

Hemoptysis from Complex Pulmonary Aspergilloma Treated by Cavernostomy and Thoracoplasty

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Research article

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Abstract

Background In high-risk patients with complex pulmonary aspergilloma but unable for lung resection, cavernostomy and thoracoplasty could be performed. This study aimed to evaluate this surgery compared two material used (table tennis ball and tissue expander) as a filler. **Methods:** The prospective study evaluated 63 in high-risk patients who had hemoptysis due to complex pulmonary aspergilloma that submitted to cavernostomy and thoracoplasty surgery from November 2011 to September 2018. Patients were allocated to the table tennis ball group (46 patients) and tissue expander group (17 patients). We evaluated at the time of before operation, six months and 24 months after operation.

Results The most common comorbidity diseases were tuberculosis in two groups. Upper lobe occupied almost location. Hemoptysis symptoms plunged from time to time. Statistically significant Karnofsky score was observed in both groups. BMI showed slightly increasing but not statistically significant. Postoperative pulmonary functions (FVC and FEV1) have remained in both groups at all time points. The remarkable results were no death in the postoperative period, and long-term complication of surgery was low. There was no statistical significance between two groups in operative time, blood loss during operation, ICU length-stay time. Four patients died because of co-morbidity in 24 months follow-up.

Conclusion: Cavernostomy and thoracoplasty was safe and effective surgery for the treatment of high-risk patients with complex pulmonary aspergilloma. There was no mortality related to surgery. The postoperative complications and long-term complication were low. The was no inferiority when compared table tennis ball group and tissue expander group.

Keyword: Complex Pulmonary Aspergilloma (CPA), Hemoptysis, Cavernostomy, Thoracoplasty, Table Tennis Balls, Tissue expander,

Background

In developing countries, pulmonary aspergilloma is a common disease [1, 2] that difficult to treat diseases because of medical treatment with low effectiveness [3]. Surgical treatment emerged as the priority choice that offered good outcomes with acceptable morbidity in a challenging clinical situation[4]. Some studies showed that it was the most effective treatment [5]. Surgery became a valid indication but choosing the types of surgery depending on many factors.

In low-risk patients, the first choice of surgical treatment was pulmonary resection [5], which was considered as an appropriate therapy for simple pulmonary aspergilloma with low morbidity and mortality [6-8]. However, it was not the preferred therapy in high-risk patients such as complex pulmonary aspergilloma which has a thick wall of aspergilloma or underlying pleural and parenchymal sequelae. In patients who had hemoptysis due to complex pulmonary aspergilloma, immediate treatment is critical because of life-threatening. Anti-fungal therapy and bronchial artery intervention did not show precise results in this situation [9]. Pulmonary resection was considered to perform, but it was associated with significant morbidity [10]. In the case of patients with life-threatening symptoms but unable for lung resection, cavernostomy can be performed [11]. It also was an effective treatment in patients who had

pulmonary function insufficiency, poor general condition, bilateral disease, complex aspergilloma or severely ill patients [5, 6, 11-13]. Cavernostomy was less invasive procedures with the technically easy, simple and effective procedure, with many advantages [12, 14], [15]. This study presented the details of high-risk patients who underwent cavernostomy and thoracoplasty for complex pulmonary aspergilloma with hemoptysis.

Methods

We evaluated 63 high-risk patients with hemoptysis due to complex pulmonary aspergilloma (fungal ball) submitted to cavernostomy and thoracoplasty from November 2011 to September 2018. Patients were allocated into two groups. Table tennis ball (TTB) group was 46 patients who used a table tennis ball, and tissue expander (TE) group was 17 patients who used tissue expander as the material used.

Inclusion criteria were: patients aged above 18 years old who had hemoptysis (massive or recurrent) due to complex pulmonary aspergilloma (CPA) and poor general condition. CPA was diagnosed by typical clinical symptoms, finding of the classic image in the conventional x-ray and/or computed tomography, some tests to confirm such as (bronchoscopy, biochemistry: Aspergillus-specific IgG (+), microbiology: microscope and culture) and pathologically confirmed pulmonary pathology after surgery. Patients had an indication for surgery: defined as at least had one of three criteria: hemoptysis (massive or recurrent) may become life-threatening; poor general condition (BMI index < 18.5, Karnofsky score < 70), compromised pulmonary function (FEV1 < 50,0% or < 1.5 litter), surgeon decision depend on the condition of complex pulmonary aspergilloma. Patients agreed to participate in this study with surgery and follow-up by a protocol that had been approved by the Ethics Committee.

