

Technical points of the operative procedure for robotic-assisted lung resection and lymph node dissection

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The left-lung upper lobe resection and lymph node dissection

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as follows: an incision is made in the 8th or 9th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted inside the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted through the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

The selection of the operative procedure (single direction lobectomy or anatomical) is based on the state of

development of the oblique fissure, as follows:

- (I) If no oblique fissure has developed, then the single direction lobectomy operative procedure is selected. First, the left upper pulmonary veins are treated (i.e., after the left upper pulmonary veins are freed, the lens is adjusted to the auxiliary operation hole, and a dissecting sealer is inserted through the thoracoscope-entry hole and used to staple and cut off the blood vessels). Next, the left upper lobar apical segmental artery and anterior segmental artery are freed; a dissecting sealer is inserted through the auxiliary operation hole and used to staple and cut off the blood vessels. The left upper lobar bronchus (including the lingular segmental bronchus) is treated. The lens is again adjusted to the auxiliary operation hole. A dissecting sealer is inserted through the thoracoscope-entering hole and used to clip the upper lobar bronchus. Afterward, the anesthetist is instructed to inflate the lung. After confirming that the lower lobe of the left lung has been well inflated, the upper lobar bronchus is clipped and cut off. Subsequently, the remaining upper lobar arteries are treated. After the group 11 lymph nodes inside the oblique fissure are dissected, the lung tissue in the undeveloped oblique fissure is treated. The lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. Groups 2L, 5, 6, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation

hole on the anterior axillary line;

- (II) If a pulmonary fissure has well developed, then the anatomical operative procedure is selected. First, the left upper pulmonary veins are treated (i.e., after the left upper pulmonary veins are freed, the lens is adjusted to the auxiliary operation hole, and a dissecting sealer is inserted through the thoracoscope-entering hole and used to staple and cut off the blood vessels). Next, the remaining upper lobar arteries, excluding the apical segmental artery and the anterior segmental artery are treated. Last, the left upper lobar apical segmental artery and anterior segmental artery are freed, and a dissecting sealer is inserted through the thoracoscope-entry hole and used to staple and cut off the blood vessels. The left upper lobar bronchus (including the lingular segmental bronchus) is freed. After the upper lobar bronchus is clipped using a dissecting sealer, the anesthetist is instructed to inflate the lung. After confirming that the lower lobe of the left lung has been well inflated, the upper lobar bronchus is clipped and cut off (whether to first treat the upper lobar apical segmental artery and anterior segmental artery or the upper lobar bronchus depends on their anatomical relationship and should also be based on safety and convenience). The lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. Groups 2L, 5, 6, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation hole on the anterior axillary line.

The resection of lingular segment of the left-lung upper lobe

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as

follows: an incision is made in the 8th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted through the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted through the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

First, the left upper-lobe lingular segmental veins are treated (i.e., after the left upper-lobe lingular segmental veins are freed, the lens is adjusted to the auxiliary operation hole, and a dissecting sealer is inserted through the thoracoscope-entry hole and used to staple and cut off the blood vessels). Next, the lingular segmental artery is treated. Last, the lingular segmental bronchus is freed. After the left upper-lobe lingular segmental bronchus is clipped using a dissecting sealer, the anesthetist is instructed to inflate the lung. After confirming that the proper upper and lower lobes of the left lung have both been well inflated, the lingular segmental bronchus is clipped, and the lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole.

