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Are we neglecting port-site complications in laparoscopic surgeries: A single centre study

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ABSTRACT

Introduction: Port site complications are troublesome problems which weaken the aids of minimally invasive surgery, not only does it add to the morbidity of the patient but also haul the reputation of the specialist. The study aims to determine the morbidities associated in laparoscopic surgeries at the port sites and to identify risk factors for complications at the port sites and how we can prevent them. *Patients and Methods:* In our present prospective study, 120 patients underwent laparoscopic surgeries during the period of 1st January 2021 to 31st December 2021 at our hospital were observed for complications at their port sites and statistically analysed for significance using SPSS ver. 20.0. *Results:* From a total of 120 patients the mean age was 37.84 ± 15.76 years. A total of 10 (8.19%) port site complications were observed in this study. Comparison of various procedures by the number of ports used was recorded to be significant $p < 0.0142$. Comparison of various procedures with the presence of co-morbidities was observed $p < 0.4069$. The association of obesity with the number of ports used is found to be statistically significant with $p < 0.0001$ in our study. *Conclusion:* The study showed that port site complications were least observed in elective laparoscopic surgeries. Complications were associated with the total number of ports; umbilical port involvement is the most common. Most complications were practicable with minimum morbidity and can be further minimalized with careful surgical technique during entry and exit.

Keywords: Port site complication, comorbidity, laparoscopic, minimally invasive.

1. INTRODUCTION

Laparoscopic surgeries are the most common surgeries performed among the minimally invasive/access procedures worldwide (Karthik et al., 2013). Laparoscopic procedures have made it possible to perform a wide range of surgical procedures with comparatively smaller incisions and are less painful with a speedy recovery. They are associated with less operative stress, decreased morbidity, lesser hospital stays as an advantage as compared to conventional open surgeries (Ahmad et al., 2008). Though laparoscopic surgeries are associated with the least number of complications, problems associated with them should be considered in the present era of minimal

access surgeries (Kodner et al., 2014).

Major laparoscopic port site complications include, port site infection/ seroma formation/ discharge, pain, port site or trocar site hernias, bleeding, metastasis and other miscellaneous complications like Port site pain, Loss of port position, leaking of ports, failed entry and nerve injuries are the complications which have also been shown in the studies (Jansen et al., 2004). The incidence rate of complications in laparoscopic surgery is about 1.4 percent/ Twenty-one/one lakh procedures (Jansen et al., 1997). Complications increase in incidence in relation to abdominal access difficulties, ineffective fascia closure, improper sterilization of instruments and in obese patients. Complications can present early (within 1 week of surgery) or late (upto 1 year) (Kodner et al., 2014). Early complications like infection/ discharge/ seroma formation, bleeding and delayed complications like hernia and metastasis have been mentioned in the study (Noblett et al., 2009). Most common laparoscopic procedure associated with port site complications is laparoscopic cholecystectomy (Sasmal et al., 2015). Obesity is the most important risk factor for PSCs, because to operate on obese patient we need lengthier trocars, need to take bigger skin incision and there will be restrictions in movement of the Laparoscopic instruments because of their thicker tissue content of the abdominal wall and there is poor wound healing in obese patients (Sasmal et al., 2015). PSC will be more with the higher number of ports (Chiu et al., 2006). The present study aims to determine the morbidities associated in laparoscopic surgeries at the port sites and to identify risk factors for complications at the port sites and how we can prevent them.

2. MATERIALS AND METHODS

All patients undergoing laparoscopic surgeries in our centre were observed prospectively after receiving the Institutional ethics committee approval (MDC/DOME/75). A total of 120 cases were enrolled during the study period from 1st January 2021 to 31st December 2021 were observed. The Inclusion criteria- All patients undergoing laparoscopic surgeries in KLE hospital Belagavi with ages ranging from 8 to 80 years. Exclusion criteria- Laparoscopic surgeries converted to open, pregnant women, immunocompromised patients, age < 8 years. Port sites were observed for complications prospectively for the period of one year postoperatively.

Study Protocol

Written informed consent was taken from the patient, data is collected, the patient was enrolled for the study and screening was done and taken up for the procedure (Table 1).

Table 1 Age-wise distribution.

