Technical highlights of robotic-assisted mediastinal tumor resection

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Technical highlights of anterior upper mediastinal tumor resection

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus with slight backward bending, contralateral one-lung ventilation, upper limb buckling and head crossing.

Incision design—the "6-3-5" incision design method

An incision is made in the sixth intercostal space on the posterior axillary line of the affected side to place a 12-mm-diameter trocar, which is used to insert a thoracoscope. Incisions are made in the third and fifth intercostal spaces on the ipsilateral anterior axillary line to place an 8-mm-diameter trocar for the insertion of equipment connected to the instrument arm. If necessary, during the operation, another incision is made in the sixth intercostal space on the midaxillary line to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the ipsilateral pleural cavity during the operation to fully collapse the lung to facilitate the operation.

Technical highlights of the surgical operation

Careful observation

After the insertion of the lens, the relationship between the lesion and its surrounding tissue structures is carefully confirmed, including the relationship between the lesion and superior vena cava, as well as the relationship between the lesion and left and right innominate veins and heart, to avoid accidental injury.

Device selection

The left hand uses a bipolar coagulation forceps, and the right hand uses a monopolar coagulation hook.

Operation procedures

If the tumor is obvious and protruding to the affected side, a monopolar coagulation hook is used to make a sharp separation of mediastinal pleura at about 0.5 cm proximal to the mediastinal pleura on the surface of the tumor. The tumor is then completely isolated and excised by cutting the inherent tumor capsule from top to bottom, front to back and ipsilateral side to contralateral side. One of the incisions used for equipment insertion is extended appropriately to insert a disposable specimen retriever to remove the specimen, and then, the wound is given a complete hemostasis. If there is no obvious bleeding and oozing of the wounds during the operation, after the anesthesiologist has fully expanded the lung, each operation incision is sutured and closed without maintaining a thoracic drainage tube, and the operation is complete. Otherwise, a thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If the tumor is relatively small, and the lesion is not seen after the lens is inserted, a coagulation hook is used to isolate and excise the whole anterior mediastinal tissue (thymus and adipose tissue) in front of the phrenic nerve and superior vena cava and below the innominate vein. Next, one of the incisions used for the equipment insertion is extended appropriately to insert a disposable specimen retriever to remove the excised specimen, carefully examine it and search for the lesion. After confirming an accurate and complete

excision of the lesion tissue, the wound is given a complete hemostasis. If no lesion is found in the excised tissue, the same method is used to expand the excision of the anterior mediastinal tissue until an accurate and complete excision of the lesion tissue is confirmed, and then, the wound is given a complete hemostasis. A thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If, during the operation, the ipsilateral lung does not show a satisfactory collapse, or the tumor has abundant blood vessels and too much oozing interfering with the operation, an incision in the sixth intercostal space at the midaxillary line is made on the affected side to place an 8-mm trocar to assist in the operation, which is performed by an assistant.

Technical highlights of anterior lower mediastinal tumor resection

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus with slight backward bending, contralateral one-lung ventilation, upper limb buckling and head crossing.

Incision design—the "6-3-6" incision design method

An incision is made in the sixth intercostal space on the posterior axillary line of the affected side to place a 12-mm-diameter trocar, which is used to insert a thoracoscope. Incisions are made in the third and sixth intercostal spaces on the ipsilateral anterior axillary line to place an 8-mm-diameter trocar, which is used for the insertion of equipment connected to the instrument arm. If necessary, during the operation, another incision is made in the sixth intercostal space on the midaxillary line to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the ipsilateral pleural cavity during the operation to fully collapse the lung to expose the operative field and facilitate the operation.

Technical highlights of the surgical operation

Careful observation

After the insertion of the lens, the relationship between the lesion and its surrounding tissue structures is carefully confirmed, including the relationship between the lesion and lungs, as well as that between the lesion and the phrenic nerve and heart, to avoid accidental injury.

Device selection

The left hand uses bipolar coagulation forceps, and the right hand uses a monopolar coagulation hook.

