Robotic video-assisted lung resection

Purpose and target group
For surgical resection of suitable lung tumours

Speciality
Surgery

Technology type
Procedure

Setting
Tertiary Hospital

Stage of development in Australia

☐ Yet to emerge
☐ Experimental
☐ Investigational
☐ Nearly established
☐ Established
☐ Established but changed indication or modification of technique
☐ Should be taken out of use

Australian Therapeutic Goods Administration approval

☒ Yes
☐ No
☐ Not applicable

ARTG number: 97348 (2003)

International utilisation

<table>
<thead>
<tr>
<th>Country</th>
<th>Trials underway or completed</th>
<th>Level of use</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>United States (USA)</td>
<td>✓</td>
<td>✓*</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Korea</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* located on a number of hospital websites, ^ assumed

Impact summary

Intuitive Surgical (Sunnyvale, California) provides the da Vinci Surgical System with the aim of facilitating robotic video-assisted surgery for a number of surgical sub-specialties and indications (e.g., cardiac, urological and gynaecological surgeries). For robotic video-assisted thoracic surgery (RVATS) in particular, the technology would be made available through specially trained thoracic surgeons at tertiary surgical centres for patients with resectable lung tumours, particularly non-small cell lung cancer (NSCLC).
Background

Lung cancer is commonly categorised into two general categories according to histology: small cell lung cancer and NSCLC, the latter being subdivided into squamous cell carcinoma, adenocarcinoma and large cell carcinoma. Treatment differs between groups, as do survival rates. Surgical tumour removal provides the best chance of cure for early stage NSCLC in suitable patients, including procedures such as lobectomy (removal of lobe of the lung), partial resection (removal of a segment of the lung) and pneumonectomy (removal of the entire lung). \(^1\)

Recent clinical practice guidelines suggest that lobectomy (rather than pneumonectomy) is the standard of care for early stage NSCLC. \(^2,3\) Rather than open procedures, minimally invasive video-assisted surgery has become an option for surgery on smaller tumours due to lower morbidity and shorter hospital stays. \(^2\)

Robotic surgery allows for minimally invasive procedures using miniaturised surgical instruments mounted on robotic arms. The dominant manufacturer is Intuitive Surgical (Sunnyvale, California) with its da Vinci Surgical System, a device that has been marketed for over a decade. A 2008 publication reported that there were at least 400 United States (USA) medical centres with robotic surgery devices installed and that over 80,000 robotic surgery procedures had been performed. \(^4\)

State-of-the-art robotic and computer technologies translate the operator’s hand movements into precise micro-movements of the instruments. \(^5\) Robotic arms (generally four) are controlled by a surgeon working on a console in the operating room with two robotic arms controlled by each of the surgeon’s hands; placing his fingers into the master controls, the surgeon is able to operate all four arms of the da Vinci simultaneously (Figure 1). One robotic arm includes a magnified high-definition 3-D camera that guides the surgeon during the procedure. Every movement the surgeon makes with the master controls is replicated precisely by the robot – the system cannot be programmed and it cannot make decisions on its own. A bedside surgical assistant (generally a second surgeon) is currently also required.

The minimally invasive nature of the procedures means there is less trauma to the body, minimal scarring and faster recovery time. \(^6\) Also, compared with video-assisted thoracic surgery (VATS), the three-dimensional visual system allows for binocular vision plus instrumentation capable of seven degrees of freedom enabling wristed movement for dissection. \(^7,8\)
Clinical need and burden of disease

A 2011 Australian Institute of Health and Welfare (AIHW) report on lung cancer provides useful information. In 2007, lung cancer was the fourth most commonly diagnosed cancer (excluding basal and squamous cell carcinoma of the skin for which data was not collected) with nearly 10,000 cases reported (5,948 males, 3,755 females). It is the leading cause of cancer deaths for both sexes, accounting for 21 per cent of all cancer deaths in males and 17 per cent in females. Disease incidence increases with age, with 84 per cent of new lung cancers in males and 80 per cent in females diagnosed at age 60 years and over. From 1982 to 2007, incidence decreased by 32 per cent in males but increased by 72 per cent in females, reflecting patterns of smoking behaviour. The prognosis is poor and has not improved over the past 25 years: five-year relative survival was 11 per cent for males and 15 per cent for females in 2000–2007, compared with 8 per cent for males and 10 per cent for females in 1982–1987.

