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Original Research Article

EFFICACY OF PROLENE VS VICRYL IN TRACHEAL RESECTION AND ANASTOMOSIS

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Abstract

Background: Tracheal resection with primary reanastomosis is a common treatment for stenosis, tracheal tumours, malignancies, secondary tracheal tumours, and tracheoesophageal and tracheal innominate fistulas; however, there is disagreement regarding the ideal suture material. This study aimed to compare the incidence of morbidity/mortality due to leaks and long-term recurrence of tracheal stenosis. **Materials and Methods:** We conducted a prospective observational study between January 2022 and June 2023 at Madras Medical College, Institute of Cardiology and Cardiothoracic Vascular Surgery in Chennai. There were a total of 66 cases that required tracheal resection and anastomosis. Among them, 32 underwent tracheal resection with Prolene, and the remaining 34 underwent tracheal resection with vicryl. Outcome parameters included the proportion of cases with mortality and morbidity. The Statistical Package for Social Sciences was used to conduct the statistical analyses. **Result:** In assessing the causes of tracheal stenosis in group P, 40.6%, 21.9%, and 37.5% had stenosis due to a previous history of intubation, tracheostomy and tumours, respectively. Similarly, in group V, 47.15, 23.5%, and 29.4% of the patients had stenosis due to a previous history of intubation, tracheostomy, and tumours, respectively. However, no significant association was observed between the groups. Importantly, 9.4% of patients in the prolene group and none in the vicryl group died due to trachea-related complications. Notably, 18.8% and 2.9% of cases in the prolene and vicryl groups leaked following anastomosis. **Conclusion:** We infer that vicryl is comparably better than prolene in causing lesser morbidity (leak); however, the mortality remained similar in both groups.

INTRODUCTION

Cricotracheal or tracheal excision with primary anastomosis is the standard treatment for tracheal stenoses. Numerous studies have reported high success rates (83–97%) and low death rates (0–5%) have been found.[1] Postoperative complication rates are still substantial (17–46%).[2] Endoscopic techniques have been created and used, including stenting, laser therapy, and balloon dilatation. They are well tolerated and offer instant relief; nevertheless, the requirement for frequent interventions and high recurrence rates make them unsatisfactory over the long term.[3]

The primary cause of tracheal stenosis is previous tracheotomy or intubation caused by mucosal irritation or aberrant wound healing near the stoma site. Low-pressure, high-volume cuffs were introduced, which decreased the incidence, but 2-12% of intubated patients still experience tracheal stenosis.[4] Further to primary tracheal tumours, primarily adenoid cystic carcinoma, squamous cell carcinoma, and idiopathic stenosis. The latter condition, the aetiology of which is unknown, exclusively affects middle-aged females. Idiopathic stenosis recurrence rates are high, especially when treated with endoscopic techniques (up to 87% after five years).[5] Tracheal surgery is difficult and has a high rate of morbidity.[3]

Results from earlier studies comparing absorbable and non-absorbable sutures have shown inconsistent findings. According to other authors, polyglycolic acid and braided polyglactin weren't the best options and didn't offer many benefits over nylon or polypropylene.[6] Others favoured non-absorbable sutures because they believed absorbable sutures had a higher risk of separation and stenosis.[7] According to another study, non-absorbable sutures made of nylon or polypropylene were inferior to absorbable polyglycolic acid or polyglactin.[8] Grillo et al. rejected polydioxanone after several disappointing findings. They believed that absorbable sutures (polyglactin) were less likely to induce granulations based on their considerable clinical experience.[9]

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Polydioxanone has certain advantages over polyglactin, in theory. It is a monofilament, is more flexible, has a predictable absorption rate, preserves its tensile strength for a longer period, and might result in less inflammation.[10] Conversely, it has a lower tensile strength than polyglactin. Theoretically, a simple continuous suture has the following benefits for tracheal anastomosis: a more uniform distribution of tension around the tracheal lumen, decreased risk of localised tissue ischaemia, and improved tensile strength. A continuous suture provides an airtight and waterproof seal.[11] The suitability of the continuous suture approach for tracheal anastomosis, however, has been the subject of mixed findings in recent research.[12] Sutures inserted submucosally are preferred by some writers because they may promote mucosal healing more effectively.[13] With these in view, this study aimed to compare the incidence of morbidity/mortality due to leaks and long-term recurrence of tracheal stenosis.

