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A Study on Short-Term Outcomes of Extended View Totally Extraperitoneal Rives Stoppa (e-TEP RS) Repair versus Laparoscopic Intra-Peritoneal Onlay Mesh (IPOM) Plus Repair for Ventral Hernia

Dangeti Bhuvana[1], K. Suhas Chaitanya[2], G. Sai Subrahmanyam[3]

[1]Post Graduate Resident, Department of General Surgery, Narayana Medical College and Hospital, Nellore, Andhra Pradesh, India
Email id: *bhuvana.dangeti28[at]gmail.com*

[2]M. B. B. S, M. S General Surgery, Associate Professor, Department of General Surgery, Narayana medical college and hospital, Nellore, Andhra Pradesh, India

[3]M. B. B. S, M. S General Surgery, Assistant Professor, Department of General Surgery, Narayana medical college and hospital, Nellore, Andhra Pradesh, India

Abstract: ***Background: A ventral hernia is a hernia which can be occur at any location along the midline (vertical center) of the abdomen wall. It can be classified as spontaneous (primary) or acquired (secondary). Also, there are basically 3 types of ventral hernia and these are: Epigastric or stomach area hernia, Umbilical or belly button hernia and the Incisional hernia. Currently, minimally invasive approach is preferred for the treatment of ventral hernias. After the introduction of extended view totally extraperitoneal (e-TEP RS) technique, there has been a constant debate over the choice of better approach. In this study, we compare the short-term outcomes of e-TEP RS and laparoscopic IPOM Plus repair for ventral hernias. Methods: This is a comparative, prospective single-center study done at Narayana Medical College And Hospital, Nellore, India from January 2021 to July 2022. All patients who underwent elective ventral hernia surgery with defect size of 2 to 7cm were included. Patient demographics, hernia characteristics, operative and peri-operative findings, and postoperative complications were systematically recorded and analyzed. Results: We evaluated 100 cases (n = 100), 50 in each group. Mean age, sex, BMI, location of hernia, primary and incisional hernia, and comorbidity were comparable in both the groups. Mean defect size for IPOM Plus and e-TEP RS was 4 cm and 3.87 cm, respectively. Operative time was significantly higher for e-TEP RS, while postoperative pain (VAS), analgesic requirement, and postoperative hospital stay were significantly less as compared to IPOM Plus. However, 1 cases (2%) of e-TEP RS had recurrence but none in IPOM Plus. Conclusion: Our study showed that the e-TEP RS repair had shown promising results and was being widely accepted. It results less presence of co-morbidities and less complications when compared to IPOM repair. More randomized controlled and multicentric studies are required with longer follow-up to validate our findings.***

Keywords: IPOM plus, eTEP RS, Ventral Hernia, Retro-muscular mesh, Observational, Laparoscopic Hernia Repair

1. Introduction

Ventral hernia is a hernia which can occur anywhere on the abdominal wall along the midline (vertical). [1] It is a protuberance of tissues through a vent in the cavity containing it caused by a weakness in the muscles of the abdominal wall. It can be either spontaneous (primary) or acquired (secondary). Ventral hernia can present as 3 types, including Epigastric or stomach area hernia, which occurs anywhere from just below the xiphisternum to umbilicus or belly button, Umbilical or belly button hernia which occurs in the belly button area and Incisional hernia can develop at any site of previous surgical scar. [1] Approximately one-third patients operated on for any major abdominal surgery have a chance of developing an incisional hernia at any site of their scar, which can occur at any length of time after abdominal surgery. The scar tissue becomes weak or thins out, forming a lump in the abdomen. This lump is a part of a tissue, a part or whole organ pushing against the abdominal wall. It is frequent in both sexes, depending on the site on the abdominal wall. Hernias over the abdominal wall are significantly formed due to morbid obesity, associated comorbidities, wound site infections, immunosuppression, and prostatism. Studies had found that hernia repair is one of the most commonly done surgical procedures as more than 20 million incidence occurs per year across the world. [2, 3] Minimally invasive (laparoscopic) surgery for ventral hernia has gained popularity in the last two decades, despite controversy regarding the optimal approach. Laparoscopic anterior wall hernia surgery has grievous complications due to direct contact of intraperitoneal viscera and implanted mesh, such as small bowel obstruction due to adhesions, mesh infection, erosion, and entero-cutaneous fistula. [3, 6] According to dated literature, open retro-muscular mesh hernioplasty (Rives-Stoppa) has better benefits than other procedures in reference to mesh-related complications. [2] Jorge Daes described the enhanced view totally extraperitoneal (e-TEP RS) repair for inguinal hernia in 2012, and subsequently, this approach was endorsed for ventral hernia by Belyansky et al. [3, 4]. The e-TEP RS is the procedure where retro-rectus space, along with the preperitoneal space and spaces of Retzius and Bogros, at the groin level. It has created an opportunity for surgeons to explore the possibility of utilizing the retro-rectus space for ventral hernia repair. The technique, as of now, is viral among minimal access surgeons and is called eTEP or endoscopic Rives and Stoppa (eRS). Study results to date have been encouraging, but definitive studies are lacking. The IPOM or Intraperitoneal Onlay Mesh is a unique repair technique where a mesh is introduced into the abdominal