Lung cancer is estimated to be the fourth leading cause of the burden of disease for males and the seventh for females, and first among males and second among females as a cause of the burden of disease due to cancer. The burden of disease is estimated to be 57,100 disability-adjusted life years for males and 42,300 for females, and it is estimated that the burden of disease due to lung cancer will be concentrated in those aged 50 to 89 years.

In Australia, numbers of procedures (public and private) in 2008–09 were: lobectomy, 954; partial resection, 701; pneumonectomy, 137; and other procedures on lung or pleura, 22. This equalled 1,814 total surgical procedures for lung cancer. Total overnight lung cancer-related hospitalisations were 15,189.

With respect to estimated costs (2004–05), the 2011 AIHW document reports that total expenditure on lung cancer was $166 million with 80 per cent spent on hospital-admitted patient services ($131 million); costs specific to surgery were not
reported. Total expenditure on lung cancer grew by 33 per cent from $125 to $166 million over the 5 years from 2000–01 to 2004–05.\textsuperscript{1}

**Diffusion of technology in Australia**

The da Vinci Surgery System received ARTG approval in 2003 as a Medical Device Class IIb, sponsored by Device Technologies Australia Pty Ltd. The ARTG intended purpose is ‘to assist in the control of endoscopic instruments for various surgical procedures’. In 2003, the Epworth Richmond Hospital in Melbourne was the first Australian hospital to have a da Vinci Surgical System installed. The system has since been installed in 11 other hospitals around Australia, including three public hospitals, the Royal Adelaide Hospital (SA), the Peter MacCallum Cancer Centre (VIC) and the Royal Brisbane and Women’s Hospital (QLD).

Three private hospitals in New Zealand additionally have the system installed, the MercyAscot Hospital (Auckland), Grace Hospital (Tauranga) and Southern Cross Hospital (Christchurch).\textsuperscript{10} Indications for use are typically for assistance in urological, cardiac, and gynaecological procedures, and there is no indication that the technology is being used in thoracic indications in either Australia or New Zealand.

**Comparators**

The traditional surgery for resectable lung lesions is open thoracotomy, a major surgical procedure involving a 20+ cm incision, sternotomy or rib retraction, and prolonged recovery of up to 12 weeks.\textsuperscript{11} A more recent alternative, and direct comparator to RVATS, is minimally invasive video-assisted thoracic surgery (VATS). Studies have demonstrated benefits of VATS over thoracotomy, such as decreases in length of stay, postoperative pain and complications. Uptake of VATS has been slow due to technical issues such as two-dimensional imaging and limited manoeuvrability of instrumentation, lack of adequate training and concerns about the consequences of major vascular injury with a closed chest approach.\textsuperscript{7, 8, 12}

**Safety and effectiveness**

Reviewed for this brief were: a systematic review including nine studies that reported on RVATS\textsuperscript{13} and a subsequent primary case-control analysis from the USA.\textsuperscript{14} Additional detail is included here from a multi-centre registry study of long-term oncologic results for 325 patients;\textsuperscript{8} these data were included in the systematic review but the large size of the registry study renders it worthy of additional description.
Cao et al\textsuperscript{13}

\textbf{Study description}

Researchers from Sydney, Australia (The Baird Institute for Applied Heart and Lung Surgical Research), performed a systematic review that focused on the use of RVATS for pulmonary resections; the authors declared they had no conflicts of interest for this research. Five databases were searched up to March 2012 with an English language limitation. Ultimately, nine studies (all retrospective observational studies) were included, reporting on 941 patients from 12 institutions.

