

# Study the Sensitivity and Positive Predictive Value of Clinical Finding, Ultrasonography, and Computed Tomography Finding to Detect the Defect Size and Number of Incisional/Ventral Hernia

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## ABSTRACT

Despite the importance of defect size, there are no standardized recommendations on how to measure ventral hernias. Our aims were to determine<sup>1</sup> if any significant differences existed between various methods of measuring ventral hernias and<sup>2</sup> the effect of these methods of measurement on selection of mesh size.

**Materials and methods:** A prospective study of all patients enrolled in a randomized trial assessing ventral hernia repair at our institution from January 2018 to June 2019 was eligible for inclusion. Abdominal wall hernia defect size will be obtained using the following methods: clinical examination, ultrasonography (USG), and computed tomography (CT) finding. Clinically, measurement will be determined by feeling the edges of muscle and measuring the defect using the measuring tape or thread. Computed tomography abdomen/USG abdomen was done to every patient to confirm the size of defect and its contents of hernia and other associated hernia for estimating the size of the prosthesis to be used. Then, defect size and number of incisional/ventral hernia will be measured intraoperatively using the measuring tape or thread, and this measurement will be compared with the earlier three findings of clinical examination, USG, and CT findings.

**Results:** Thirty patients met inclusion criteria for assessment. Defect size measured by clinical examination in comparison with intraoperative finding of defect size is found out to be statistically significant with a mean value (5.10) more than that of the intraoperative finding (4.85), and  $p$  value is  $<0.05$ , i.e., 0.012, and defect size measured by USG in comparison with intraoperative finding of defect size is also found out to be statistically significant with a mean value (3.87) less than that of the intraoperative finding (4.85), and  $p$  value is  $<0.05$ , i.e., 0.036. But the size of defect of hernia measured by CT scan is almost same as that of hernia measured during intraoperative finding with a mean value of 4.60 and 4.85, respectively.

**Conclusion:** Among the three methods of measuring ventral hernia defect, CT scan is most sensitive in detecting the number of hernia and measuring the size of defect followed by clinical examination. Although our study has some limitations due to which we can make no recommendations regarding the ideal measurement method right now. Further studies are needed to determine which method results in optimally sized abdominal wall prostheses and superior ventral hernia repair.

**Keywords:** Correlation, Hernia defect, Measurements, Mesh, Ventral.

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## INTRODUCTION

Incisional/ventral hernia is defined as any abdominal wall gap with a bulge in the area of a postoperative scar perceptible or palpable by clinical examination or imaging. Also, it represents a breakdown or loss of continuity of a fascial closure.<sup>1</sup> Ian Aird defines incisional/ventral hernia as a diffuse extrusion of peritoneum and abdominal contents through a weak scar of an operation or accidental wound. Incisional hernias occur as a result of excessive tension and inadequate healing of a previous incision, which is often associated with surgical site infection. These hernias enlarge over time and lead to pain, bowel obstruction, incarceration, and strangulation. Obesity, advanced age, malnutrition, ascites, pregnancy, and conditions that increase intra-abdominal pressure are factors that predispose to the development of an incisional/ventral hernia.

Incisional/ventral hernias are one of the most common problems faced by general surgeons; they occur in up to 28% of patients after initial laparotomy.<sup>2</sup> Diagnosis and characterization of incisional hernias can be challenging, and few well-designed studies are available to guide surgeons through the process of diagnosis, management, and follow-up in these patients.

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Diagnostic tools such as ultrasonography (USG) and computed tomography (CT) are commonly used for imaging hernias.<sup>3</sup> Most incisional/ventral hernias noted at cross-sectional imaging are incidental findings encountered during radiological examination for unrelated other clinical problems. However, accurate demonstration

of size and location of hernial orifice may be useful in assessing the success of hernia repairs.

While ventral hernia defect size may affect surgical technique, size of mesh selected, and outcomes,<sup>4,5</sup> no standardized measurement recommendations currently exist. Scant published research assesses different methods of determining abdominal wall defect area. Even less evidence exists concerning determination of mesh dimensions from hernia size.<sup>6</sup> This lack of standardization in mesh selection may have clinical repercussions. Current strategies to measure defects include clinical examination, radiographic (CT and USG), and intraoperative finding. Our aim is to assess the size and number of ventral/incisional hernia defect by different methods, i.e., clinical examination, USG, and CT.<sup>7-9</sup>

## AIMS AND OBJECTIVES

To study the sensitivity and positive predictive value of clinical finding, USG, and CT finding to detect the defect size and number of incisional/ventral hernia.