Exclusion criteria were: Patients refused to participate in studying or discontinued at any stage of our study. Patients who had any procedure or surgery concurrent with our procedure and did not follow-up study protocol were excluded from our study.

We evaluated: patients demographics, pre-operative signs and symptoms, preoperative tests, an indication of surgery, surgery characteristics and postoperative outcomes, postoperative complications. Three-time points were before the operation, six months after the operation and 24 months after the operation.

The operative technique

Patients were under general anaesthesia with single-lung ventilation with lateral decubitus position. A metal chest retractor was used for a chest incision to approach complex pulmonary aspergilloma. The fungus ball was removed with a spoon. Others necessary technique was done due to the lesions. The cavern was a full using table tennis ball or tissue expander. One catheter (24– 32 F) were placed into the cavity to follow bleeding if necessary.

The material used (Figure 1: table tennis ball and tissue expander)

We used sterilise table tennis ball (ping-pong) which have been used widely before in the TTB group [16]. The table tennis ball material (celluloid ball or plastic ball) that did not have any reaction to the human body. It has 40 millimetres in diameter, 2.7 gram in weight with the colour of orange or white [17]. A tissue expander (Polytech Tissue Expander, Polytech Health and Aesthetics GmbH, Germany) was a product that has been approved by the U.S. Food and Drug Administration. We used it in the TE group with the size from 200 to 300 ml and it filled by saline through 23 G needle.

Statistical analysis

We used SPSS v21 package for statistical data analysis. Descriptive analyses were performed with mean and standard deviation. Comparing characteristics between the two groups used a Student's *t*-test with the level of significance set at 95%. The comparison of serial measurement was performed by two-way ANOVA test.

Results

Sixty-three patients underwent cavernostomy and thoracoplasty for CPA in Pham Ngoc Thach Hospital, Ho Chi Minh City, Vietnam, from November 2011 to September 2018. Patient characteristics of both groups showed in Table 1. There was no statistically significant of age, size of CPA between TTB group and the TE group. The most common comorbidity diseases were tuberculosis in two groups. Upper lobe (both right and left of the lung) occupied almost location.

Hemoptysis symptoms (figure 2) plunged from time to time. Body mass index (figure 3) and Karnofsky score (figure 4) were compared at the three-time point: before the operation, six months post-operation, 24 months post-operation. No significant differences were shown between the two groups in each time points. While BMI showed slightly increasing but not statistically significant, statistically significant Karnofsky score was observed in both groups. Compared to before operation values, post-operative pulmonary functions (FVC and FEV1) remained in both groups at all time points (Table 2).

Surgical characteristics detailed in table 3. The remarkable results were no death in the postoperative period, and long-term complication of surgery was low. There was no statistical significance between two groups in operative time, blood loss during operation, ICU length-stay time. The statistically significant only showed in rib retraction.

In 63 patients, three patients died in 6 months period after surgery in TTB group because of myocardial infarction, stroke, and lung cancer while in the TE group 1 patient died because of complication of diabetes.

Discussion

CPA caused many lesions of the lung and has been very associated with the life-threatening condition when its complication occur, such as hemoptysis [18, 19]. Immediately treatment for these cases was

critical, and surgery was priority treatment of choice if the pulmonary function was not severely insufficiency [20]. Many studies had been carried out to confirm that surgical treatment (almost surgical resection) of pulmonary aspergilloma brought out many advantages such as preventing recurrent hemoptysis, and excellent long-term results [2, 3, 8, 21]. Although modern technology such as Robotic resection of lung used to get further advantages [22] but less invasive surgery such as sub-lobar resection and video-assisted thoracoscopic surgery (VATS) was more preferred with good results just in patients, who had simple pulmonary aspergilloma [23-26].

Anti-fungal medication (voriconazole, itraconazole) also was a safe and effective modality and should be considered if surgery contraindicated [27-29]. In the case of both medical and surgical treatment were ineffective or contraindicated in massive hemoptysis due to aspergilloma, intervention treatment was an alternative therapy with the success rate was 40.0% [30]. Bronchial artery embolism could be considered when systemic embolism was ineffective or to reduce perioperative bleeding [20, 31, 32]. Another therapy such as bronchoscopic procedure and radiotherapy also was a potential option for selected cases [33, 34]. The remarkable result in our study was that the hemoptysis symptoms plunged statistically significant with no cases in the TE group and 2 cases in TTB group. The recurrence rate in 24 months was low, with just only one cases in the TE group had hemoptysis, but its severity was lesser than before the operation.

In low-resource countries, surgery for CPA was very challenging, but it would be the best treatment modality for symptomatic diseases in such conditions [35]. However, in high-risk patients with CPA, alternative therapies should be advised because lung resection was considered too invasive. When resection was not feasible, patients may underwent palliative procedures such as cavernostomy [13, 32], intracavitary Amphotericin-B [36] or bronchial artery occlusion [30]. Cavernostomy was a useful option for high-risk patients [20, 37]. In our study, although four patients died, there was no death related to surgery. The reasons for all deaths were a complication of co-morbidity diseases. That results confirmed the efficacy of cavernostomy and thoracoplasty surgery for CPA with hemoptysis. Another study showed that the mortality rate was variants from one in 17 patients to 4 in nine patients. The reasons behind this may be that the number of patients was small, and the experience of the surgeon may be a lack in this type of surgery [12, 38].

Karnofsky score (Karnofsky performance status, Karnofsky Performance Scale) in this study showed statistically significant changes from time point to time point. It also has been used as an index to monitor using in peri-operative and post-operative of lung transplantation.[39][40] In our study, the almost pulmonary function of patients was diminished. After surgery, there was no change in pulmonary function, but the Karnofsky score had significant changes that showed overall efficacy of surgery in patients with CPA. The reason behind this may be that hemoptysis was serious sequela in CPA patients that plunged remarkably [20, 41].

One of the surgical disadvantages was that the cavity after cavernostomy occurred. The collapse had to be maintained by filler, and in our study, we used the table tennis ball and tissue expander to fill the space. Over the years many tissues and materials were tried as a filler, cavernostomy had been performed and showed useful such as single-stage cavernostomy and a muscle transposition flap [15, 42], cavernostomy with limited thoracoplasty [15] and simplified cavernostomy with Alexis Wound Protector [43]. The remained space may lead to recurrence. In our study, we performed single-stage cavernostomy, and thoracoplasty with no recurrence patient was recorded. This result was in line with Chen et al. [9]. According to our viewpoints, the critical elements of this technique to ensure the recurrence rate was low depended on the bronchial fistula and the cavity condition. The bronchial fistula must be closed that was checked by anesthesia through to expand the lung and no gas leakage if it closed. The cavity was filled with the material used (both table tennis ball and tissue expander).

The table tennis ball was the material that emerged as low-cost, easy to find anywhere, but because of the fixed size, it was difficult to manipulate when filled the space. Its complications included shortness of breath, bronchopleural fistula extrusion, superior vena cava obstruction, haemorrhage, pain [16]. There was a report showed that it still working after 46 years with uncomplicated outcome [44]. Tissue expander used in this surgery as the material used was applicable methods. It has been recognized as a standard procedure in the United States for breast reconstruction [45]. Although it has a higher risk of reconstructive failure and surgical-site infection, this was the right choice for high-risk patients or unavailable for autologous reconstruction.[46, 47] This was the reason why we choosed tissue expander because of its benefits. We can modified volume to keep fit with CPA which has been removed. Several complications of tissue expander in breast reconstruction such as infection, hematoma/seroma, and explantation were reported [48], and there were differences among stages with stage I rather than the later stage.[49] In this study, complications were low. Only one stage was performed, and no patient had the next stage.

Conclusion

Cavernostomy and thoracoplasty was a safe and effective technique for the treatment of high-risk patients with complex pulmonary aspergilloma. There was no mortality related to surgery. The postoperative complications and long-term complication were low. The was no inferiority when compared table tennis ball group and tissue expander group.

Abbreviations

CPA: Complex Pulmonary Aspergilloma

TTB: Table tennis ball

TE: Tissue expander

Declarations

Acknowledgments

Not applicable.

Funding

Not applicable.

