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General Surgery

USE OF TANAKA INDEX IN PLANNING OF PREOPERATIVE PROGRESSIVE PNEUMOPERITONEUM (PPP) FOR THE REPAIR OF GIANT INCISIONAL HERNIAS WITH LOSS OF DOMAIN IN A TERTIARY CARE HOSPITAL

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ABSTRACT **BACKGROUND AND OBJECTIVES :**Incisional hernia is the most common iatrogenic malady. Not only does it lead to complications, aesthetic problems and a prolonged disability, there is also the problem of recurrences. Incisional hernias occur in 2–15% of patients who undergo laparotomy, with recurrence rates after treatment of 0–46%. In this study, we have used the Tanaka index in planning of preoperative pneumoperitoneum for the repair of large incisional hernias with loss of domain. METHODS: In this study, all patients with large incisional hernias with loss of domain who were admitted to surgical wards of McGann District Teaching Hospital, attached to Shimoga Institute of Medical Sciences during the study period of 18 months (01/01/2021 to 30/06/2022) are included. After satisfying inclusion and exclusion criteria, these patients have been thoroughly examined, investigated and evaluated preoperatively and subjected to pre operative progressive pneumoperitoneum (PPP) and subsequently to various surgical repairs. Follow up post operatively has been done for a maximum of 6 months after discharge. RESULTS: Incidence of Incisional hernias was more in females with male to female ratio of 1.7:1.On an average ,10 PPP sessions were needed and the volume of air inflated was 4000ml(average) .Rives stoppas repair with left Transverse abdominis release repair was performed in maximum cases.We received good results with healthy wound status post 6 months of surgery. CONCLUSION For large incisional hernias with LOD, PPP and the use of TANAKA Index has been found to be useful with excellent results.

KEYWORDS : Hernia; Incisional; Loss of domain; Artificial pneumoperitoneum;Abdominal hernia; Computerised tomography

1.INTRODUCTION

Hernias are one of the most commonly performed surgeries in the daily life a general surgeon.It is one of the first surgeries independently performed by a junior resident,yet its management remains very much complex.Advancement in surgical techniques sheds new light of hope in the management of all hernias.Incisional hernia is a protrusion of abdominal viscera through the site of previous operation or traumatic wound of the abdominal wall except hernial site.1 Incisional hernias occur in 2–15% of patients who undergo abdominal surgery,2 with recurrence rates after treatment of 0–46%. Incisional hernia treatment is challenging for surgeons and their incidence is next only to inguinal hernia. Since, most of the cases of incisional hernia are asymptomatic, the actual incidence may be higher than reported.

It has become an iatrogenic disease, an unavoidable complication of laparotomy and other abdominal incisions.

The difference between abdominal incisions and other incisions is that the abdominal wall itself is subject to variable pressure from within. Hence, we should put more physiological incisions which produces less anatomical distortions. Among the abdominal incisions, the lower abdominal incisions are seen to be associated with highest incidences of incisional hernia. Most of the gynaecological operations are done through this incision. More females are in risk of developing incisional hernia after lower section caesarean section and open tubectomy on a routine level. The pressure in the lower abdomen is more than upper abdomen and the posterior rectus sheath is deficient below the umbilicus and the stress and strain on the lower abdomen predispose for herniations.[3]

Though there are a number of aetiological factors for the development of incisional hernia, the increased intra abdominal pressure and the immediate post operative wound infections are the most important causes.

Sometimes, prevention is better than cure. So, as surgeons we should take utmost care in planning the incisions for our abdominal surgeries, do adequate preoperative preparations and give post operative care in such a way as to prevent post op wound infections.

Adding to all the challenges incisional hernia management can offer is especially when there is loss of domain. This "loss of domain" means that the herniated viscera of the abdominal content inhabit, in a permanent way, the hernia sac, which behaves like a second abdominal cavity.4 Once the hernia sac contents are restored to the abdominal cavity, it may lead to respiratory and circulatory disturbances. It can also result in abdominal compartment syndrome (ACS), which occurs when the intra-abdominal pressure (IAP) rises faster than physiological adaptations and can be fatal in severe situations.[5]

Preoperative progressive pneumoperitoneum (PPP) treatment prior to the repair of large abdominal hernias and eventrations was first described by Gon˜i Moreno in 1940 6. There is no consensus in the literature on the amount or type of gas that should be insufflated in PPP programs or even how long it should be maintained. We have used the Tanaka index for calculating the hernia sac volume (HSV) and abdominal cavity volume (ACV) based on abdominal computerized tomography (ACT) scanning that eliminates the need for subjective criteria for inclusion in a PPP program and shows the amount of gas that must be insufflated into the abdominal cavity in the PPP program.