MATERIALS AND METHODS

We conducted a single-centre retrospective observational study using January 2022 and June 2023 data to compare the two suture materials, Prolene and Vycryl, in tracheal anastomosis.

This study was carried out at the MMC Institute of Cardiology and Cardiothoracic Vascular Surgery in Chennai among patients who underwent tracheal resection and anastomosis.

All participants provided written informed consent after the institutional ethics committee authorised the study. There was a total of 66 cases that required tracheal resection and anastomosis. Among them, 32 patients underwent tracheal resection with Prolene (Group P), and the remaining 34 underwent tracheal resection with vicryl (Group V). Demographic, clinical, and echocardiographic data were extracted from hospital records using a systematic proforma.

Using a structured proforma, demographic information, including socioeconomic status, sex, and age at operation, was obtained. Outcome parameters included the proportion of cases with mortality and morbidity.

Statistical Analysis

The Statistical Package for Social Sciences was used to conduct statistical analyses. Data are presented as the applicable mean or percentage. The chi-square, Fisher's exact, independent sample t-test, and Mann-Whitney U tests were used as necessary.

RESULTS

The mean age of the study participants in groups P and V was 57.5 years and 59.7 years, respectively, with no remarkable difference in mean age. Similarly, there was a male predominance, with 59.4% and 58.8% males in groups P and V, respectively [Table 1].

On assessing the causes of tracheal stenosis in group P, 40.6%, 21.9%, and 37.5% of cases had stenosis due to a previous history of intubation, tracheostomy, and tumours, respectively. Similarly, in group V, 47.15, 23.5%, and 29.4% of the patients had stenosis due to a previous history of intubation, tracheostomy, and tumours, respectively. However, no significant association was observed between the groups. On assessing the proportion of cases with leaks following tracheal resection anastomosis, group P leaked in 18.8%, and group V leaked in 2.9% of cases. Notably, this association was also statistically significant [Table 1].

The duration of hospital stay was 26.7 days and 23.5 days in groups P and V, respectively, with no remarkable difference. 9.4% of cases in group P and none from group V died due to trachea-related complications; however, the association was insignificant [Table 2].

Table 1: Demographic profile of study participants

Variables		Group P	Group V	P value
Mean age (in years)		57.5±13.5	59.7±12.3	0.491
Gender	Male	19 (59.4)	20 (58.8)	0.9636
	Female	13 (40.6)	14 (41.2)	
Cause for Tracheal stenosis	History of previous intubation	13 (40.6)	16 (47.1)	0.7793
	History of previous tracheostomy	7 (21.9)	8 (23.5)	
	Tumors	12 (37.5)	10 (29.4)	
Leak following TRA	Present	6 (18.8)	1 (2.9)	0.0371*
	Absent	26 (81.3)	33 (97.1)	

Table 2: Duration of stay in hospital and mortality due to trachea-related complications

Variables		Group P	Group V	P value
Duration of study in hospital (in days)		26.7±8.5	23.5±7.2	0.1031
Mortality due to trachea-related complications	Present	3 (9.4)	0 (0.0)	0.2164
	Absent	29 (90.6)	34 (100)	

DISCUSSION

In this study, the mean age of participants in groups P and V were 57.5 years and 59.7 years, respectively, with no remarkable difference in mean age between groups. Similarly, there was a male predominance, with 59.4% and 58.8% of males in Groups P and V, respectively. On assessing the causes of tracheal stenosis in group P, 40.6%, 21.9%, and 37.5% of cases had stenosis due to a previous history of