The left-lung lower lobe resection and lymph node dissection

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as

follows: an incision is made in the 8th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted inside the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted inside the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

The selection of the operative procedure (single direction lobectomy or anatomical) is based on the state of development of the oblique fissure, as follows:

- (I) If no oblique fissure has developed, then the single direction lobectomy operative procedure is selected. First, the left lower pulmonary veins are treated. Next, the left lower-lobe bronchus is treated. Prior to stapling and cutting off the left lower-lobe bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper lobe of the left lung has been well inflated, the lower lobar bronchus is clipped and cut off. Then, the lower lobar proper artery and dorsal segmental artery are treated. After the group 11 lymph nodes inside the oblique fissure are dissected, the lung tissue in the undeveloped oblique fissure is treated. Mediastinal lymph nodes are routinely dissected;
- (II) If a pulmonic fissure has well developed, then the anatomical operative procedure is selected. First, the left lower pulmonary veins are treated. Next, the lower lobar proper artery and dorsal segmental artery are treated. After the group 11 lymph nodes inside the oblique fissure are dissected, the left lower-lobe bronchus is treated. Prior to stapling and cutting off the left lower-lobe bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper lobe of the left lung has been well inflated, the lower lobar bronchus is clipped and cut off. Groups 2L, 5, 6, 7, 8, 9, and 10 mediastinal

lymph nodes are routinely dissected.

The right-lung upper lobe resection and lymph node dissection

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as follows: an incision is made in the 8th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted through the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted through the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

The selection of the operative procedure (single direction lobectomy or anatomical) is based on the state of development of the oblique fissure, as follows:

- (I) If no oblique fissure has developed, then the single direction lobectomy operative procedure is selected. First, the right upper pulmonary veins are treated (i.e., after the right upper pulmonary veins are freed, the lens is adjusted to the auxiliary operation hole, and a dissecting sealer is inserted through the thoracoscope-entry hole and used to staple and cut off the blood vessels). Next, the right upper-lobe apical segmental artery and anterior segmental artery are treated simultaneously. Afterward, the right upper-lobe bronchus is freed. Prior to stapling and cutting off the upper lobar

bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the middle and lower lobes of the right lung have both been well inflated, the upper lobar bronchus is clipped and cut off. After the group 11 lymph nodes inside the oblique fissure are dissected, the pulmonary tissue in the undeveloped oblique fissure is treated along the levels of potential horizontal and oblique fissures. Groups 2R, 3, 4R, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation hole on the anterior axillary line;

- (II) If a pulmonic fissure has well developed, then the anatomical operative procedure is selected. First, the right upper pulmonary veins are treated (i.e., after the right upper pulmonary veins are freed, the lens is adjusted to the auxiliary operation hole, and a dissecting sealer is inserted through the thoracoscope-entry hole and used to staple and cut off the blood vessels). Next, the right upper-lobe apical segmental artery and anterior segmental artery are treated simultaneously. Afterward, the group 11 lymph nodes inside the oblique fissure are dissected. The right upper lobar bronchus is freed. Prior to stapling and cutting off the upper lobar bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the middle and lower lobes of the right lung have both been well inflated, the upper lobar bronchus is clipped and cut off. Groups 2R, 3, 4R, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected. The lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation hole on the anterior axillary line.

The right-lung middle lobe resection and lymph node dissection

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-

lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as follows: an incision is made in the 8th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted through the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted through the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

The selection of the operative procedure (single direction lobectomy or anatomical) is based on the state of development of the oblique fissure, as follows:

- (I) If neither oblique fissures nor horizontal fissures have developed, then the single direction lobectomy operative procedure is selected. First, the right middle pulmonary veins are treated (based on the intraoperative conditions, the lens can be adjusted to the auxiliary operation hole; a dissecting sealer is inserted through the thoracoscope-entering hole and can be used to staple and cut off the blood vessels). Next, the right middle-lobe bronchus is treated. Prior to stapling and cutting off the middle lobar bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper and lower lobes of the right lung have both been well inflated, the middle lobar bronchus is clipped and cut off (based on the intraoperative conditions, the lens can be adjusted to the auxiliary operation hole; a dissecting sealer is inserted through the thoracoscope-entering hole and used to staple and cut off the blood vessels). The middle lobar artery is then treated (based on the intraoperative conditions, the lens can be adjusted to the auxiliary operation hole; a dissecting sealer

is inserted through the thoracoscope-entry hole and can be used to staple and cut off the blood vessels). After the group 11 lymph nodes inside the oblique fissure are dissected, the pulmonary tissue in the undeveloped oblique fissure and horizontal fissure is treated. Groups 2R, 3, 4R, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected. The lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation hole on the anterior axillary line;