The authors observed that all surgeons used the da Vinci Surgical System, the mean patient age was approximately 67 (range 16–92 years) and gender proportion was similar. The majority of patients had a pre-operative histological diagnosis of primary NSCLC with early clinical staging; most resections were lobectomies but there were some bi-lobe resections, pneumonectomies, sleeve lobectomies, segmentectomies and wedge resections.

\begin{table}[h]
\centering
\begin{tabular}{llllll}
\hline
Authors          & Year & Country     & N     & Study period & Patients with NSCLC & Length of follow-up  \\
\hline
Park et al       & 2012 & USA & Italy & 325         & 2002-2012          & 325 / 325          & 27 months      \\
Augustin et al   & 2011 & Austria & 26    & NR          & 2002-2012          & 24 / 26          & 27 months      \\
Fortes et al     & 2011 & USA & 23    & 2008-2010  & 16 / 23            & 2002-2012        & 27 months      \\
Giulianotti et al& 2010 & USA & Italy & 38         & 2001-2009          & 38              & 2002-2012        & 60 months      \\
Gharagozloo et al& 2009 & USA & 100   & 2004-2008  & 100 / 100          & 2002-2012        & 32 months      \\
\hline
\textbf{TOTAL} & & & 941 & & & & \\
\end{tabular}
\end{table}

\begin{footnotesize}
\textsuperscript{13} N = number of patients, NSCLC = Non-small-cell lung cancer, NR = Not reported.
\end{footnotesize}

\textbf{Safety}

Among the nine included studies, the perioperative mortality rates ranged from 0 to 4 per cent. Major morbidity rates were 0 to 5 per cent in three studies with overall morbidity rates ranging from 10 to 39 per cent. The most commonly reported postoperative complications were tachyarrhythmias (3–19%), prolonged air leak (4–13%), pneumonia (1–5%) and acute respiratory distress (1–4%).

Additionally, across the nine studies conversion rates from RVATS to open thoracotomy ranged from 0 to 19 per cent, the mean operating time had a range of 132 to 238 minutes, blood loss ranged from 30 to 219 mL (maximum 2000 mL) and
the median length of hospital was between 2 and 11 days. The duration of chest drainage had a range of 1.5 to 7 days.

The included study from Korea\textsuperscript{15} was comparative (for one surgeon), assessing results for 40 RVATS patients compared to those of 40 patients who underwent conventional VATS prior to the introduction of the RVATS procedure and 40 patients who underwent conventional VATS after two years of RVATS experience. Results showed fewer complications, shorter hospital stays and lower conversion rates for RVATS versus the pre-RVATS group, but similar results post-RVATS.

**Effectiveness**

The systematic review examined long-term survival and disease recurrence rates for the patients with NSCLC in the subset of included studies reporting these data (Table 2).

### Table 2  Long-term outcomes for patients with NSCLC\textsuperscript{13}

<table>
<thead>
<tr>
<th>Authors</th>
<th>N</th>
<th>5-yr survival</th>
<th>Overall recurrence</th>
<th>Local recurrence</th>
<th>Systemic recurrence</th>
<th>Local &amp; systemic recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Park et al 2012</td>
<td>325</td>
<td>80%</td>
<td>9.8%</td>
<td>2.8%</td>
<td>5.2%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Augustin et al 2011</td>
<td>26</td>
<td>63.6%</td>
<td>7.7%</td>
<td>3.8%</td>
<td>0%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Cerfolio et al 2011</td>
<td>168</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Dylewski et al 2011</td>
<td>200</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Fortes et al 2011</td>
<td>23</td>
<td>NR</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Jang et al 2011</td>
<td>40</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Giulianotti et al 2010</td>
<td>38</td>
<td>71.4%</td>
<td>4.8%</td>
<td>0%</td>
<td>4.8%</td>
<td>NR</td>
</tr>
<tr>
<td>Gharagozloo et al 2009</td>
<td>100</td>
<td>NR</td>
<td>6%</td>
<td>0%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Anderson et al 2007</td>
<td>21</td>
<td>NR</td>
<td>NR</td>
<td>0%</td>
<td>NR</td>
<td>NR</td>
</tr>
</tbody>
</table>