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intubation, tracheostomy, and tumours, respectively. Similarly, in group V, 47.15, 23.5%, and 29.4% of the patients had stenosis due to a previous history of intubation, tracheostomy, and tumours, respectively. However, no significant association was observed between the groups. On assessing the proportion of cases with leaks following tracheal resection anastomosis, group P leaked in 18.8%, and group V leaked in 2.9% of cases. Notably, the association was statistically significant. The duration of hospital stay was 26.7 days and 23.5 days in groups P and V, respectively, with no remarkable difference. In this study, 9.4% of cases in group P and none in group V died due to trachea-related complications; however, the association was insignificant. The findings of this study are comparable to those of other studies.

To address cases of post-intubation tracheal stenosis (PITS) caused by prolonged intubation and surgical treatment in a university hospital, Ulusan et al. reported cases of PITS. They stated that the typical intubation procedure lasted 16.95 days. A collar incision was employed in 86.4% of cases; in 9.1%, a median sternotomy incision was made; and in the remaining 4.5% of cases, a right thoracotomy incision was made. The average length of tracheal stenosis was 2.14 cm. The front walls were individually stabilised with vicryl (polyglactin) sutures in 77.3% of cases. No postoperative problems were found in 54.5% of cases. There was no recurrence during long-term follow-up in 68.2% of the cases. Of the patients, 9.1% experienced early death following surgery, whereas 22.7% required stent implantation due to restenosis. Despite new stent or endoscopic approaches, they concluded that tracheal excision and end-to-end anastomosis are the most effective techniques in patients without medical contraindications.[14] According to Kutlu et al. reported 12 postoperative complications (12%) and two postoperative deaths from pneumonia and bronchoatrial fistula (2% each). Five patients experienced stricture as a late consequence, and two needed a bronchial stent. Bougienage, reanastomosis, and complete pneumonectomy were three more late complications, one of each.[15]

First-line surgical resection and anastomosis performed in healthy patients with post-intubation tracheal stenosis were investigated by Elsayed et al. They stated that 30 individuals underwent surgery. The age was 23.5 years on average. Among the patients, 56.7% had undergone endoscopic tracheal dilatation, 13.3% had tracheal stents placed before surgery, and 3.3% had undergone tracheal resection. The percentage of patients who underwent tracheostomies was 63.3%. The patients in the 26.7% group had never undergone tracheal interventions. Patients who developed tracheal stenosis underwent intubation for a median of 20.5 days. The typical length of hospital stay was 10.5 days. Anastomoses had a success rate of 96.7%. A permanent tracheostomy was required in one patient. The in-hospital mortality rate was 3.3%, and one patient died 21 days after surgery due to chest infection. In the group receiving first-line surgery for de novo tracheal lesions, there was no death or morbidity.[16] According to Wynn et al., two attending otolaryngologists performed circumferential tracheal excision with end-to-end anastomosis on 28 patients. Patients were disqualified if they were younger than 12 years or if a thyroid or tracheal tumour was the surgical indication. The reasons for tracheal resection were intubation stenosis (32%), post-tracheotomy stenosis (25%), both post-intubation and post-tracheotomy stenosis (32%), external tracheal trauma (7%), and presence of a foreign body (4%). The follow-up period ranged from 18 months to 13.5 years. The success rate of anastomosis was 89%. The technique had no fatal side effects in any of the patients. They concluded that, in carefully chosen patients, tracheal resection with end-to-end anastomosis is a generally safe and effective treatment for tracheal stenosis.[17]