cavity and placed from the inside over the hernial sac opening after suturing the hernial defect. In this study, we are comparing the short-term outcomes of e-TEP RS and IPOM Plus procedures for ventral hernial repair to accentuate the advantages, disadvantages, and feasibility of e-TEP RS.

2. Materials and methods

This study is a single-centre, prospective observational comparative study done at Narayana Medical College And Hospital, Nellore, from January 2021 to July 2022, after obtaining approval from Hospital Ethics Committee. A total of 100 patients were included in this study after taking their consent, randomized into two groups of 50 patients each and compared the short-term outcomes of eTEP and IPOM Plus procedures. Inclusion Criteria include Adult patients presented with primary ventral or incisional hernial defects with Midline defect of size equal to or less than 7 centimetres, Elective hernia repair, Considered eligible for hernia repair through a minimally-invasive approach, Able to tolerate GA, Able to give consent for participation. Defects greater than 7 centimetres, Hernia defects considered to require an open approach, Prior mesh placement in the retro-rectus space, Emergency cases, recurrent ventral hernias, hernias with skin infections and entero-cutaneous fistula, patients who were not fit for GA, and those with body mass index (BMI) more than 35, Patients not able to understand and sign a written consent form were excluded from this study. After fulfilling the study's inclusion criteria, written informed consent was taken about their acceptance to participate in the research, and they were informed by which method they would be operated on. The diagnosis was made with the help of detailed medical history, clinical examination and details of previous operative procedures from the proper authority.

Preoperatively, ultrasonography (USG) abdomen was done in all patients to measure hernia defect size (width). Baseline demographic characteristics, including age, sex, body mass index, site and size of primary or incisional hernia, and comorbidities, were collected and analyzed. Intra-operative criterion include operative time, amount of blood loss, and intra-operative difficulties, were noted and compared. All procedures were performed by well-trained laparoscopy surgeons with a minimal experience of 15 cases for each technique. Post-operative problems like seroma, surgical site infections (SSI), post-operative pain, the requirement of parenteral analgesia, and total hospital stay after surgery were compared. A visual analogue scale ranging from 0 to 10 (no pain to worst possible pain) was used to grade pain in the post-operative period. Pain score was calculated at 12 hrs and 24 hrs after surgery using VAS. Intravenous tramadol was used as post-operative analgesia in all cases in a dose of 50 mg two times a day; additional doses if used, were recorded. The readmission rate and any recurrence were also recorded and analyzed. All patients were followed up for six months after surgery. According to our hospital policy for hernia surgery, all patients received a clean shower and antibiotic prophylaxis. Deep vein thrombosis (DVT) prophylaxis was given in selected patients before surgery. Foley's catheter was placed in all patients after GA and was usually removed on 1st postoperative day (POD-1).

For e-TEP RS, we started dissection either in the upper or lower retro-rectus space, based on the location of the hernial defect. [5] For supra-umbilical or epigastric defects, we prefer to dissect the right lower retro-rectus space initially, starting below the umbilicus through the infra-umbilical port. For paraumbilical, umbilical, infra-umbilical, and suprapubic defects, we began with the dissection of retro-rectus space in the left upper quadrant just below the costal margins about 2.5 cm lateral to the midline. After the skin incision, dissection was performed till the posterior rectus sheath was under vision using a 10-mm optical trocar and 0° telescope. Retrorectus space was dissected using telescopic dissection and positive pressure from the carbon dioxide insulation with pressure at 15 mmHg. After adequate dissection, a 10-mm port was placed approximately 5 cm lower to the camera port, just medial to linea semi-lunaris, and one more 5-mm port was placed more inferiorly (Fig.1). Then incision on the medial aspect of the posterior rectus sheath made approximately 5 to 7 mm below the linea alba and crossing over was done in the preperitoneal space under linea alba but above falciform ligament to visualize the right posterior rectus sheath.