## MATERIALS AND METHODS

- Type of study: prospective cohort study.
- Period of study: January 2018 to June 2019.
- Place of study: General Surgery Outpatient Department (OPD), Mahatma Gandhi Medical College and Hospital, Jaipur.
- Institute Ethics Committee approval will be obtained before start of study.

### Sample Size

This study includes all adult patients presenting with incisional/ventral hernia in General Surgery OPD of Mahatma Gandhi Medical College and Hospital, Jaipur.

### Plan of Study

- Patients presenting to surgical OPD with hernia on the ventral aspect of the abdomen excluding inguinal hernia will be evaluated.
- Inclusion criteria: All adult patients with ventral hernia who will be fit for general anesthesia and is being taken up for surgical correction both laparoscopically or open.<sup>10-12</sup>
- Exclusion criteria:
  - Patient unfit for general anesthesia;
  - Incarcerated or strangulated bowel loops or any evidence of vascular compromise on imaging and with pregnancy;<sup>13-15</sup>
  - Inguinal hernias were excluded.

## MATERIALS AND METHODS

### Principle

The principle used in ventral hernia repair is same in both laparoscopic and open ventral hernia repair popularized by Stoppa, Rives et al.<sup>16-21</sup> It includes the use of polypropylene mesh, adequate overlap of hernia defect (more than 3–5 cm), and should be tension-free repair. All the findings, clinical examination, investigations, USG, size, and CT scan/USG scan location of defect, were recorded.

### Evaluation

- Past history of operative interference to assess the intra-abdominal adhesions.

- Size, number, and location of the defect by clinical examination and CT scan/USG abdomen.

## Technique

Preoperative preparation—All adult patients presented in general surgery OPD of Mahatma Gandhi University of Medical Sciences and Technology (MGUMST) with ventral/incisional hernia will have detailed medical history documented and undergo a thorough physical examination with estimation of the hernia defect. All routine blood parameters including complete blood counts, renal and hepatic function tests, and coagulation profile will be evaluated.<sup>22,23</sup> Computed tomography abdomen/focused USG abdomen will be done to every patient to confirm the size and number of defect and its contents and other associated hernia missed on physical examination. Abdominal wall hernia defect size will be obtained using the following methods: clinical examination, USG, and CT finding.<sup>24-26</sup> Clinically, measurement will be determined by feeling the edges of muscle and measuring the defect using the measuring tape or thread. Computed tomography abdomen/USG abdomen was done to every patient to confirm the size of defect and its contents of hernia and other associated hernia for estimating the size of the prosthesis to be used. Then, defect size and number of incisional/ventral hernia will be measured intraoperatively using the measuring tape or thread, and this measurement will be compared with the earlier three findings of clinical examination, USG, and CT findings.<sup>3,27,28</sup>

## RESULTS

A total of 30 patients of incisional/ventral hernia were enrolled in this study and the number and size of defect of hernia was examined clinically, by USG and CT and then compared with intraoperative finding. Although patients of all age groups were included in the study, a maximum number of patients were between 51 years and 60 years of age, i.e., 33.3%, followed up by the age group of above 60 years which had 26.7% of cases. A total of 23 females and 7 males were studied. In total, 60% of the patients are housewives followed by farmers who constitute 23.3%. The incisional hernias are most commonly seen in patient who have undergone cesarean sections (36.7%) followed by previous gastrointestinal surgeries (20%) and postsurgical site infections. Clinical examination, USG, and CT scan are equally sensitive in detecting the number of ventral hernia defects. The hernia mostly contained omentum as content (50%) followed by small bowel (33.3%) and both small bowel and omentum together constituting 13.3%.

Among 30 patients, 46.7% of patients underwent laparoscopically mesh hernia repair, 36.7% of patients underwent double-layer primary repair of hernia, and the rest underwent primary repair of hernia by single-layer repair. Prolene is the mostly used suture to repair hernia in primary repair which constitutes 26.7% followed by polydioxanone suture (PDS) which constitutes 23.3%. Nylon suture and recently V-Loc sutures are also used for primary repair of hernia. Although the primary closure of hernia by V-Loc suture is very much efficient, it is used rarely due to its high cost. In maximum number of patients (76.7%), prolene mesh is used for the repair of hernia as it is cost-effective. Only one patient underwent anterior compartment release after primary repair of hernia to prevent recurrence of hernia formation. Out of 30 patients, only two patients developed postoperative complications in the form of seroma formation which was managed conservatively. To find

