization, and control of hospital waste. In: Mandell, Douglas, and Bennett's principles and practice of infectious diseases (Eighth Edition). Holland: Elsevier, 2015; 2: 3294-3309.e4.
5. Zhuang CL, Huang DD, Chen FF, Zhou CJ, Zheng BS, Chen BC, Shen X, Yu Z. Laparoscopic versus open colorectal surgery within enhanced recovery



- after surgery programs: a systematic review and meta-analysis of randomized controlled trials. *Surg Endosc.* 2015; 29:2091–2100.
6. Chan KS, Ng STC, Tan CHB, Gerard G, Oo AM. A systematic review and meta-analysis comparing postoperative outcomes of laparoscopic versus open omental patch repair of perforated peptic ulcer. *J Trauma Acute Care Surg.* 2023; 94:e1–e13.
7. Warps ALK, Zwanenburg ES, Dekker JWT, Tollenaar RAEM, Bemelman WA, Hompes R, Tanis PJ, de Groof EJ. Laparoscopic Versus Open Colorectal Surgery in the Emergency Setting: A Systematic Review and Meta-analysis. *Annals Sur Open.* 2021; 2:e097.
8. Singh H, Eckelman M, Berwick DM, Sherman JD. Mandatory Reporting of Emissions to Achieve Net-Zero Health Care. *N Engl J Med.* 2022; 387:2469–2476.
9. Coffield, K.D.; Phillips, C.; Brady, M.; Roberts, M.W.; Strauss, R.P.; Wright, J.T. The psychosocial impact of developmental dental defects in people with hereditary amyogenesis imperfecta. *J. Am. Dent. Assoc.* 2005, 136, 620–630.
10. Schwendicke, F.; Elhennawy, K.; Reda, S.; Bekes, K.; Manton, D.J.; Krois, J. Global burden of molar incisor hypomineralization. *J. Dent.* 2018, 68, 10–18.
11. Zhao, D.; Dong, B.; Yu, D.; Ren, Q.; Sun, Y. The prevalence of molar incisor hypomineralization: Evidence from 70 studies. *Int. J. Paediatr. Dent.* 2018, 28, 170–179.
12. Weerheijm, K.L.; Groen, H.J.; Beentjes, V.E.; Poorterman, J.H. Prevalence of cheese molars in eleven-year-old Dutch children. *ASDC J. Dent. Child.* 2001, 68, 259–262.
13. Dantas-Neta, N.B.; Moura, L.F.; Cruz, P.F.; Moura, M.S.; Paiva, S.M.; Martins, C.C.; Lima, M.D. Impact of molar-incisor hypomineralization on oral health-related quality of life in schoolchildren. *Braz. Oral Res.* 2016, 30, e117.
14. Leal, S.C.; Oliveira, T.R.M.; Ribeiro, A.P.D. Do parents and children perceive molar-incisor hypomineralization as an oral health problem? *Int. J. Paediatr. Dent.* 2017, 27, 372–379.
15. Hanlin, S.M.; Burbridge, L.A.L.; Drummond, B.K. Restorative management of permanent teeth enamel defects in children and adolescents. In *Planning and Care for Children and Adolescents with Dental Enamel Defects*; Drummond, B.K., Kilpatrick, N., Eds.; Springer: Berlin/Heidelberg, Germany, 2015; pp. 139–155. ISBN 978-3-662-44800-7.
16. Casanova, M.F.; Baruth, J.M.; El-Baz, A.; Tasman, A.; Sears, L.; Sokhadze, E. Repetitive transcranial magnetic stimulation (rTMS) modulates event-related potential (ERP) indices of attention in autism. *Transl. Neurosci.* 2012, 3, 170–180.
17. Vitiello, V., Lee, S. L., Cundy, T. P., & Yang, G. Z. (2012). Emerging robotic platforms for minimally invasive surgery. *IEEE reviews in biomedical engineering*, 6, 111-126.
18. Ayme, A. P. P., Suárez, J. M. C., Ortega, M. M. P., Gualoto, D. S. G., Lima, J. C. S., Campoverde, A. E. R., ... & Serrano, G. D. M. (2023). Advancements in Minimally Invasive Surgical Techniques: A Comprehensive Review. *Salud, Ciencia y Tecnología-Serie de Conferencias*, 2, 622-622.
19. Simaan, N., Yasin, R. M., & Wang, L. (2018). Medical technologies and challenges of robot-assisted minimally invasive intervention and diagnostics. *Annual Review of Control, Robotics, and Autonomous Systems*, 1, 465-490.
20. Villena Gonzales, W., Mobashsher, A. T., & Abbosh, A. (2019). The progress of glucose monitoring—A review of invasive to minimally and non-invasive techniques, devices and sensors. *Sensors*, 19(4), 800.
21. De Rooij, T., Van Hilst, J., Boerma, D., Bonsing, B. A., Daams, F., van Dam, R. M., & Dutch Pancreatic Cancer Group. (2016). Impact of a nationwide training program in minimally invasive distal pancreatectomy (LAELAPS). *Annals of surgery*, 264(5), 754-762.
22. Amatachaya, A.; Auvichayapat, N.; Patjanasontorn, N.; Suphakunpinyo, C.; Ngernyam, N.; Aree-uea, B.; Keeratanont, K.; Auvichayapat, P. Effect of anodal transcranial direct current stimulation on autism: A randomized double-blind crossover trial. *Behav. Neurol.* 2014, 2014.
23. D'Urso, G.; Bruzzese, D.; Ferrucci, R.; Priori, A.; Pascotto, A.; Galderisi, S.; Altamura, A.C.; Bravaccio, C. Transcranial direct current stimulation for hyperactivity and noncompliance in autistic disorder. *World J. Biol. Psychiatry* 2015, 16, 361–366.
24. Enticott, P.G.; Fitzgibbon, B.M.; Kennedy, H.A.; Arnold, S.L.; Elliot, D.; Peachey, A.; Zangen, A.; Fitzgerald, P.B. A double-blind, randomized trial of deep repetitive transcranial magnetic stimulation



-
- (rTMS) for autism spectrum disorder. *Brain Stimuli*. 2014, 7, 206–211.
25. Schneider, H.D.; Hopp, J.P. The use of the Bilingual Aphasia Test for assessment and transcranial direct current stimulation to modulate language acquisition in minimally verbal children with autism. *Clin. Linguist. Phon.* 2011, 25, 640–654.