While undertaking this study, I have been fortunate to be a part of this complex management of large incisional hernias with loss of domain and the management of recurrent incisional hernias with loss of normal anatomical planes and unhealthy scars. Through my study, I hope to shed some light in the management of these 'iatrogenic hernias'.

2. METHODOLOGY

In this study, all patients with incisional hernias who were admitted to surgical wards of McGann District Teaching Hospital, attached to Shimoga Institute of Medical Sciences during the study period of 18 months (01/01/2021 to 30/06/2022) are included. After satisfying inclusion and exclusion criteria, written informed consent has been taken after explaining in local language. Consent in both English and Kannada were taken (forms attached). Detailed history, clinical examination findings were entered in pre-designed proforma (attached). Necessary investigations were noted. These patients have been thoroughly examined, investigated and evaluated preoperatively. Patients fit for anaesthesia were taken up for surgery after written consent. Depending on the age, presentation, tone of the abdominal muscles and affordability of the patient for the operative procedures

patients were subjected to the various surgical repairs. Follow up post operatively has been done for a maximum of 6 months after discharge.

Inclusion Criteria

- All the patients of incisional hernia irrespective of age and sex, were included in this study.
- Electively operated cases of incisional hernia were included in this study.
- Patients who were willing to give consent.
- Patients with recurrent incisional hernia were also included.

Exclusion Criteria

- Skin infection.
- Emergency operated case of incisional hernia
- Any general contraindication for surgery
- Pregnant females with incisional hernia

Data Analysis

Statistical analysis was done by calculating mean, standard deviation. The statistical significance between proportions were determined by Chi-Square test.

SAMPLE SIZE ESTIMATION

Sample size is calculated using estimation technique
S = Z2pq/d2
The estimated sample size is 50.

Preoperative progressive pneumoperitoneum (PPP) is a safe and effective procedure in the treatment of large incisional hernia (size >10 cm in width or length) with loss of domain (LIHLD). The surgeon should evaluate the possibility of reducing the hernia prior to or following auxiliary therapeutic methods during preoperative planning, in order to avoid life-threatening complications such as abdominal compartment syndrome, which may be a fatal condition if diagnosis or treatment are delayed. Abdominal compartment syndrome is classified in degrees, with evaluation of Intra Abdominal Pressure (IAP) according to the World Society of Abdominal Compartment Syndrome (WSACS) Grading (IAP from 12 to 15 mmHg is Grade 1, IAP from 16 to 20 mmHg is grade 2 and IAP from 21 to 25 mmHg is grade 3 and IAP 25 mmHg is grade 4). The lower the IAP, the more physiological are the intraabdominal conditions. These patients were subjected to an abdominal computerised tomography with confirmation of the size of the hernia (more than10 cm in width or length). The abdominal computerised tomography enables study of the hernia sac and abdominal cavity, evaluation of the abdominal wall components and calculation of hernial sac volume (HSV) and abdominal cavity volume (ACV). The abdominal cavity and the hernia sac can be considered to be ellipsoid structures, thereby allowing estimation of their volume. This requires that longitudinal (cranio-caudal), transverse and anterior– posterior measurements of the abdominal cavity (A, B and C, respectively) and hernia sac (a, b and c, respectively) be obtained. The anterior limit of the abdominal cavity is determined by a line that unites the muscle groups of the healthy wall, and the posterior limit by a line that passes through the transverse process of the vertebrae. The upper or cranial limit of the abdominal cavity for craniocaudal measurement of the abdominal cavity is the first axial slice that shows the diaphragm, and the lower or caudal limit of the abdominal cavity is the last axial slice that shows the coccyx. The latero–lateral (transversal) limits for measurement of the abdominal cavity are the parietal peritoneum of each side of the abdominal cavity.