Operation procedures

If the tumor is obvious and protruding to the affected side, a monopolar coagulation hook is used to make a sharp separation of the mediastinal pleura at about 0.5 cm proximal to the mediastinal pleura on the surface of the tumor. The tumor is then completely isolated and excised by cutting the inherent tumor capsule from top to bottom, front to back and ipsilateral side to contralateral side. One of the incisions used for the insertion of equipment is extended appropriately to insert a disposable specimen retriever to remove the specimen, and then, the wound is given a complete hemostasis. If there is no obvious bleeding and oozing of the wounds during the operation, after the anesthesiologist fully expands the lung, each operation incision is sutured and closed without maintaining a thoracic drainage tube, and the operation is complete. Otherwise, a thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If the tumor is relatively small, and the lesion is not seen after the lens is inserted, a coagulation hook is used to isolate and excise the whole anterior mediastinal tissue from the lower mediastinum (estimated tumor location) in front of the phrenic nerve and pericardium. Next, one of the incisions used for the equipment insertion is extended appropriately to insert a disposable specimen retriever to remove the excised specimen, carefully examine it and search for the lesion. After confirming an accurate and complete excision of the lesion tissue, the wound is given a complete hemostasis. If no lesion is found in the excised tissue, the same method is used to expand the excision of the anterior lower mediastinal tissue until an accurate and complete excision of the lesion tissue is confirmed, and then, the wound is given a complete hemostasis. A thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured,

and the surgery is complete.

If, during the operation, the ipsilateral lung does not show a satisfactory collapse, or the tumor has abundant blood vessels and produces too much oozing that interferes with the operation, an incision in the sixth intercostal space at the midaxillary line is made on the affected side to place an 8-mm trocar for to assist in the operation, which is performed by an assistant.

Technical highlights of posterior upper mediastinal tumor resection

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus, contralateral one-lung ventilation, upper limbs buckling and crossing the head.

Incision design—the "6-4-7" incision design method

An incision is made in the sixth intercostal space on the ipsilateral posterior axillary line to place a 12-mm-diameter trocar, which is used to insert a thoracoscope. Next, 0.8-cm-long incisions are made, respectively, in the seventh intercostal space at the posterior axillary line and infrascapular line and in the fourth intercostal space at the anterior axillary line and midclavicular line on the ipsilateral side for the operation. If necessary, during the operation, another incision is made in the fifth or sixth intercostal space on the midaxillary line of the ipsilateral side to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the ipsilateral pleural cavity during the operation to fully collapse the lung to expose the operative field and facilitate the operation.

Technical highlights of the surgical operation

Careful observation

After the insertion of the lens, the relationship between the lesion and its surrounding tissue structures is carefully confirmed, including the relationship between the lesion and superior vena cava, as well as that between the lesion and left and right innominate veins, azygos vein, esophagus and trachea, to avoid accidental injury.

Device selection

The left hand uses a bipolar coagulation forceps, and the right hand uses monopolar coagulation hook.

Operation procedures

At about 0.5 cm from the base and on the surface of the tumor, a monopolar coagulation hook is used to make a sharp and circumferential separation of the parietal pleura on the surface of the tumor. The tumor is then completely isolated and excised by cutting the inherent tumor capsule from top to bottom and from front to back (during the operation, the relationship between the tumor and its surrounding tissue structures is carefully confirmed, particularly paying attention to the relationship between the tumor and intervertebral foramen, to avoid secondary injury). One of the incisions used for the insertion of equipment is extended appropriately to insert a disposable specimen retriever to remove the specimen, and then the wound is given a complete hemostasis. If there is no obvious bleeding and oozing of the wounds during the operation, after the anesthesiologist fully expands the lung, each operation incision is sutured and closed without maintaining a thoracic drainage tube, and the operation is complete. Otherwise, a thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If, during the operation, the ipsilateral lung does not show a satisfactory collapse, or the tumor has abundant blood vessels and produces too much oozing that interferes with the operation, an incision in the fifth or sixth intercostal space at the midaxillary line on the affected side is made to place an 8-mm trocar to assist in the operation, which is performed by an assistant.