Age groups	Number	Percent
<=20yrs	14	11.67
21-30yrs	31	25.83
31-40yrs	35	29.17
41-50yrs	13	10.83
51-60yrs	16	13.33
>=61yrs	11	9.17
Total	120	100.00
Mean age	37 .84	
SD age	15 .76	

Procedures were taken under general anaesthesia. All patients undergoing laparoscopic surgeries were given antibiotics preoperatively. Reusable ports were used after sterilization with ethylene oxide. Access into the abdomen was gained by open Hasson's technique and pneumoperitoneum was created. A 10mm trocar was used for umbilical port (camera port), another 10mm trocar for an additional epigastric port and 5mm trocars 2-4 in number were used (multiple working ports). Reusable conical rotatory-type trocars were used. The fascia of ports of 10mm was closed with vicryl sutures and the skin was closed with ethilon suture.

Post-operatively port sites were observed for complications by myself and my co-pgs in the following way: Within 24hours, post-op day 3, during the next follow-up (within 1 week), after 1 month and subsequent follow ups and if further complications through telephonic conversation up to 1 year (Table 2).

Table 2 Comparison of various procedures by number of ports.

Procedure	3	%	4	%	5	%	Total	%
D Lap	7	53.85	4	30.77	2	15.38	13	10.83
LA	33	62.26	20	37.74	0	0.00	53	44.17
LC	21	53.85	18	46.15	0	0.00	39	32.50
LUHR	6	75.00	2	25.00	0	0.00	8	6.67
Others	3	42.86	4	57.14	0	0.00	7	5.83
Total	70	58.33	48	40.00	2	1.67	120	100.00
Chi-square= 19.1288 p=0.0142* *p < 0.05								

And at the presentation to the hospital with complaints such as pain, discomfort, discharge, swelling, fever at the port site post-operatively up to one-year. Various laparoscopic procedures like laparoscopic appendectomy, laparoscopic cholecystectomy, laparoscopic hernia repair, lap diagnostic scopies, laparoscopic Splenectomy and lap-nephrectomy, laparoscopic rectopexy were observed in our study (Table 3).

Table 3 Comparison of various procedures with presence of co-morbidities.

Procedure	Present	%	Absent	%	Total	%
D Lap	0	0.00	13	100.00	13	10.83
LA	6	11.32	47	88.68	53	44.17
LC	2	5.13	37	94.87	39	32.50
LUHR	0	0.00	8	100.00	8	6.67
Others	0	0.00	7	100.00	7	5.83
Total	8	6.67	112	93.33	120	100.00
Chi-square= 3.9934 p=0.4069						

Most common being lap appendectomy and lap cholecystectomy. Various comparisons were made to see the association of port site complications with risk factors, such as Age, Number of ports used for various procedures, Association with obesity, Previous abdominal surgeries, Obesity with the number of ports, Obesity with comorbidities, Use of retrieval or endobags and then statistical significance was analysed using software SPSS 20.

3. RESULTS

In the current study, 120 patients who have undergone laparoscopic surgeries were observed and the incidence of port site complications was found to be 8.19%, i.e., 10 patients had different port site complications like port site infection (5), port site seroma formation (1), port site bleeding (2), port site hernia (2), all were recognized and treated timely with minimal morbidities. All the results presented in tables 4 to 9; & figures 1 to 2.

Table 4 Comparison of various procedures with presence of PSI.

Procedure	Yes	%	No	%	Total	%
D Lap	0	0.00	13	100.00	13	10.83
LA	4	7.55	49	92.45	53	44.17
LC	1	2.56	38	97.44	39	32.50
LUHR	0	0.00	8	100.00	8	6.67
Others	0	0.00	7	100.00	7	5.83
Total	5	4.17	115	95.83	120	100.00
Chi-square= 2.9854 p=0.5603						