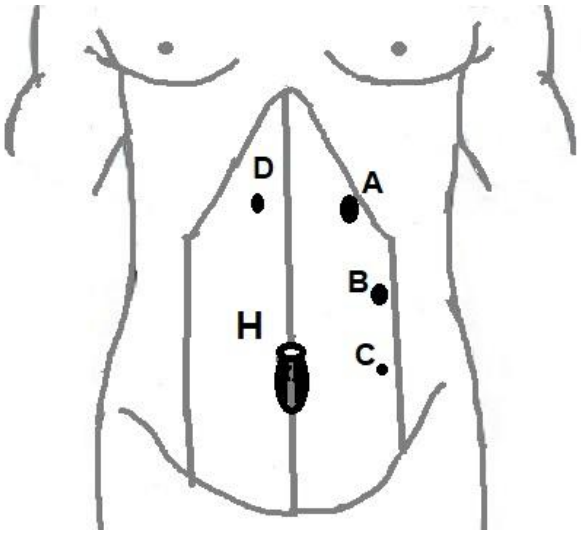

Figure 1: Port sites for e-TEP RS. *H* Hernia, *A* 12-mm optical port, *B* 10 mm working/camera port, *C* 5-mm working port, *D* 5-mm working port

After incising the right posterior rectus sheath about 5 to 7 mm below the linea alba, dissection was done in the right retro-rectus space, and one 5-mm port was placed below the costal margin. Retrorectus space dissection was done cranially and caudally up to 5 cm according to defect size and site. Laterally space was dissected uptill the semilunar line on both sides. After creating adequate retro-rectus space on both sides, we tried reducing the sac. If it was not possible due to dense adhesions between contents and sac or irreducibility, we opened the peritoneum proximal to the sac, entered into the peritoneal cavity, and did adhesiolysis, reducing the contents, and the peritoneum along with posterior rectus sheath bilaterally using absorbable barbed suture (V-Loc) 2-0 in continuous fashion were closed. After completing retro-rectus dissection, we closed the hernia defect using non-absorbable barbed suture (V-Loc) no.1 with maintaining carbon dioxide insulation pressure at around 10 mmHg. A medium-weight, macroporous polypropylene mesh of size 15×15cms or 20×15cms was

tailored and placed in retro-rectus space with a minimum 5 cm of overlap around the defect without any fixation. Insufated gas was deflated slowly under vision, ensuring the proper positioning of mesh.

The conventional laparoscopic IPOM Plus procedure was done in the other group. A veress needle was used to create pneumoperitoneum (14 mm Hg), followed by the placement of 3 ports. One 10 mm in the epigastric region, about 5 cm below the xiphoid, and two 5 mm in the left and right midclavicular region, about 3–5 cm below costal margins (Fig.2). For epigastric and supra-umbilical hernia, ports were placed laterally maintaining triangulation. Hernia contents were reduced, and the urinary bladder and falciform ligament, if required, were set down to place the mesh properly. The defect was closed intra-corporeally using loop nylon suture material No.1 (Ethilon) on a low pneumoperitoneum (10 mmHg). Composite (polyester mesh along with a second layer of the anti-adhesive absorbable barrier of collagen) mesh of size 15×15 or 20×15 was fixed to the abdominal wall using four transfascial and intracorporeal sutures with nylon suture material No.2-0 (Ethilon), with at least 5 cm overlap around the defect in all directions. Omentum was splayed over bowel, pneumo-peritoneum was deflated under vision.