Technical highlights of posterior lower mediastinal tumor resection

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus with slight forward bending, contralateral one-lung ventilation, upper limb buckling and head crossing.

Incision design—the "6-4-7" incision design method

A 1.2-cm incision is made in the fifth intercostal space on

the right anterior axillary line to insert a thoracoscope. Next, 0.8-cm-long incisions are made, respectively, in the third intercostal space at the right midaxillary line and in the eighth intercostal space at the right posterior axillary line and infrascapular line for the operation. If necessary, during the operation, another incision is made in the sixth or seventh intercostal space on the midaxillary line of the ipsilateral side to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the ipsilateral pleural cavity during the operation to fully collapse the lung to expose the operative field and facilitate the operation.

Technical highlights of the surgical operation

Careful observation

After the insertion of the lens, the relationship between the lesion and its surrounding tissue structures is carefully confirmed, including the relationship between the lesion and esophagus, and that between the lesion and the heart and trachea, to avoid accidental injury.

Device selection

The left hand uses bipolar coagulation forceps and the right hand uses monopolar coagulation hook.

Operation procedures

At about 0.5 cm from the base and on the surface of the tumor, a monopolar coagulation hook is used to make a sharp and circumferential separation of the parietal pleura on the surface of the tumor. The tumor is then completely isolated and excised by cutting the inherent tumor capsule from top to bottom and from front to back (during the operation, the relationship between the tumor and its surrounding tissue structures is carefully confirmed, particularly paying attention to the relationship between the tumor and intervertebral foramen, to avoid secondary injury). One of the incisions used for equipment insertion is extended appropriately to insert a disposable specimen retriever to remove the specimen, and then the wound is given a complete hemostasis. If there is no obvious bleeding and oozing of the wounds during the operation, after the anesthesiologist fully expands the lung, each operation incision is sutured and closed without maintaining a thoracic drainage tube, and the operation is complete. Otherwise, a thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lung is fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If, during the operation, the ipsilateral lung does not show a satisfactory collapse, or the tumor has abundant blood vessels and produces too much oozing that interferes with the operation, an incision in the sixth or seventh intercostal space at the midaxillary line on the affected side is made to place an 8-mm trocar to assist in the operation, which is performed by an assistant.

Technical highlights of full thymectomy and anterior mediastinal adipose tissue removal

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus with slight backward bending, contralateral one-lung ventilation, upper limb buckling and head crossing.

Incision design—the "6-3-6" incision design method

If the thymoma is on the right side, or there is no thymoma, the right thoracic cavity entrance is normally chosen because it is convenient and safe for the operation. An incision is made in the sixth intercostal space on the right posterior axillary line to place a 12-mm-diameter trocar, which is used to insert a thoracoscope. Incisions are made in the third and sixth intercostal spaces on the right anterior axillary line to place an 8-mm-diameter trocar, which is used for the insertion of equipment connected to the instrument arm. If the patient has the complication of myasthenia gravis and thymoma (i.e., the thymoma is larger, ≥3 cm), the left thoracic cavity entrance is chosen, and incisions are made the same way as those on the right side. If necessary, during the operation, another incision is made in the sixth intercostal space on the midaxillary line of the operative side to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the pleural cavity of the affected side during the operation to fully collapse the lung to expose the operative field and facilitate the operation.

Technical highlights of the surgical operation

Careful observation

First, the lens is inserted to observe whether there are any

adhesions in the pleural cavity and to separate them if there are any. The anatomical positions of the superior vena cava, right and left innominate veins, heart and phrenic nerve are carefully confirmed to avoid accidental injury. The operation arm is then connected.

Device selection

The left hand uses bipolar coagulation forceps, and the right hand uses a monopolar coagulation hook.

