



Surgical treatment of invasive thymomas: which approach?

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Comment on: Fujiwara A, Funaki S, Ose N, *et al.* Surgical resection for advanced thymic malignancy with pulmonary hilar invasion using hemi-clamshell approach. *J Thorac Dis* 2018;10:6475-81.

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Surgery is the mainstay of treatment of thymic epithelial neoplasms (1). Complete removal of the tumor and involved lymph-nodes is the aim of surgical treatment. Manipulation of the tumor should be limited in order to prevent cell seeding, which may lead to loco-regional recurrence of the disease (2). The choice of the surgical approach has a major role in determining the success of treatment. The ideal approach should provide an adequate exposure of the surgical field in order to achieve complete tumor removal and avoid intraoperative complications. Control of the vascular anatomy and in particular of the pulmonary vessels is mandatory when the tumor extends to the pulmonary hilum and anatomic pulmonary resections are required to obtain complete treatment. An appropriate exposure of the pleural cavity and of the diaphragm may also be required to remove satellite neoplastic lesions. In case of giant thymomas the surgical approach should also allow mobilization of the tumor without causing compression on the heart and great vessels.

In the last decades mini-invasive video-assisted thoracoscopic surgery (VATS) and robot-assisted thoracoscopic surgery (RATS) approaches have been introduced in clinical practice in the surgical treatment of thymic tumors. Potential advantages of mini-invasive approaches include better postoperative and long-term pain control, lower impact on the respiratory function, shorter hospital stay and better aesthetic results. An increasing number of studies have reported favourable oncological results and limited morbidity with the use of VATS and RATS in Masaoka-Koga stage I and II tumors (3). However, the use of mini-invasive approaches in locally advanced thymic tumors has been rarely reported both

due to technical factors and to the concern of a potentially incomplete resection. Nevertheless, Agasthian described the use of a hybrid bilateral VATS approach in stage III thymic tumors involving the innominate vein and the pericardium with favourable results. However, major mediastinal or pulmonary involvement were not present in the study (4). In fact, although future technological improvement and specific expertise may lead in the future to a further development of mini-invasive hybrid techniques in the treatment in mediastinal tumors, at present open approaches are still to be considered the gold standard in the treatment of advanced stage thymomas.

Limitations for the use of mini-invasive approaches are particularly significant for tumors that involve the great vessels and pulmonary hilum, since in this setting mini-invasive approaches do not allow adequate visualization and mobilization of the tumor to obtain a safe and complete tumor removal, and open approaches are thus still required. Different surgical approaches have been proposed on the basis of tumor stage and size, topographical anatomy and surgeon preference and expertise. Median sternotomy is the standard approach in the treatment of thymic tumors, and allows an adequate exposure of the great vessels, but in case of bulky tumors or pulmonary hilar involvement, it may be inadequate. This is particularly true when large tumors impair visualization and control of the pulmonary hilum, especially on the left hemithorax, where the heart also limits visualization of the lower hilum. Associating a posterolateral thoracotomy to a median sternotomy may allow to overcome this limitation, but patient repositioning is required during surgery and this combined approach may be associated with significant postoperative pain

and respiratory impairment. Lateral decubitus during posterolateral thoracotomy may also determine compression of the heart and great vessels in case of large and heavy mediastinal masses. Other alternative approaches have been reported in the treatment of advanced thymic tumors. In particular, the antero-lateral thoracotomy has been used in the treatment of giant thymomas involving the lung, although this approach may not allow an adequate exposure of the posterior chest cavity (5). Conversely, the clamshell incision gives a superb exposure of the mediastinum and both chest cavities, but due to its invasiveness seems justified only when emergency control of the heart and great vessels is required due to massive bleeding (6).

The use of the hemi-clamshell incision, first described by Masaoka *et al.*, has been previously described in the surgical treatment of cervicothoracic and mediastinal lesions (7). Grillo reported the use of this approach in the treatment of lesions of the intrathoracic trachea, and other authors as Korst *et al.* also emphasized its role in the treatment of superior sulcus tumors (8,9). The hemi-clamshell approach consists of a partial median sternotomy prolonged in an antero-lateral thoracotomy, usually in the IV and V intercostal space. Division of the first rib cartilage may allow further cranial mobilization of the chest wall flap to improve exposure of the upper chest in case of involvement of the cervicothoracic junction. The incision may be extended to the neck when control of the cervical region is required. In a recent manuscript by Fujiwara *et al.*, the hemi-clamshell approach was used in a group of 14 patients who had advanced (stage III and IV) thymic tumors with an involvement of the pulmonary hilum, in whom anatomic pulmonary resection had been planned on the basis of the preoperative evaluation (10). A macroscopically complete surgical treatment was reached in 13 out of 14 patients, the majority of whom submitted to induction therapy, including seven patients with regionally disseminated tumors. This approach allowed to obtain a satisfactory exposure of the surgical field in all patients, and to perform a diaphragmatic plication in a subgroup of 8 patients with neoplastic involvement of the phrenic nerve. One important issue to be noted is that in 4 out of 14 patients the clamshell incision was performed by modifying a sternotomic approach. A major advantage of this incision is in fact the possibility of promptly converting a sternotomy or an anterolateral thoracotomy into the hemi-clamshell incision if additional surgical exposure is required during surgery. The potential disadvantages of the hemi-clamshell approach are, on the other hand, related to a potential impact on chest wall

mechanics and to the onset of flail chest and long-term postoperative pain, although these complications were not observed in the study by Fujiwara *et al.* Visualization of the posterior chest cavity may also be relatively limited with this approach, a point which may be solved by associating a videothoroscopic exploration.

Another important point to be taken into due account in the choice of the surgical approach concerns the accuracy of the preoperative evaluation, particularly focusing on the assessment of great vessel and pulmonary hilum neoplastic invasion. The current preoperative staging, based on computed tomography, magnetic resonance imaging and positron emission tomography (PET) scan, has a relatively high staging accuracy, but may have some limits in the evaluation of the vascular anatomy, particularly after induction oncological treatments, a point that may lead to an incorrect choice of the surgical approach (11). A preliminary videothoroscopic exploration may be useful in the search for pleural or diaphragmatic neoplastic implants, but has low accuracy in the evaluation of the direct involvement of the mediastinum and lung parenchyma, especially in case of large tumors. Due to these factors, the optimal surgical approach should be liable to be adapted during surgery according to the intraoperative findings, with the possibility of extending the surgical approach during the procedure. A preliminary VATS exploration may be useful in order to obtain more information concerning pleural dissemination. If only minor pulmonary involvement is expected, a sternotomy may be adequate to complete the surgical treatment. In case of more extensive disease with a possible involvement of the pulmonary hilum the hemi-clamshell approach may be a viable option, as a first choice when the preoperative assessment clearly demonstrates an extension to the pulmonary hilum, or by converting a partial sternotomy or antero-lateral thoracotomy once the intraoperative findings demonstrate major mediastinal or pulmonary involvement.

In conclusion, although a further development of hybrid VATS approaches may be expected in the future, at present open approaches are still required in the treatment of invasive thymic tumors in order to obtain complete and safe tumor removal. The hemi-clamshell incision is a useful option in case of tumors with a major mediastinal or pulmonary hilar involvement.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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