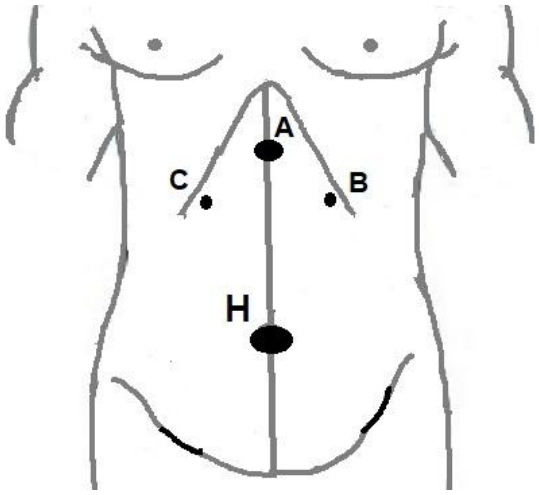

Figure 2: Port sites for IPOM Plus. *H* Hernia, *A* 10-mm camera port, *B* and *C* 5-mm working ports

SPSS (Statistical Package for Social Sciences version 21.0) was used for statistical analysis. Between the two groups, Mann–Whitney test (as the data sets were not normally distributed) was used to compare quantitative variables. Chi-Square test/Fisher's Exact test was utilized to compare qualitative variables. Statistical significance was considered if the p-value was less than 0.05.

3. Results

In this study, total 100 patients were included, out of which 50 patients underwent e-TEP RS and IPOM Plus was done in other 50. In both the groups, there were no difference in age, sex, BMI, location of the hernia, primary or incisional hernia, and co-morbidities throughout the patients. In age group 18-27, 6 (12%) were in e-TEP and 5 (10%) were in IPOM plus and followed by 14 (28%) and 15 (30%) were in age group 28-37, 19 (38%) and 22 (45%) were in age group which shows the highest participation in both techniques and 11 (22%) and 8 (16%) were >47. Among the participants, there were 30 (60%) male who received e-TEP RS and 29 (58%) received IPOM plus treatment and followed by female were 20 (40%) and 21 (42%). Mean BMI in the IPOM Plus group was 30.57 kg/m2 and 28.60 kg/m2 in e-TEP RS group. The presence of co-morbidities was found in both e-TEP RS and IPOM. Hypertension was observed in 19 (38%) cases in e-TEP RS and 20 (40%) cases in IPOM and followed by stroke in 11 (22%) and 12 (24%), Hypothyroidism in 3 (6%) and 2 (4%) and Diabetes in 11 (22%) and 10 (20%). Total 68% were primary hernia, with no significant difference in any group. Most of the hernias were M3 and M4 as per EHS classification. The mean defect size in IPOM Plus group was 4 cm with no statistical difference compared to e-TEP RS group (3.87 cm). Basicpatient demographics and clinical condition are given in Table 1 and Table 2.

Table 1: Demographic characteristics of the study population

Demographic characteristics		e-TEP RS (n=50)	(%)	IPOM (n=50)	(%)
Age	18-27	6	12	5	10
	28-37	14	28	15	30
	38-47	19	38	22	45
	>47	11	22	8	16
Gender	Male	30	60	29	58
	Female	20	40	21	42
BIM (mean ± SD)		28.60 ± 3.9		30.57 ± 3.2	

Table 2: The clinical history of the study population

Clinical history		e-TEP RS (n=18)	(%)	IPOM (n=20)	(%)
Presence of co-morbidities	High blood pressure	19	38	20	40
	Stroke	11	22	12	24
	Hypothyroidism	3	6	2	4
	Diabetes	11	22	10	20
Mean Defect size of lesion (cms)		3.87 ± 0.82		4.0 ± 0.71	
Hernia location as per EHS classification	M1	0		0	
	M2	1		2	
	M3	28		26	
	M4	21		22	
	M5	0		0	

The IPOM Plus group had a significantly lower operative time, with mean of 82.83 min as compared to 115.52 min in e-TEP RS group. None of the patient had intra-operative complications, and drain was not placed in any of the patients. Patients in e-TEP RS group expressed significantly less pain at 12 and 24-h post procedure as compared to

IPOM Plus group. Postoperatively, requirement of parenteral analgesia was significantly more in patients of IPOM Plus group. Detailed pain score and analgesia required post procedure are shown in Table 3. In e-TEP RS group, mean length of hospital stay post surgery was 2.11 days as compared to 2.7 days post IPOM Plus which was significantly less.