**Table 1:** Bivariate comparison by paired sample *t* test

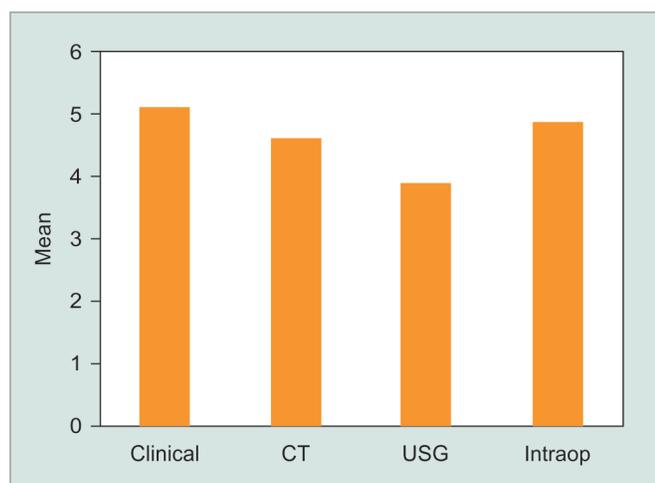
		Mean	Mean difference	Standard deviation	<i>t</i> value	<i>p</i> value
Pair 1	Clinical	5.10	0.253	3.78	2.6700	0.012*
	Intraoperative	4.85		3.47		
Pair 2	USG	3.87	0.976	2.81	2.1980	0.036*
	Intraoperative	4.85		3.47		
Pair 3	CT	4.60	0.250	3.76	1.0950	0.282#
	Intraoperative	4.85		3.47		

\*Significance at  $p < 0.05$ ; # No significance at  $p > 0.05$

**Table 2:** Intraclass correlation coefficient

	ICC	95% CI		<i>p</i> value
		LB	UB	
Clinical	0.995	0.989	0.998	0.0005*
USG	0.825	0.633	0.917	0.0005*
CT	0.969	0.935	0.985	0.0005*

\*Highly significance at  $p < 0.01$  level  
LB, lower bounds; UB, upper bounds

**Fig. 1:** Relation of size of defect of hernia with intraoperative measurement

the significant difference between the bivariate samples in paired groups, the paired sample *t* test was used, and intraclass correlation (ICC) was used to find the agreement between the tools (Tables 1 and 2). In our study, defect size measured by clinical examination in comparison with intraoperative finding of defect size is found out to be statistically significant with a mean value (5.10) more than that of the intraoperative finding (4.85), and *p* value is  $< 0.05$ , i.e., 0.012, and defect size measured by USG in comparison with intraoperative finding of defect size is also found out to be statistically significant with a mean value (3.87) less than that of the intraoperative finding (4.85), and *p* value is  $< 0.05$ , i.e., 0.036. But size of defect of hernia measured by CT scan is almost same as that of hernia measured during intraoperative finding with a mean value 4.60 and 4.85, respectively. The ICC coefficient of defect size via clinical examination is 0.995 [95% confidence interval (CI): 0.989–0.998; nearly perfect correlation], USG is 0.825 (95% CI: 0.633–0.917; strong correlation), and CT finding is 0.969 (95% CI: 0.935–0.985; nearly perfect correlation) (Fig. 1).

## DISCUSSION

The treatments of ventral/incisional hernias include open primary repair of ventral hernia by single-layer or double-layer closure, mesh hernioplasty, component separation techniques if the defects are large in size or under tension, and newer technique like laparoscopic intraperitoneal onlay mesh repair is being used nowadays.<sup>29</sup>

Due to variations in size of defect, the clinical implications also vary. An undersized mesh could lead to inadequate overlap of defect which leads to higher recurrence rates. And oversized mesh leads hernia repair more challenging and difficult as it is difficult to handle and may lead to errors in mesh fixation. Mesh eventration may lead to clinical bulging and poor functional status.

Our study involved a prospective assessment of hernia defects measured by different modalities as substantial differences do exist between different modalities of measuring hernia defect, and it is directly linked with the selection of mesh size.

In our study, 30 patients who presented to surgical OPD with ventral hernias (excluding inguinal hernias) were studied. As the number of patients for this study is less and time period is limited, this study will not reflect the true incidence of ventral hernias in MGUMST.