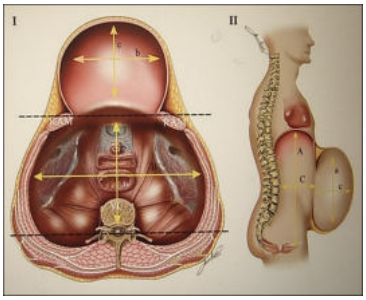

Figure 1: Graphic Layout of Transverse (I) and Sagital (II) Slices of the Abdominal Cavity and of the Hernia Sac. VC Vetrebral Column, Ram Rectus Abdominus Muscle, A. Longitudinal Measure of Hernia Sac, B. Transverse Measure of hernia Sac, C. Anterior-Posterior Measure of Hernia Sac, a. Longitudinal Measure of Abdominal Cavity, b. Transverse Measure of Abdominal Cavity, c. Anterior-Posterior Measure of Abdominal Cavity For measurement of the hernia sac, the limits are the parietal peritoneum of the hernia sac in the upper/cranial, lower/caudal and latero–lateral (transversal) limits of the hernia sac. The exception is the posterior limit of the hernia sac, which is determined by the same line that determines the anterior limit of the abdominal cavity, i.e. the line that unites the muscle groups of the healthy wall. Once the limits are known, the distances between the respective points can be measured to obtain the longitudinal or cranio-caudal (a), transverse or latero-lateral (b), and anterior–posterior (c) measures of the abdominal cavity and hernia sac. With these values, we can calculate the volumes of the abdominal cavity and hernia sac using the formula for the volume of an ellipsoid (V): $V = 4/3 \times \pi \times r1 \times r2 \times r3$ r1 radius 1, r2 radius 2, and r3 radius 3 of the ellipsoid and the longitudinal measure (a = 2 x r1), b is the transverse measure (b = 2 x r2), and c is the anterior–posterior measure (c = 2 x r3).

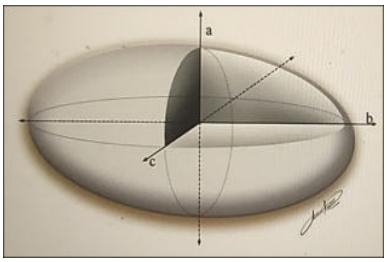

Figure 2: Ellipsoid and the diameters

This equation can be further simplified as:

HSV (or ACV)= 0:52 x a x b x c. Based on the relationship between HSV and ACV, I have used the TANAKA INDEX for calculating these volumes in patients presenting with incisional hernia. We defined VR = HSV/ACV.

All patients who presented with a VR C 25% were included in a PPP program for abdominal hernioplasty. Initially, a 500 ml volume is insufflated, with a daily increase of 500 ml (e.g., 1st day = 500 ml; 2nd day = 1,000 ml; 3rd day = 1,500 ml; 4th day = 2,000 ml, etc.) until the final calculated volume is reached. After the final volume is reached, the patient is ready for the major surgery that will treat the hernia.7

3.RESULTS

Age distribution of incisional hernia in our study is as follows.

Table 1: Age distribution

Age group (years)	Number	Percent
<20	1	2.0
21-30	4	8.0
31-40	11	22.0
41-50	10	20.0
51-60	11	22.0
61-70	8	16.0
70+	5	10.0
Total	50	100.0

In this study maximum patients belonged to both 31-40 and 51-60 years age group. The youngest patient was 19 years old and oldest patient was 91 years old.

Table 2: Gender distribution

Sex	Number	Percent
Male	18	36.0
Female	32	64.0
Total	50	100.0

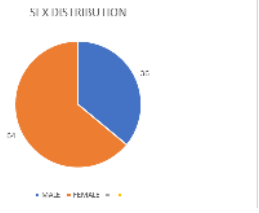

Figure 3 : Gender distribution

Out of 50 cases, 32 were females (64%) with incisional hernia. Therefore, the sex incidence is 1.7:1 (female:male).