Table 3: Perioperative details

Variable	e-TEP RS	IPOM Plus	*p* value
Mean operative time (min)	115.52 ± 20.14	82.83 ± 7.35	S
Blood loss over 50 ml	0	0	NS
Mean VAS Score at			
12 h after surgery	4.46 ± 0.62	7.59 ± 0.75	S
24 h after surgery	2.8 ± 0.62	5.87 ± 0.91	S
POD 7	0.3 ± 0.51	1.63 ± 0.53	S
Mean postoperative parenteral analgesia required (equivalent to morphine in mg)	12.28 ± 2.52	31.41 ± 5.54	S
Mean length of stay after surgery (days)	1.11 ± 0.31	1.7 ± 0.66	S

Incidence of Surgical site infection was 2 (4%) in e-TEP RS is and 3 (6%) in IPOM, seroma in e-TEP RS is 8 (16%) and in IPOM 2 (4%), Postoperative ileus in e-TEP RS is 5 (10%) and in IPOM 15 (30%), Mesh infection in e-TEP RS 1 (2%) and in IPOM 1 (2%), Recurrence in e-TEP RS is 1 (2%) and no recurrence observed in IPOM group. Details of postoperative complications are given in Table 4. All were managed conservatively except for 1 patient post e-TEP RS managed with ultrasound-guided aspiration in this study. There were no readmission in IPOM Plus group, but one patient in e-TEP RS group was admitted with recurrence within 6 months of follow-up period and were managed by IPOM Plus. The cause of recurrence was posterior rectus sheath dehiscence.

Table 4: Postoperative complications

Complications	e-TEP RS	(%)	IPOM	(%)
Surgical site infection	2	4	3	6
Seroma	8	16	2	4
Postoperative ileus	5	10	15	30
Mesh Infection	1	2	1	2
Recurrence	1	2	0	0

4. Discussion

Nowadays, there are variety of options for ventral hernia repair from open method with different mesh positions to variable minimally invasive techniques. Most of these techniques were developed in the last decade. [7] But decision-making process in ventral hernia surgery becomes very difficult due to the variety of techniques and levels of mesh positioning. Several different techniques with different mesh positions are as mentioned above. [8] Management of giant ventral hernias was challenging due first to the diversity of clinical presentations and numerous therapeutic possibilities and second to the mortality associated with large ventral hernia repair, which could exceed rates observed for neoplastic pathologies. [9] This study basically showed a comparison between the two-treatment technique the e-TEP RS and IPOM. The retro muscular e-TEP RS technique has not only the benefits of the sub lay position of the mesh but also all the advantages from the minimal invasiveness of the procedure. Besides, avoiding foreign bodies in the abdominal cavity would result in less complications due to the procedure. [10] In a study, advantages of IPOM procedure without compromising the recurrence rates had shown through several randomized control trails and meta-analyses. [11] A study showed IPOM is associated with increased risk of bowel injury, Acute Small Bowel Obstruction, bowel erosion and increased morbidity in redo surgery with the risk of visceral injury going up to 21%. [18]

e-TEP RS offers the benefit of a minimally invasive procedure along with mesh in sublay/retrorectus position, hence avoiding the intra-abdominal mesh-related complications. Another advantage of e-TEP RS, in large ventral hernia is that if closure is difficult or not possible, then posterior component separation technique in the form of transversus abdominis release can be combined as plane of dissection is the same. As per available evidence it is believed that mesh in sublay position offers superior quality of postoperative connective tissue formation, less recurrence, and less cost as compared to composite mesh with anti-adhesion barrier used for intraperitoneal position [13]. The current data are lacking, as till now only one retrospective comparative study by Penchev et al. of both the approaches has been published. [12] They retrospectively collected data of total 54 patients, 27 in each group, with mean defect area for eTEP and IPOM being 71.4 and 76 cm2, respectively. Median visual analog pain score post surgery was significantly less in e-TEP RS group, mean operative time for e-TEP RS was 186 min as compared to 90 min for IPOM. Only one patient in IPOM group required readmission for recurrence, no patient got readmitted in e-TEP RS group, total 7 patients developed postoperative seroma, 4 in e-TEP RS and 3 in IPOM group. All were managed conservatively except for 1 patient post e-TEP RS managed with ultrasound-guided aspiration in this study. In our study, The VAS pain score and hospital stay after surgery were significantly less in e-TEP RS group and operative time was significantly more as compared to IPOM Plus group. Belyensky et al., in a multicentric retrospective review of total 79 patients showed that 38 underwent e-TEP RS and 41 underwent e-TEP RS with TAR. Mean defect size (width) for e-TEP RS only patients were 6.2 cm, while it was 11.1 cm in e-TEP RS with TAR group. Mean length of stay was 1.0 day for e-TEP RS and 2.7 days for e-TEP RS with TAR and one case had recurrence post e-TEP RS in their study [4]. Mean length of stay and recurrence seen in our study are comparable to Belyensky et al. study. Baig et al., a retrospective study of 21 patients showed that 9 patients underwent e-TEP RS only while remaining 12 patients required TAR along with e-TEP RS, 2 patients had surgical