Operation procedures

After the clarification of the lesion area, a monopolar coagulation hook is used to make a sharp opening of the mediastinal pleura in front of the phrenic nerve. Starting from the right bottom end of the thymus (including the adipose tissue at the right bottom, in front of the pericardium), the right lobe of the thymus is isolated by moving along the surface of the pericardium, moving from the right bottom to the top until the right top end of the thymus, and care should be taken when moving to the superior vena cava and left and right innominate veins to avoid injury. After the isolation of the right lobe, movement is made from the left bottom end of the thymus to the top (adjacent to the pericardium, the mediastinal adipose tissue is isolated as well), closely against the left mediastinal pleura, and then movement is continued from the bottom to the top until the left top end of the thymus to isolate the left lobe of the thymus. Because the top end of thymus is adjacent to the innominate vein and other large vessels, extreme care should be taken during the operation. During the isolation, care should also be taken to avoid heat loss from blood vessels that will result in blood vessel rupture and bleeding. Normally, there are two to three thymus veins to merge to the left innominate vein. First, the thymus veins are carefully identified and confirmed. Bipolar coagulation forceps, which are placed far from the left innominate vein, are used to perform multiple electrocoagulations of the thymus veins. A monopolar coagulation hook is then used to sever the thymus vein from the distal end of the coagulated position so that the thymus and anterior mediastinal adipose tissues can be removed altogether completely. Finally, the residual thymus tissue and anterior mediastinal adipose tissues are cleaned and removed to empty the anterior mediastinum so that the contralateral mediastinal pleura are clearly observed. One of the incisions for the operation is extended to approximately 2 cm, and the specimen is removed using a disposable specimen retriever bag. The wound is given a complete hemostasis. A thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. The anesthesiologist is then instructed to fully expand the lungs and close the incisions for the operation; the surgery is then complete.

Oral administration of a preoperative dosage of pyridostigmine bromide should be continued after the surgery, and the dosage can be gradually reduced according to the patient's clinical symptoms.

If, during the operation, the lung does not show a satisfactory collapse, an incision in the sixth intercostal space at the midaxillary line on the operative side can be made to place an 8-mm-diameter trocar to assist in the operation.

Technical highlights of tumor resection at the top of the pleura

Anesthesia, intubation, position

The operation uses general anesthesia, double-lumen endotracheal intubation, contralateral decubitus, contralateral one-lung ventilation, upper limbs buckling and both hands holding together and crossing the head with a jackknife position.

Incision design—the "8-8-5-7" incision design method

An incision is made in the seventh or eighth intercostal space on the posterior axillary line of the affected side to place a 12-mm-diameter trocar, which is used to insert a thoracoscope. Incisions are made in the seventh or eighth intercostal space at the infrascapular line and in the fifth intercostal space at the anterior axillary line to place an 8-mm trocar, which is used for the insertion of equipment connected to the instrument arm. If necessary, during the operation, another incision is made in the sixth intercostal space on the midaxillary line to place an 8-mm-diameter trocar to assist in the operation. An artificial 6-10 mmHg pneumothorax (usually 8 mmHg) is established in the pleural cavity of the affected side during the operation to fully collapse the lung to facilitate the operation.

Technical highlights of the surgical operation

Careful observation

After the insertion of the lens, the relationship between

the lesion and its surrounding tissue structures is carefully confirmed, including the relationship between the lesion and esophagus, trachea, azygos vein and subclavian artery and vein, to avoid accidental injury.

Device selection

The left hand uses bipolar coagulation forceps, and the right hand uses a monopolar coagulation hook.

Operation procedures

At a position on the tumor, which is approximately 0.5 cm from the tissues of the top of the pleura, a coagulation hook is used to make a sharp separation of the mediastinal pleura outside the tumor. The tumor is then completely isolated and excised through sharp and blunt isolation of the tumor from outside of the inherent tumor capsule. One of the incisions used for the insertion of the equipment is extended appropriately to insert a disposable specimen retriever to remove the specimen, and then the wound is given a complete hemostasis. A thoracic drainage tube, which is connected to an external water-sealed drainage bottle, is inserted through the incision for a thoracoscope. After the lungs are fully expanded, all of the incisions for the operation are sutured, and the surgery is complete.

If, during the operation, the lung at the affected side does not show a satisfactory collapse, or the tumor has abundant blood vessels and produces too much oozing that interferes with the operation, an incision in the sixth intercostal space at the midaxillary line is made on the ipsilateral side to place an 8-mm trocar to assist in the operation, which is performed by an assistant.

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