TABLE 3 :INCISIONAL HERNIA CHARACTERISTICS

Abdominal cavity volume(ml)	4200	1860-6780
Hernia sac volume(ml)	9300	7200-19,980
Volume ratio	35	25-75
PPP sessions	10	4-17
Volume PPP sessions	4000	2000-7000

TABLE 4:TYPE OF REPAIR

TYPE OF REPAIR	NUMBER	PERCENTAGE
RS+B/L TAR	10	20
RS+L TAR	25	50
RS+R TAR	15	30
TOTAL	50	100

RS – RIVES STOPPAS,B/L- BILATERAL,L-LEFT,R-RIGHT, TAR-TRANSVERSUS ABDOMINIS MUSCLE RELEASE

Table 5: Postoperative complications after repair of incisional hernia

Postoperative complications	Number	Percent
Nil	45	90
Seroma	4	8.0
WD(WOUND DISRUPTION)	1	2.0
Total	50	100.0

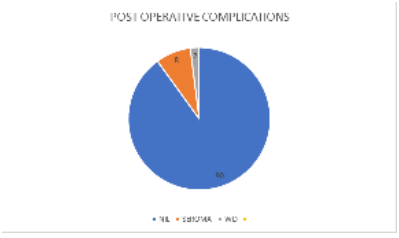

Figure 4: Postoperative complications after repair of incisional hernia

Table 6 : Nature of wound on follow up

Nature of wound	Number	Percent
H(HEALTHY)	49	98.0
SS(SUTURE SINUS)	1	2.0
Total	50	100.0

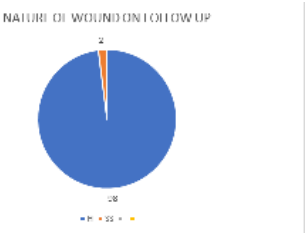

Figure 5: Nature of wound on follow up

Six months follow up, 98% of our patients had a healthy wound. One patient developed suture sinus which was excised.

4.DISCUSSION

- With permission from the patient, I have included a clinical picture of a 49 year old female who came with complaints of swelling in right upper abdomen x 2 years following open cholecystectomy 16 years ago.
- On examination she had a 27x23cm reducible swelling in right hypochondrium extending to right lumbar region.
- EHS L4 W3 non-recurrent

Figure 3: Clinical photograph of female patient with large incisional hernia with loss of domain

INVESTIGATION

- Abdominal CT revealed a defect of width 11 cm.
- We used TANAKA index to calculate volume ratio (VR) and the quantity of air to be inflated while performing PPP.
- The PPP was performed only if the volume ratio HSV/ACV (VR = HSV/ACV) was >25% (VR > 25%). HSV-hernia sac volume, ACV- abdominal cavity volume.
- Here VR was 36% (4,500/12,500).
- To deliver air to abdominal cavity, a silicon catheter was placed into the abdomen as a minor procedure.

Figure 6: Clinical photograph of patient after insertion of 3 way catheter

- Initially, a 500 ml volume is insufflated, with a daily increase of 500 ml until the final calculated volume is reached (VR<1%).
- Patient was taken for hernioplasty and a 30x30cm composite mesh was placed in retro rectus space with right transverse abdominis release (TAR).

RESULTS

The postoperative course was uneventful, asymptomatic at 1-year follow-up

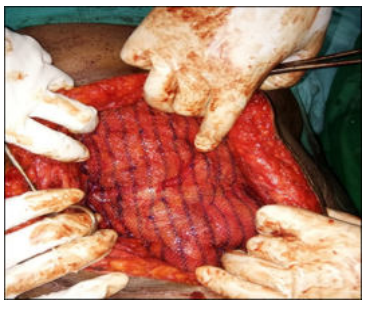

Figure 7: Intra operative picture of 30x30 cm composite mesh in retro rectus plane

Tanaka et al performed this technique on 23 patients with incisional hernia and loss of domain and volume ratio more than 25% from 2001 to 2008. Below showing a table summarising the study:

Table 22: Incisional hernia characteristics[7]

Hernia sac volume(ml)	4,500(1,850-6,600)
Abdominal cavity volume(ml)	9,410(6,060-19,230)
Volume ratio (%)	36(26-73)
PPP sessions	10(4-18)
Volume PPP (ml)	4,000(2,000-7,000)

However, there is no consensus in the literature as to the quantity of gas to be insufflated, how long PPP should be maintained, or even the type of gas to be used to perform PPP.We have used air to insufflate as it is easier and avoids the complications offered by co2.

5.CONCLUSION

We conclude that TANAKA INDEX is a useful tool in the treatment of LIHLD, providing objective data for volume calculation for both the hernia sac and the abdominal cavity and also for estimation of the volume of gas that should be insufflated into the abdominal cavity in PPP.

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