site occurrence and one patient had recurrence, median pain score using VAS at 1st postoperative day was 3 and time to discharge after surgery was 3 days and is comparable to the results of our study [14]. When mesh is sandwiched between muscle and posterior sheath that is in sublay position, it can be placed without fixation. May be non-fixation of mesh in e-TEP RS with tackers or sutures could be a reason of less postoperative pain, as some studies showed direct relationship between aggressive mesh fixation and postoperative pain [15, 16].

According to recent evidences and SAGES guidelines, there is decrease in recurrence in small ventral hernia when mesh with sufficient coverage is used for repair [17]. In some study, several limitations of the e-TEP RS procedure was also found. First of all, the e-TEP RS is not suitable for large and complex ventral hernias especially where abdominal wall reconstruction is essential. Besides, the procedure can be extremely difficult in patient with multiple small defects. Limitations of e-TEP RS as per available evidences are prolonged operative time, prolonged learning curve, need of advancement of laparoscopic skills, and difficulty in crossover to the other side in large defect with previous incision [12]. Even in our study we observed prolonged operative time, this may be due to a new technique which is still in evolving phase. Our results shows e-TEP RS is a feasible and safe procedure and results are comparable to IPOM Plus in experienced hand. The differences between the two techniques are lesser postoperative pain, shorter hospital stay, and low cost mesh which favor e-TEP RS. However, recurrence due to posterior rectus sheath dehiscence is of concern.

5. Conclusion

The above study showed that the e-TEP RS repair had shown promising results and was being widely accepted. It results less presence of co-morbidities and less complications when compared to IPOM repair which results in less overall cost of treatment procedure, faster return to normal daily activity, lower rate of postoperative complications and low rate of recurrence as compared to IPOM ventral hernia repair. Hence, the e-TEP RS repair is considered as first choice for ventral hernia repair in most of the studies. However, e-TEP RS isstill evolving and needs more randomized control and multicenter studies with longer follow-up to validate our findings and to prove the potential benefit of the procedure.

6. Future Scope

Multiple randomized control trail studies and multicentric studies over large population in different parts of world are required for validation of eTEP as a treatment option for ventral hernia repair. Studies with long term follow up and it's outcomes are to be evaluated compared to previous literature. The complications like posterior rectus sheath dehiscence may mirror out a long learning curve and can be avoided in future with experience, as e-TEP RS is in its initial phase. Long-term advantages of mesh in sublay location should be kept in mind. Smaller size of sample population, single-center study, and pain estimation as the only criteria to evaluate quality of life after mesh implantation are few limitations of our study. Also longer follow-up period and a larger size of sample population is required to evaluate recurrence post ventral hernia repair.

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Author Profile

Dr Dangeti Bhuvana, Post Graduate in Department of General Surgery did my MBBS (2013) from Sri Venkatesara Medical College, Tirupathi and started MS General Surgery in Narayana Medical College and Hospital, Nellore

Co author: **Dr. Suhas Chaitanya,** Associate Professor, Department of General Surgery. He completed his MBBS from Indira Gandhi Medical College, Pondicherry. He completed his post-graduation from Ashram Medical College, Eluru. He did his senior residency in KMC, Kurnool. He started working as assistant professor (2014) in Narayana Medical College and Hospital, Nellore.

Co author: **Dr. G. Sai Subrahmanyam**, Assistant Professor, Department of General Surgery. He completed his MBBS from Rajiv Gandhi Institute of Medical sciences (RIMS), Kadapa. He completed his post-graduation from Rajiv Gandhi Institute of Medical Sciences, Kadapa. He started working as Assistant Professor (2022) in Narayana medical college and hospital, Nellore.