\(N = \text{number of patients, NSCLC} = \text{Non-small-cell lung cancer, NR} = \text{Not reported.}\)

Table 2 shows, only three studies presented data on 5-year survival for patients with NSCLC; this ranged from 64 to 80 per cent. It was noted that an included study with shorter median follow-up of 32 months\textsuperscript{16} reported 99 per cent overall survival. Overall cancer recurrence ranged from about 0 to 10 per cent including, at the time of the latest follow-up, approximately 0 to 4 per cent local recurrence, 0 to 6 per cent systemic recurrence, and 0 to 4 per cent for both local and systemic recurrence.

Quality of life (QoL) was assessed in one included study\textsuperscript{17} for the 106 patients with NSCLC who successfully underwent RVATS lobectomy versus 318 patients who underwent rib- and nerve-sparing thoracotomy. Assessment was via the 12-item Short Form Health Survey. Results showed a significantly higher mental QoL score for the RVATS cohort (54 vs 40, \(p<0.001\)) and a similar trend favouring RVATS for physical QoL score three weeks postoperatively (40 vs 34, \(p=0.07\)). However, results
were similar between groups four months postoperatively. Supplemental questions about postoperative analgesic control at three weeks show pain scores to be lower in the RVATS group (2.5 vs 4.4 [maximum score 10], \( p=0.04 \)). There may have been potential for reporting bias, as patients were told RVATS was a ‘new and less invasive’ technique.

**Park et al**

**Study description**

One study included in the systematic review contributed more than one-third of the patients (n=325) with some long-term follow-up. It is therefore discussed independently here as well.\(^8\) The author of the study is a speaker and proctor for the manufacturer of the da Vinci device, Intuitive Surgical.

The multi-centre retrospective registry contains prospectively collected data from three of the main centres performing RVATS – one in New York and two in Italy – starting in late 2002. Three surgeons were involved.

Eligible patients had biopsy-proven or suspected primary NSCLC isolated to the chest. Preoperative characteristics, operative details, hospital course, pathologic findings and postoperative follow-up were recorded and analysed.

Information about the patients and procedures:

- Male = 63 per cent; current or former smokers = 85 per cent
- Surgery: upper lobectomy = 51 per cent, lower lobectomy = 40 per cent
- Type of cancer: adenocarcinoma = 73 per cent
- Median operative time = 206 minutes (range 110–383 minutes)
- Median chest tube duration = 3 days (range 1–23 days)
- Median length of stay = 5 days (range 2–28 days)
- Pathological stage (patients): IA = 176, IB = 72, II = 54, III = 20

**Safety**

No intraoperative deaths occurred; one patient who developed acute renal insufficiency followed by a pulmonary embolism died postoperatively (day 12). Overall morbidity was 25 per cent (82 patients) and major complications occurred in 4 per cent (12 patients). Major complications were bronchopleural fistula (n=2), pulmonary embolism (n=3), acute renal insufficiency (n=3), haemorrhage (n=2) and myocardial infarction (n=2). Supraventricular tachycardia was the most common postoperative complication, occurring in 37 patients (11%).

**Effectiveness**

Survival at one, two, three and five years was 98, 93, 88 and 80 per cent respectively. Overall five-year survival according to clinical stage IA, Ib, II and III was 91, 88, 49 and
0 per cent, respectively. The author commented that ‘the overall and stage-specific survivals are consistent with both the largest series of VATS lobectomies and the most recent data used for the revisions to the lung cancer staging system’ but acknowledged that a comparative study arm would be desirable. Data on other clinical outcomes are not collected, for example, postoperative pain, respiratory function, rates of post-thoracoscopy pain and quality of life (a limitation admitted by the author).