Authors' contributions

All authors contributed to drafting and revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work. Particularly, NTG made substantial contributions to the conception and design of study and is the first author. NTD, NTH, TTT, PSH, NTV, and NVN contributed to collect data. NTD and DCP contributed to acquisition data, interpret data, analyze data and draft the article. PNH prepared and revised this manuscript, acquisition of data, interpretation of data, and drafting the article and is the corresponding author. All authors have read and approved the manuscript

Ethics approval and consent to participate

The Ethics Committee of Vietnam Military Medical University approved the study protocol and authorized its conduct and follow-up. The study was in line with the Declaration of Helsinki. Individual patient consent for inclusion in the study was obtained. Before operation, written informed consent was provided to all participants after a thorough explanation of the purpose of this study. Patients had the right to discontinue at any time during the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interest.

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

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Tables

Due to technical limitations, tables are only available as a download in the supplemental files section.

Figures

Figure 1: Material used - Table tennis ball (TTB) and Tissue expander (TE)

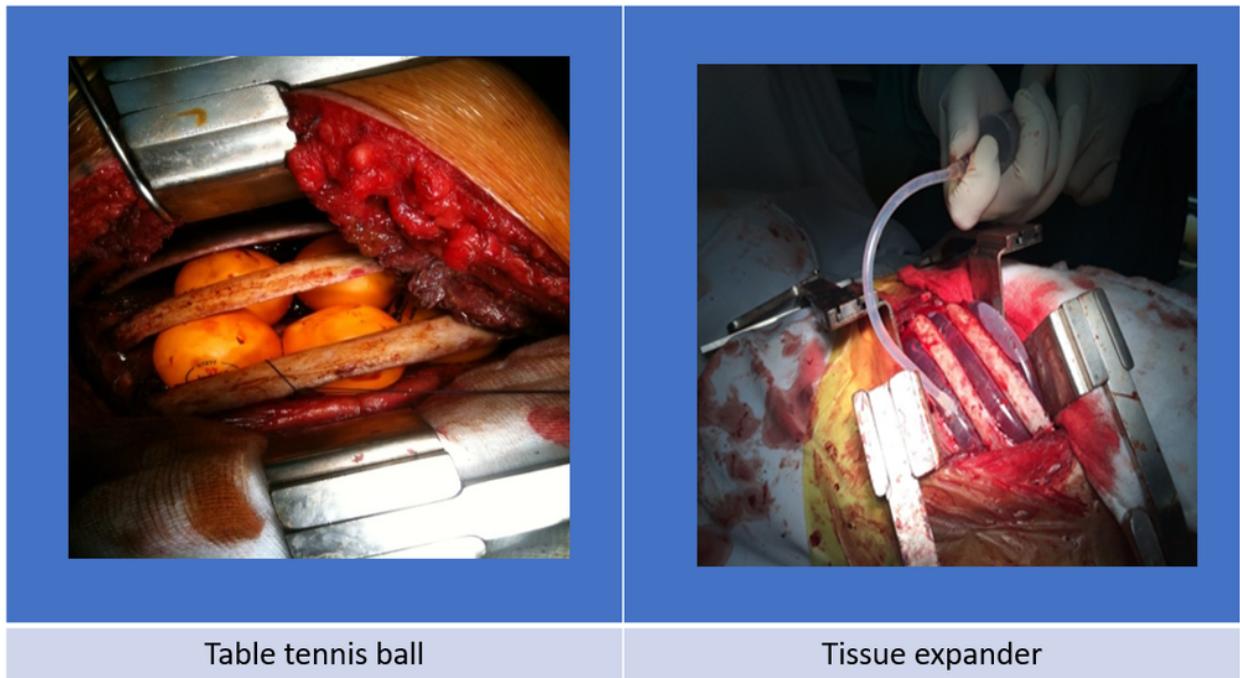


Figure 1

Material used: Table tennis ball (TTB) and Tissue expander (TE).