The characteristics and outcomes of redo tracheal resection and reconstruction have been examined by Donahue et al.[18] In their analysis, 16 of these individuals were drawn from a group of 32 patients who underwent 450 initial resections and reconstructions at our facility, but whose repairs were unsatisfactory. We received referrals from 59 individuals following unsatisfactory initial repairs. In 39 cases, T-tube placement or tracheotomy was the first treatment. Repeat resections were one to five centimetres long. 25% of the patients underwent laryngeal release to lessen anastomotic stress. 39% of individuals experienced complications, which were more common in patients who required laryngeal release (63.2%). The prognosis was good in 59 patients (78.6%) and satisfactory in 13.3%. 5.3% of the patients' attempts at repair failed, and 2.6% of the patients died. Despite the challenges involved in performing surgery again after tracheal reconstruction for post-intubation stenosis failure, a positive outcome is often possible. Retrospective evaluation of the results of surgery for benign tracheal stenosis is done by Kumar et al.[19] The patients underwent tracheostomies or were intubated as a result of a wide range of diseases. The stenosis varied in length from 1 to 4 cm. The diameter of the stenotic segment varied from 0 to 10 mm. The number of tracheal rings removed ranged from two to nine, and the average length of the removed segment was 3 cm. Postoperative complications occurred in 22.2% of the cases. At discharge and three months after release, every single one of their patients qualified as having an "excellent outcome".

Date et al. studied a variety of clinical parameters to identify the predictors of airway complications after lung transplantation. The procedure involved 229 consecutive single bilateral lung transplants. A retrospective analysis was performed on 348 bronchial anastomoses. With the use of conservative therapy, including one or a combination of dilation, stent placement, and laser treatment, 22 patients experienced satisfactory recovery. Five deaths (2.2%) were attributed to airway issues. One patient

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died shortly after surgery from a cause unrelated to an airway problem, and the other had a stubborn bronchus intermedius stricture. Complications were more common in single-lung transplantation than in bilateral lung transplantation. More difficulties occurred when a mattress suture (13.7%) was used than when a basic interrupted suture (6.6%) or figure-of-eight suture (5.5%) was used. The length of postoperative mechanical breathing was longer for patients who later experienced airway problems than those in whom airway complications did not occur. The 229 transplants were divided into three groups: Phase I, the first 77 transplants; Phase II, the next 76 transplants; and Phase HI, the most recent 76 transplants, to assess the occurrence of airway problems as our program developed. Most airway issues can be effectively managed, and death is uncommon.[20]

Schilt et al. cadaveric studies showed that the force grew naturally as more sutures were tested. Regardless of the type of suture used, tracheal suture pull-through was the most frequent cause of dehiscence in tracheal anastomoses. There was no discernible difference in anastomotic stability between the fresh and preserved cadaver tracheas. Vicryl and PDS had somewhat different mean anastomotic strengths (179.9 N vs. 161.5 N), but the difference was not statistically significant. They developed a low-cost method for evaluating the initial stability of tracheal anastomoses with human cadavers, and the results showed no distinction between Vicryl and PDS's tracheal pull-through strength.[21] Bush et al,[22] tested if the tensile strength of a running V-loc suture was comparable to that of a traditional closure. They reported that tests were performed on the tensile strength of 12 tracheal anastomoses. Anastomosis failure and the V-loc suture technique were documented in the video. The failure occurred in the membranous intercartilaginous area of the Vicryl (80%) and V-loc (100%) anastomoses. 20% of Vicryl anastomoses had sutures that broke before tissue collapse. Compared to interrupted Vicryl sutures (51 N), anastomoses with V-loc sutures showed an equal failure force (mean, 59 N). On the VAS, interrupted Vicryl closure was less satisfactory for surgeons than V-loc closure. They concluded that running a V-loc suture with tracheal anastomosis is a feasible substitute for interrupted Vicryl sutures with traditional closure. The enhanced ease of use of V-loc sutures gives them a surgical advantage.

CONCLUSION

We deduced that vicryl and prolene perform similarly in reducing morbidity (leak), but both groups' mortality rates remain the same. Therefore, to alleviate these problems, we recommend using Prolene when undergoing tracheal resection and anastomosis.

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