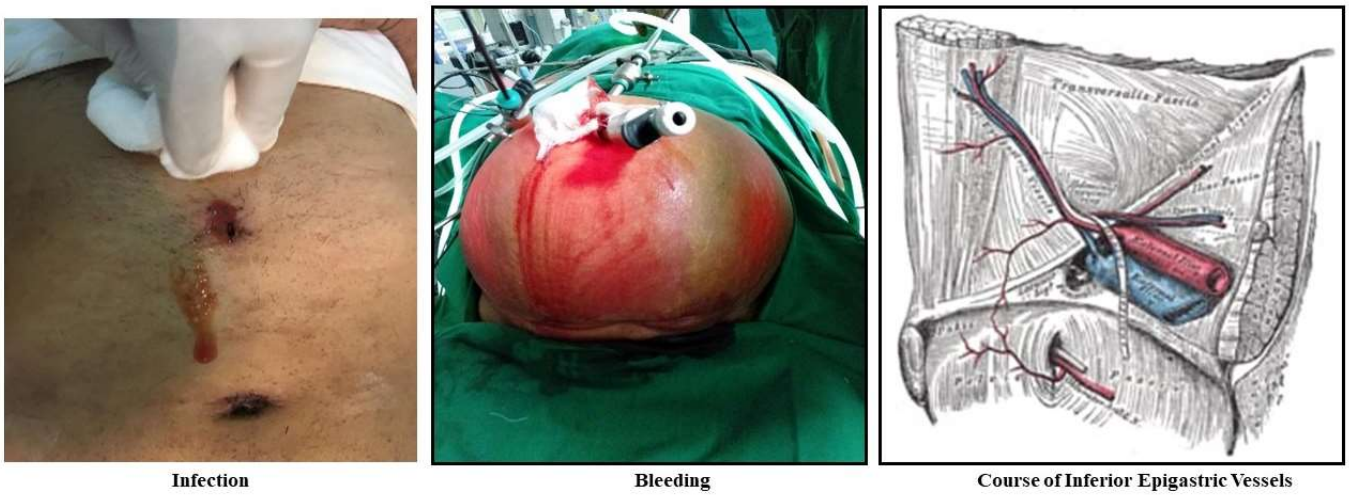

Figure 1 Shows early port-site complications, port-site infection and intra-opt port-site bleeding.

Table 5 Association between obesity with No. of ports.

No. of ports	Under weight	%	Normal	%	Over weight	%	Total	%	p-value
3	7	10.00	60	85.71	3	4.29	70	58.33	0.0001*
4	0	0.00	23	47.92	25	52.08	48	40.00	
5	0	0.00	1	50.00	1	50.00	2	1.67	
Total	7	5.83	84	70.00	29	24.17	120	100.00	

*p < 0.05

Table 6 Association between obesity with Co-morbidities.

Co-morbidities	Under weight	%	Normal	%	Over weight	%	Total	%	p-value
Present	0	0.00	6	75.00	2	25.00	8	6.67	0.7660
Absent	7	6.25	78	69.64	27	24.11	112	93.33	
Total	7	5.83	84	70.00	29	24.17	120	100.00	

Table 7 Association of obesity with complications.

	Under weight	%	Normal	%	Over weight	%	Total	%	p-value
PSI									
Yes	1	20.00	1	20.00	3	60.00	5	4.17	0.0402*
No	6	5.22	83	72.17	26	22.61	115	95.83	
Seroma formation									
Yes	0	0.00	1	100.00	0	0.00	1	0.83	0.8057
No	7	5.88	83	69.75	29	24.37	119	99.17	
PSH									
Yes	0	0.00	0	0.00	2	100.00	2	1.67	0.0411*
No	7	5.93	84	71.19	27	22.88	118	98.33	
PSB									
Yes	0	0.00	0	0.00	2	100.00	2	1.67	0.0411*
No	7	5.93	84	71.19	27	22.88	118	98.33	
PSM									
Yes	0	0.00	0	0.00	0	0.00	0	0.00	1.0000
No	7	5.83	84	70.00	29	24.17	120	100.00	
Total	7	5.83	84	70.00	29	24.17	120	100.00	

*p < 0.05, obesity is found to be statistically significant with occurrence of port site infections (p – value- 0.0402), PSH (p – value – 0.0411) and PSB (p – value – 0.0411).

Figure 2 Shows port-site hernia at the site on extension of the incision for retrieval of the specimen and at the umbilical port-site.

Table 8 Association between co morbidities with complications.