**Louie et al**

**Study description**

In Seattle, Washington, a recent case control study (level III-3 intervention evidence) compared initial experience with RVATS (the da Vinci Surgical System) to a group of their most recent patients receiving VATS for lung resections.\(^{14}\) Two of the four study authors disclosed a financial relationship with the device manufacturer.

Data for consecutive patients receiving RVATS (n=52) were collected prospectively (time span 2009–2011) and compared with retrospective data from chart review for patients receiving VATS (n=35). A total of 52 resections using RVATS were attempted of which 46 were included in the analysis, three underwent conversion to open thoracotomy and three were excluded for unknown reasons. In the VATS group there were 35 resections attempted, of those patients one underwent conversion to open thoracotomy and this patient appears to have been excluded from the analysis. All study results are reported using a per protocol analysis rather than an intent-to-treat analysis with a denominator of 46 in the RVATS group and 34 in the VATS group. For RVATS, lung resection was primarily for Stage I or II NSCLC, but also solitary pulmonary metastases and benign lung conditions, e.g. bronchiectasis, congenital malformations, and localised fungal infections. Morbidity and mortality were graded and classified using definitions validated for thoracic surgery and lobectomy.

**Safety**

Major complications occurred at similar rates in the two groups: 8 patients (17%) versus 5 patients (15%) for RVATS versus VATS. The complications (the majority of which occurred in only one patient) included acute renal failure, respiratory failure, postoperative hemorrhage, pleural effusion, bronchopleural fistula, ankle fracture. Minor morbidities (atrial fibrillation, pneumonia, ileus, lobar collapse and urinary tract infection) occurred in 12 patients (26%) versus 7 (21%) of the RVATS and VATS groups, respectively. Prolonged air leaks were similar between the groups, although all of the robotic air leaks occurred early in the experience while teams were becoming familiar with the robotic ‘touch’.
**Effectiveness**

Clinical outcomes did not differ significantly between groups (Table 3) except that patients undergoing RVATS demonstrated a shorter duration of narcotic use after discharge ($p=0.04$) and an earlier return to work or usual activities ($p=0.003$). It was noted that patients were counselled regarding narcotic use and resumption of activities by two nurse practitioners who were not blinded to procedure.

**Table 3  Clinical outcomes reported in Louie et al**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>RVATS</th>
<th>VATS</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumour or lesion size (cm), median (range)</td>
<td>2.8 (0.9–7.2)</td>
<td>2.3 (0.9–4.9)</td>
<td>0.07</td>
</tr>
<tr>
<td>Operative time (minutes)</td>
<td>213</td>
<td>207</td>
<td>0.61</td>
</tr>
<tr>
<td>Length of stay (days), median (range)</td>
<td>4.0 (2–21)</td>
<td>4.5 (2–22)</td>
<td>0.63</td>
</tr>
<tr>
<td>ICU stay (days)</td>
<td>0.92</td>
<td>0.64</td>
<td>0.43</td>
</tr>
<tr>
<td>Estimated blood loss (mL)</td>
<td>153</td>
<td>134</td>
<td>0.36</td>
</tr>
</tbody>
</table>

RAVTS = robotic video-assisted thoracic surgery, VATS = video-assisted thoracic surgery

**Cost impact**

Only one cost analysis was located, this being several years old and outside of the Australian context, however may be indicative of costs to the local context.\(^{18}\)

Compared in a retrospective analysis were RVATS ($n=12$), conventional VATS ($n=87$) and open thoracotomy\(^1\) ($n=269$) for lobectomy at an institution in New Jersey, USA. Direct and indirect costs included average hospitalisation costs plus surgeon fees. