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# Ligation of the Major Mediastinal Vessels, Safety and Complications

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## ABSTRACT

**Background:** During upper mediastinal surgical interventions, innominate vessels may be ruptured inadvertently or divided intentionally by the surgeon for a better exposure. The question, whether a divided innominate artery or vein should be reconstructed or not, has not yet been clearly answered.

**Materials and Methods:** In a retrospective study, 11 patients who underwent surgery between 1996 and 2004 in our department (7 females & 4 males) with mean age of 38.7 years old were found undergoing an upper mediastinal surgery with ligation of a great vessel.

Fourteen great vessels (6 innominate arteries, 4 left innominate veins, 3 right innominate veins and one right carotid artery) were ligated with no reconstruction.

The vessels were intentionally divided for a better exposure or ligated for controlling of severe bleeding (due to an iatrogenic trauma) in 6 and 5 patients, respectively.

**Results:** One patient with innominate artery and right innominate vein division suffered from a 48 - hour period of coma due to a cerebral edema which was completely resolved. Two patients developed infection at the site of sternotomy and were managed with antibiotics and wound care. No complication occurred in the remaining. In two cases with division of innominate arteries, the peripheral pulses disappeared, but there was no muscle weakness, or ischemic pain in the limb. The follow-up period was between 2-96 months (mean; 24.8).

**Conclusion:** In critical condition and when surgical situation is not suitable for reconstruction, innominate vessels could be safely ligated and divided for a better surgical exposure and control of bleeding; with acceptable post-op risks. (*Tanaffos* 2004; 3(10): 19-23)

**Key words:** Mediastinum, Innominate artery, Innominate vein, Ligation

## INTRODUCTION

Operation on mediastinal structures like trachea and resection of superior mediastinal and superior

sulcus tumors need an anterior approach through median sternotomy.

In these situations, innominate vessels may be ruptured inadvertently or divided intentionally by the

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surgeons (1-6).

Some surgeons ligate these vessels without reconstruction while many believe that reconstruction should be performed or at least believe that by performing intraoperative electroencephalography (EEG), they can determine whether they are able to avoid vessel reconstruction (7-10).

As a whole, reconstruction of these divided vessels is difficult and has some complications.

On the other hand, permanent ligation of innominate vessels may cause ischemia and edema of upper extremities and head; however, some studies have not shown such complications (6,11,12).

The vessel reconstruction will be a major operation for these patients in critical situation and may cause more dangerous complication than vessel division itself.

Disinclination of the surgeons for ligation of the vessels may be due to the lack of reports supporting this policy.

Since previous researches were case report studies, we report our experience on 11 patients.

## **MATERIALS AND METHODS**

Between 1995 and 2003, 11 patients (4 men, 7 women) with the age range of 9-65 years (mean: 38.7) underwent division of major mediastinal vessels without reconstruction. All necessary data, complications and follow up (2- 96 months, mean: 24.8), were obtained from hospital records and patient's files.

The operations that required division of the innominate vessels were as follows: 4 cervical exenterations, 2 tracheal resection for stenosis, one

thymectomy for myasthenia gravis, one right thoracotomy for mediastinal tumor, 3 jejunal free flap replacements (two for trachea-innominate artery fistula and 1 for cervical esophageal stenosis), and one resection of thymoma and right innominate vein.

A total of 11 patients underwent 12 surgeries with 14 vessel ligations (6 innominate arteries, 4 left innominate veins, 3 right innominate veins, and one right common carotid artery). One out of 11 patients underwent two operations.

## **RESULTS**

None of the patients showed serious complications in brain and extremities as a result of vessel ligation. One patient presented signs of cerebral edema which resolved gradually during 48 hours.

This patient was a 9-year-old girl who underwent an operation for recurrence tracheal stenosis in which innominate artery was ruptured during release of trachea in the mediastinum managed by ligation of right innominate vein and innominate artery (table 1).

Sternotomy wound infection was detected in 2 patients which improved with appropriate treatments. Peripheral pulses in the right upper extremity were not palpated after operation in 2 patients after ligation of innominate artery; none of them had ischemic signs like pain or muscle weakness in their extremities.

One patient with ligation of right innominate vein developed transient edema in the right upper extremity which resolved spontaneously after two weeks.

Patient's data and information are listed in table 1.