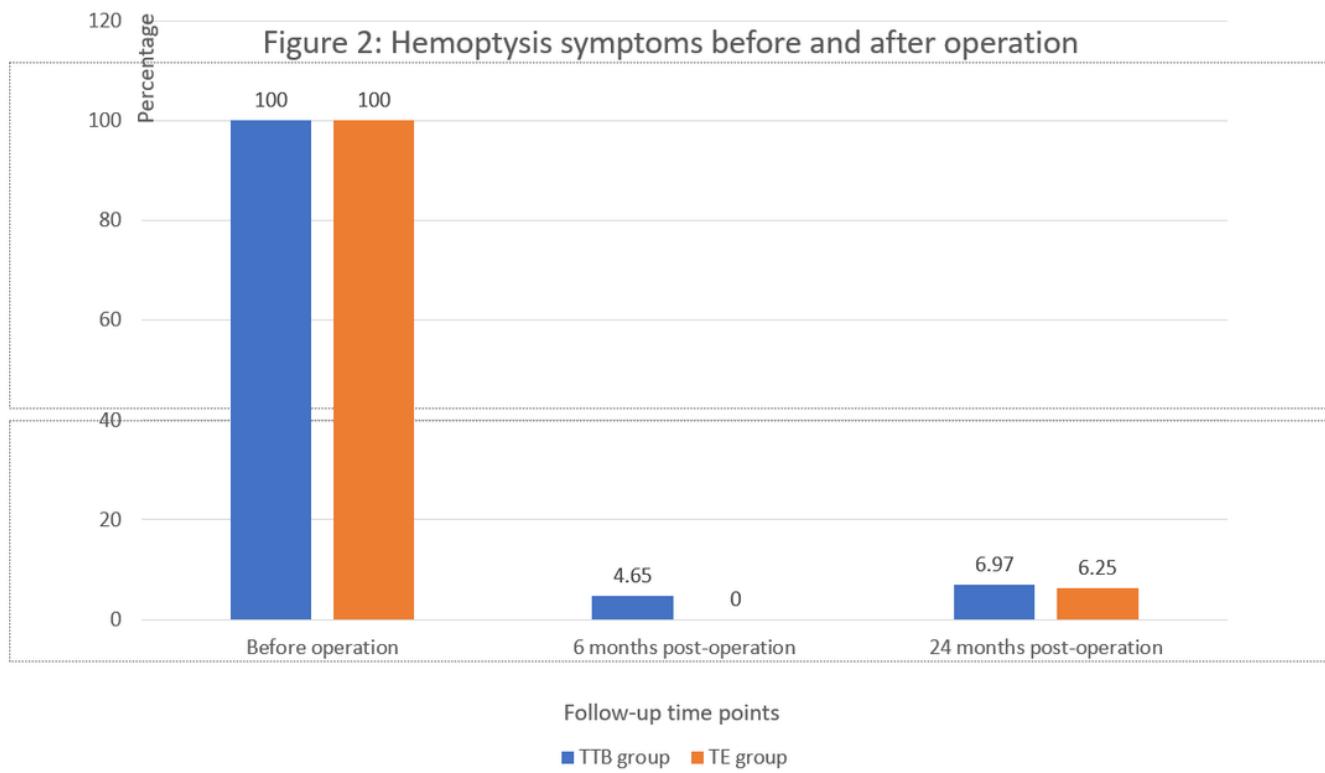


Figure 2

Hemoptysis symptoms before and after operation.

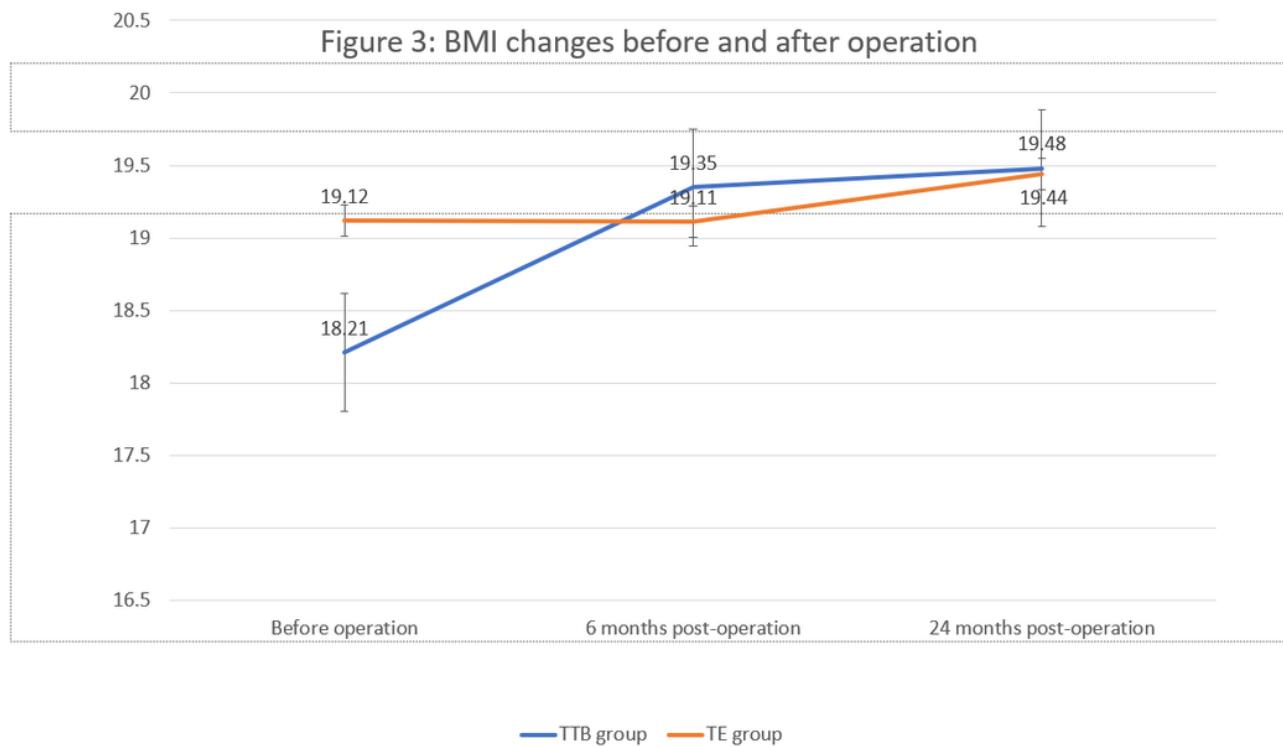


Figure 3

BMI changes before and after operation.

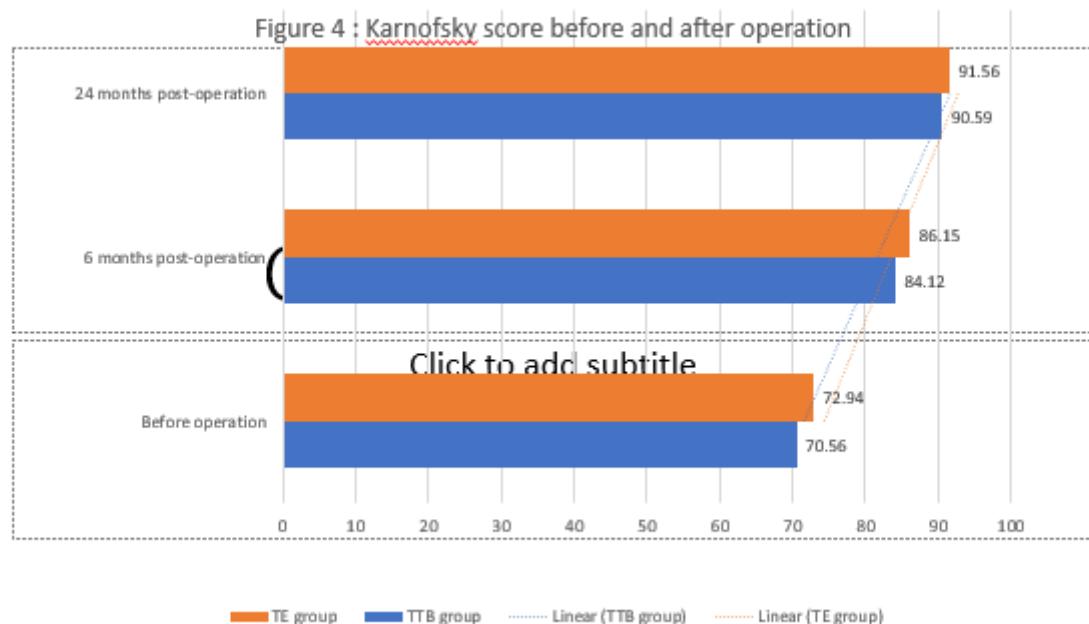


Figure 4

Karnofsky score before and after operation .

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