	Present	%	Absent	%	Total	%	p-value
PSI							
Yes	0	0.00	5	100.00	5	4.17	0.5415
No	8	6.96	107	93.04	115	95.83	
Seroma formation							
Yes	1	100.00	0	0.00	1	0.83	0.0001*
No	7	5.88	112	94.12	119	99.17	
PSH							
Yes	0	0.00	2	100.00	2	1.67	0.7030
No	8	6.78	110	93.22	118	98.33	
PSB							
Yes	1	50.00	1	50.00	2	1.67	0.0132*
No	7	5.93	111	94.07	118	98.33	
PSM							
Yes	0	0.00	0	0.00	0	0.00	1.0000
No	8	6.67	112	93.33	120	100.00	
Total	8	6.67	112	93.33	120	100.00	

*p < 0.05

"Co-morbidities like diabetes mellitus, hypertension, have been found to be significantly associated with the development of port-site complications, especially in seroma formation (0.0001) and bleeding." (p- value < 0.0132).

Table 9 Association between use status of retrieval bag with co-morbidities.

Co-morbidities	Used	%	Not used	%	Total	%
Present	6	75.00	2	25.00	8	6.67
Absent	31	27.68	81	72.32	112	93.33
Total	37	30.83	83	69.17	120	100.00

p < 0.0040* *p < 0.05

Obesity and co-morbidities are identified as the statistically significant risk factors for the development of port site complications, the most common complication being infection. By using meticulous surgical techniques and appropriate measures port site complications can be prevented, thereby reducing morbidity in patients.

4. DISCUSSION

Laparoscopic port site complications are found in both male and female gender and are also found in all age groups (Kindel et al., 2015). Literature shows that the most important risk-factor is obesity in the development of port site complications (Owens et al., 2011). Since to operate on obese patients longer trocars are needed, larger skin incision should be taken for adequate fascia exposure and they have a thicker abdominal wall, causing limitations in the mobility of instruments. Hence proper alignment of ports to their axis is necessary to avoid Swording. For proper placement of ports, the Baseball Diamond concept of port placement should be followed which avoids Swording (Alam et al., 2021).

In the current study, 120 patients with a mean age group of 37.84 years, including 77 females and 43 males who had undergone various laparoscopic procedures, were observed. The most common procedure being done was laparoscopic appendicectomy. Overall, 10 patients (8.33%) developed different port site complications like port site infection (PSI), port site seroma formation, Port site bleeding (PSB) and port site hernia (PSH). The most common procedure is laparoscopic appendicectomy and the most common port involved is the umbilical port. Obesity and co-morbidities are found to have statistical significance with port site complications which is comparable to the study conducted by Ravindranath et al., (2016), most common complication being PSI (n=5) in this study. Buckley et al., (2016) observed to have a greater number of complications with increase in number of ports, like in the procedure where a greater number of ports were used (> 4, 5, 6), more complications occurred.

Fascial closure is required for the ports with the size 10mm or more and some also advise closure in 5mm ports in children to reduce the risk of LPSCs, particularly hernia. The fascia should be re-approximated under direct visualization by adequately exposing fascia by retractors. Fascial edges should then be grasped and sutured either by the figure of eight configurations or interrupted sutures (Ataseven et al., 2016). Different techniques for the closure of fascia are now available, using specialized devices such as the Grice suture needle, Carter Thomson needle-point suture passer, Endo close, Reverdin suture needle but their benefits are yet to be proved (Mudgal et al., 2018).

In our study out of 120 patients 8.3% patients developed port site complications, most common is PSI which is 4.17%, followed by PSB and PSH which are 1.67% each, followed by port site seroma formation which is 0.8% during a minimal follow up period of one year. Other complications like Port site metastasis, omental entrapments and sub cutaneous emphysema were not found.

Port site infection

Though SSIs are less in number in laparoscopic surgeries nonetheless produce significant morbidity. Proper knowledge about PSI development is necessary which most of the times is neglected by us. In this study, of 120 patients who underwent various laparoscopic procedures, 5 patients developed PSIs which is 4.17%, most common site involved was umbilical port and most common procedure being involved was Laparoscopic appendicectomy i.e., 4 in number followed by laparoscopic cholecystectomy, which is analogous to the studies conducted by Chen et al., (2018) reported the incidence of 6.3% incidence. Obesity is the most identified risk factor in the development PSI with statistically significant value (p -value of < 0.0402). PSIs are attributed in this study because of the usage of reusable LIs, non-usage of endo bags for specimen retrieval, umbilical flora. In this study, all port site infections involved were superficial infections (skin and subcutaneous tissue) only, which is most commonly seen as stated by Jamil et al., (2016).