**Table 1.** Characteristics of the patients.

Number	Age	Gender	Divided vessels	Complication	Follow up (months)	History
1	55	Female	Innominate artery and left innominate vein	No	9	Six months after total laryngectomy and esophagectomy for cervical esophageal cancer, she had relapse of tumor at tracheostomy site. Cervical exenteration was performed again. Meanwhile, innominate artery and left innominate vein were ligated (as elective).
2	27	Female	Innominate artery	Wound infection	48	She had myasthenia gravis along with respiratory failure; thus, was connected to ventilator. She developed post-tracheostomy stenosis causing anastomosis resection of trachea. One year later, she underwent median sternotomy and thymectomy in which innominate artery was perforated and consequently ligated.
3	46	Female	Left innominate vein	No	48	She had distal post-tracheostomy stenosis. Left innominate vein was electively ligated by median sternotomy during anastomosis resection for a better surgical exposure.
4	50	Male	Right innominate vein	No	9	He underwent cervical exenteration for extended metastasis of thyroid cancer to trachea. Meanwhile, right innominate vein was ligated as elective.
5	9	Female	Innominate artery and right innominate vein	Coma and cerebral edema (lasted 2 days)	96	During operation of post-tracheostomy stenosis via mid-cervical incision, innominate artery was perforated causing ligation of both innominate artery and right innominate vein.
6	40	Male	Left innominate vein	No	8	He had history of SCC (squamous cell carcinoma) of the larynx and underwent laryngectomy along with radiotherapy. He was admitted for metastasis of tumor to sternum. Left innominate vein was electively ligated during resection of tumor.
7	15	Female	Innominate artery	No	2	She underwent total laryngectomy and esophagectomy for treatment of upper esophageal cancer. One week later, there was a tracheo-innominate artery fistula which was repaired urgently; innominate artery was also ligated.
8	25	Female	Innominate artery and right common carotid artery	Wound infection	36	She had spontaneous rupture of esophagus and underwent esophagectomy and colon replacement. She developed cervical anastomosis fistula and stenosis. During operation for repairing of fistula with free jejunal loop, right common carotid artery was perforated and ligated. Jejunal loop was replaced at the site of stenosis by vascular microscopic anastomosis. After few weeks, she developed mediastino-innominate artery fistula. In another surgery, this artery was also ligated. Instead of jejunum and colon, her stomach was pulled-up and anastomosed to hypopharynx.
9	31	Female	Innominate artery	No	3	Innominate artery had ruptured during right thoracotomy for resection of upper mediastinal tumor. The artery was ligated.
10	63	Male	Left innominate vein	No	2	He had SCC of larynx and underwent laryngectomy plus radiotherapy. One year later, cervical exenteration was performed because of tumor relapse in trachea. Left innominate vein was electively ligated.
11	65	Male	Right innominate vein	Transient upper extremity edema	12	He underwent coronary bypass surgery. Accidentally, a tumor was detected in thymus which had invaded right innominate vein. Radical thymectomy along with right innominate vein resection and coronary bypass were performed.

Mean of follow up: 8.24 months    mean of age: 38.7 years

## DISCUSSION

Although various reasons caused division of mediastinal vessels in our patients, no major ischemic problem was seen.

It seems that the cause of cerebral edema in the patient mentioned above is not directly due to innominate vein ligation. When her innominate artery ruptured, we controlled bleeding with digital compression on the vessels and then incised sternum for ligation of perforated vessel. The digital compression on vessels lasted for one hour and probably transferred to carotid artery at the same time, so brain blood circulation was decreased.

In a study conducted by Sai Sudhakar et al. (13), left innominate vein was electively ligated to approach aortic arch and resect mediastinal tumor in 12 and 2 patients, respectively. All their patients had transient left upper extremity edema after operation, which resolved after 7-10 days by the limb elevation. One of their patient needed another operation for controlling the bleeding of venous stamp, another patient also died because of multiorgan dysfunction. The above mentioned complications were not detected in our patients but we found; as Sai Sudhakar's study, division of innominate vessels can result in a better exposure for surgeons. No EEG or angiography was performed before or after surgery.

## CONCLUSION

During mediastinal surgeries, there is the possibility of unintentional rupture of major vessels. Thus, in presence of "unstable patients condition" and "unsuitable surgical facilities, vascular repairing could be relinquished and be ligated only. In these circumstances, vessel ligation as compared to vessel repair is associated with fewer complications and risks.

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