- (II) If a pulmonary fissure and a horizontal fissure have well developed, then the anatomical operative procedure is selected. First, the right middle lobar veins are treated (based on the intraoperative conditions, the lens can be adjusted to the auxiliary operation hole; a dissecting sealer is inserted through the thoracoscope-entry hole and can be used to staple and cut off the blood vessels). Next, the middle lobar artery is treated (based on the intraoperative conditions, the lens can be adjusted to the auxiliary operation hole; a dissecting sealer is inserted through the thoracoscope-entry hole and can be used to staple and cut off the blood vessels). Last, the right middle-lobe bronchus is treated. Prior to stapling and cutting off the right middle-lobe bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper and lower lobes of the right lung have both been well inflated, the middle lobar bronchus is clipped and cut off. Groups 2R, 3, 4R, 7, 8, 9, 10, and 11 mediastinal lymph nodes are routinely dissected. The lower pulmonary ligament is loosened so that it reaches the level of the lower pulmonary veins. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole, and another closed thoracic drainage tube is implanted through the operation hole on the anterior axillary line.

The right-lung lower lobe resection and lymph node dissection

Anesthesia, intubation, and posture

The operation is performed under general anesthesia with

double-lumen endotracheal intubation. The patient is placed in the lateral position on the unaffected side. Single-lung ventilation is performed on the unaffected side. The patient holds a pillow with both upper limbs flexed and is placed in the jackknife position.

Design of the hole positions

We use the “8-8-5-7” hole position design method, as follows: an incision is made in the 8th intercostal space on the posterior axillary line on the affected side. A trocar with a diameter of 12 mm is implanted through the incision, which is used as the thoracoscope-entry hole. In addition, two more incisions are also made: one in the 8th intercostal space on the infrascapular line and the other in the 5th intercostal space on the anterior axillary line. A trocar with a diameter of 8 mm is implanted through each incision, which is used as the instrument-entry hole, through which the arm of the instrument is connected. A 3-4-cm-long incision is made in the 7th intercostal space on the midaxillary line, and a disposable incision protector is implanted through the incision, which is used as the auxiliary operation hole.

Technical points of the operative procedure

The selection of the operative procedure (single direction lobectomy or anatomical) is based on the state of development of the oblique fissure, as follows:

- (I) If no oblique fissure has developed, then the single direction lobectomy operative procedure is selected. First, the right lower pulmonary veins are treated. Next, the right lower-lobe bronchus is treated. Prior to stapling and cutting off the right lower-lobe bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper and middle lobes of the right lung have been well inflated, the lower lobar bronchus is clipped and cut off. Then, the lower lobar proper artery and dorsal segmental artery are treated. After the group 11 lymph nodes inside the oblique fissure are dissected, the lung tissue in the undeveloped oblique fissure is treated. Groups 2R, 3, 4R, 7, 8, 9, and 10 mediastinal lymph nodes are routinely dissected;
- (II) If a pulmonal fissure has well developed, then the anatomical operative procedure is selected. First, the right lower pulmonary veins are treated. Next, the lower lobar proper artery and dorsal segmental artery are treated. After the group 11 lymph nodes inside

the oblique fissure are dissected, the right lower-lobe bronchus is treated. Prior to stapling and cutting off the lower lobar bronchus, the anesthetist must be instructed to inflate the lung. After confirming that the upper and middle lobes of the right lung have been well inflated, the lower lobar bronchus is clipped and cut off. Groups 2R, 3, 4R, 7, 8, 9, and

10 mediastinal lymph nodes are routinely dissected. One closed thoracic drainage tube is implanted through the thoracoscope-entry hole.

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