Among port site infection umbilical port site is the most common site because of umbilical flora and retrieval of specimen many times was done through umbilical port, next common is epigastric port. As per the literature, much weightage is towards the raised incidence of PSI at the umbilicus and the part played by umbilical flora in the occurrence of Port site infection (Usman et al., 2016). Much weightage has also given to the site of extraction of specimen, wherein most of the times gall bladder is extracted via epigastric port. PSIs are prevented by using proper sterilization techniques, administration of appropriate prophylactic antibiotics, use of endo bags for specimen extraction. Once PSIs have occurred they have to be managed by proper cleaning, drainage, packing and appropriate antibiotics according to culture sensitivity reports.

Port site hemorrhage/bleeding (PSB)

In our study 1.67% i.e., 2 patients were found to have developed PSB out of 120 patients. Bleeding was recognized soon and was managed by the application of local pressure and cauterization, this is comparable to studies conducted by Lambertz et al., 2017;

Sultan et al, 2022; Sultan et al, 2022, on 25,764 laparoscopic procedures. Most of the times Epigastric vessels are injured during the secondary port placement, hence ports should be inserted with utmost care by direct visualization and with better lighting of the abdominal wall. PSB goes unseen till the ports are in place because the port may tamponade muscular or subcutaneous bleeding (Christoffersen et al., 2015). Bleeding points can be controlled by cauterization, rarely need the extension of an incision to control the bleeding. If still bleeding persists Foley's catheter is placed and U-stitches can be applied.

Port site hernia

In this study port site hernias (PSH) were 2 out of 120, i.e., 1.67%. One of which was in the umbilical region and the other was in the right lumbar region (Maharaul et al., 2019). Obesity is significantly associated with the occurrence of PSHs with the p-value of 0.0411 both with BMI of >30. One PSH which had occurred at the umbilical port had a history of previous surgery i.e., exploratory laparotomy with midline infraumbilical scar which resulted in the PSH this is comparable to Gupte et al., (2017), who found that 12% of patients who had laparoscopic cholecystectomies were having previous fascial defects and 83.7% were without any symptoms. Obese patients have the higher risk for the development of PSH because of their thicker preperitoneal fat and increased intraabdominal pressure. Hence closure of fascia alone is not helpful.

Another patient who developed PSH at the right lumbar region underwent an extension of port site incision for the extraction of specimen following laparoscopic nephrectomy, which resulted in port site hernia. Risk of occurrence of port site hernias is low with the use of trocars of less than 12mm, "radially dilating trocars or bladeless trocars" (Al-Naser et al., 2017). Most surgeons do fascia closure of port where in trocars of >12mm size are used, also 10mm port's fascia must be closed. At 5mm port sites, though port site hernia is rare, but has been reported in the study. Keeping a "SURGICEL plug" into muscular layer has also been anticipated that dramatically expanding trocars could be useful to avoid the need to close fascial defects. Verma et al., (2018) also studied to have lesser rate of PSH with the use of para median incision and non-bladed trocars with conical tip. As compared with other methods like "Deschamps needle" and "non-bladed trocars", the simple closure and the cost-effectiveness of the classical approach is promising.

Following laparoscopic surgery if PSH develops, the port site must be repaired to avoid development of intestinal complications like obstruction and strangulation (Manvelyan et al., 2016). Numerous causes have been identified in the development of hernia including a) removal of the trocars before full deflation of the abdominal cavity is done, b) wrong techniques of port closure, c) bigger incisions at port site. PSH can be prevented and managed accordingly a) After the procedure, trocars should to be removed with utmost caution and vision, b) other working trocars are also to be removed with care and then deflate the abdomen c) Cannula and camera should be removed together, after the removal of gas fully with a clear vision port site incision every time that the port if free of any entrapped bowel d) the size of port incision should limited. A secure and appropriate closure of the ports of size >10mm should be ensured."

Port site metastasis

In our study, no single case of port site metastasis was found. In various oncological procedures performed laparoscopically, port sites have been found to have metastases at the port sites by the implantation of tumor cells. PSM has been testified for all types of malignancy treated with laparoscopy with an incidence of 1% and 2.3% for colorectal (Gao et al., 2020) and gynecological malignancies respectively. Evidence of direct influence of carbon dioxide gas on neoplastic cells is an important factor for PSM after the surgery by laparoscopic approach. Lago et al., (2019) found that the carbon dioxide gas used to create pneumo-peritoneum in laparoscopic surgery promoted growth of tumor cells in an animal model of laparoscopy when compared to helium/controls. Using an animal model of laparoscopy Rehman et al, (2021) also described the proliferative growth of neoplastic cells in a carbon-dioxide insufflation group when compared to those with no pneumo-peritoneum (Saini et al., 2019).