In this study, the majority of the ventral hernias was seen in female in menopausal age group, housewife by occupation, who have undergone previous gynecological operation or gastrointestinal operation with a lower abdominal scar. The lower abdominal hernia repair has technical difficulty due to less space for mesh fixation due to proximity to bladder and major vessels. Mean age in this study is 60 years ranging from 50 to 70 years age group. Certainly, incisional hernia is not unique to elderly patients, but wound healing in elderly patients is poor due to tissue senescence which leads to increased incidence of incisional hernia in elderly as reported by Robert J Baker et al.<sup>29</sup>

In our study, maximum incidence of ventral hernia is seen in incisional hernia (56.7%) followed by epigastric hernia which constitutes 33.3%. Others are umbilical and paraumbilical hernias. The hernia mostly contained omentum as content (50%) followed by small bowel (33.3%) and both small bowel and omentum together constituting 13.3%.

In this study, among 30 patients, 46.7% of patients underwent laparoscopically mesh hernia repair, 36.7% of patients underwent double-layer primary repair of hernia, and the rest underwent primary repair of hernia by single-layer repair. Prolene is the mostly used suture to repair hernia in primary repair which constitutes 26.7% followed by PDS which constitutes 23.3%. Nylon suture and recently V-Loc sutures are also used for primary repair of hernia. Although the primary closure of hernia by V-Loc suture is very much efficient, it is used rarely due to its high cost.<sup>30</sup>

In our study, only one patient underwent anterior compartment release (3%) so as to prevent recurrence of hernia as hernia was closed primarily but was under tension and only two patients developed seroma postoperatively which was managed conservatively by daily dressings. There are no mortality and recurrences in our study. In the study by Peronne et al. there was perforation of bowel (3.3%) and resulted in death of patient secondary to sepsis.

In our study, number of defects of ventral hernia are detected by clinical finding, USG, and CT scan and found that all three modalities are equally effective in detecting the number of defects with sensitive 100%.

In our study, defect size measured by clinical examination in comparison with intraoperative finding of defect size is found out to be statistically significant with a mean value (5.10) more than that of the intraoperative finding (4.85), and *p* value is <0.05, i.e., 0.012, and defect size measured by USG in comparison with intraoperative finding of defect size is also found out to be statistically significant with a mean value (3.87) less than that of the intraoperative finding (4.85), and *p* value is <0.05, i.e., 0.036. But size of defect of hernia measured by CT scan is almost same as that of hernia measured during intraoperative finding with a mean value 4.60 and 4.85, respectively. The ICC coefficient of defect size via clinical examination is 0.995 (95% CI: 0.989–0.998; nearly perfect correlation), USG is 0.825 (95% CI: 0.633–0.917; strong correlation), and CT finding is 0.969 (95% CI: 0.935–0.985; nearly perfect correlation). This is comparable with the analysis done by De la Pena et al.

Bernal et al. had described a new visual simultaneous localization and mapping (VSM) technique that utilizes images obtained from endoscopes during laparoscopic ventral hernia repair to provide three-dimensional models of body cavities which are subsequently be used to estimate hernia defect measurements. The VSM technique is faster and as accurate as other more traditional methods in measuring defect size, but it is new and, hence, not yet widely used.

Our study has some limitations which include limited generalizability, lack of multiple measurements per patient to ensure precision, less number of patients, limited time period of the study, and interobserver variability for ultrasound and CT finding due to which we can make no recommendations regarding the ideal measurement method right now. More studies are required to determine the ideal method for the measurement of hernia defect size. Baseline data regarding variations in practice should be assessed by further surveying hernia surgery experts as well as practicing general surgeons and also the observations of expert radiologist and practicing radiologist to determine ideal modality for measuring hernia defect size.

## CONCLUSION

In our study, among the three methods of measuring ventral hernia defect, CT scan is most sensitive in detecting the number of hernia and measuring the size of defect followed by clinical examination. Although our study has some limitations which include limited generalizability, lack of multiple measurements per patient to ensure precision, less number of patients, limited time period of the study, and interobserver variability for ultrasound and CT finding due to which we can make no recommendations regarding the ideal measurement method right now. More comparative effectiveness studies are required to determine the ideal method for the measurement of hernia defect size and evaluating the impact of

different measurement methods on mesh selection and ultimately on patient outcomes. Baseline data regarding variations in practice should be assessed by further surveying hernia surgery experts as well as practicing general surgeons and also the observations of expert radiologist and practicing radiologist to determine ideal modality for measuring hernia defect size.<sup>19</sup>

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