Many other studies showed that the micro environment of the port site could be imperative in tumor growth and that the local factors at the port site play a significant role in the mechanism of development of PSM. Injury to the tissue and local abdominal factors may be as significant as cell aerosolization, Tan et al., (2017), studied the effect of tissue injury and the local abdominal factors. However various explanations are given in the literature saying Endo bags and extension of the incision are the measures to be taken to avoid the recurrence of the tumor.

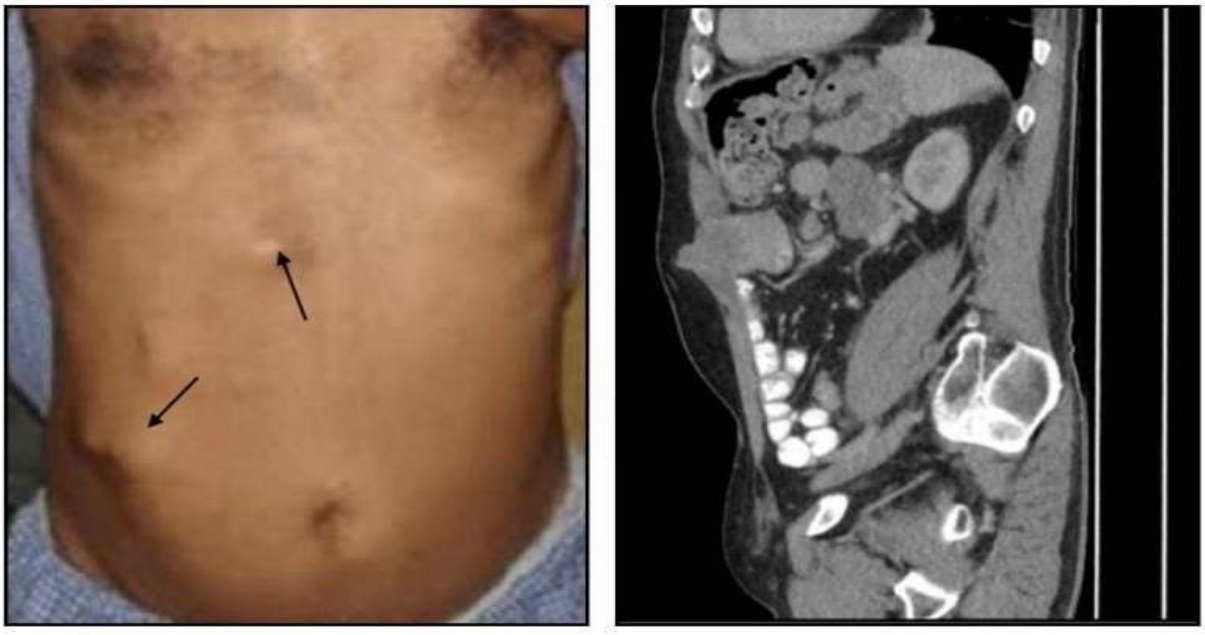

Figure 3 Shows clinical image of port-site metastasis and CT image showing seeding of the metastasis.

5. CONCLUSION

Surgeries with a laparoscopic approach are found to have fewer port site complications. PSCs include port site infection/ wound dehiscence, herniation, entrapment of omentum, port site bleeding and hematoma formation and port site metastasis. Incidences in the present study of individual complications are comparable with statistics worldwide (0.2-6%). Overall complications seen were port infections at the umbilical port and most of them were in obese patients. Most of the LPSCs are treatable with little morbidity by taking careful operative precautions and strictly following sterilization methods, careful placement of ports and removal of all ports and proper fascia closure so that all these complications and morbidities are avoided.

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Author Contributions

KH & MDT: Planned the study designed, executed and wrote the manuscript, KH & BGH: Collected the data and analysed the statistics in the study. All the authors reviewed, edited and approved the manuscript.

Ethical approval

The study was approved by the Medical Ethics Committee of the Institutional ethics committee approval (MDC/DOME/75).

Informed consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

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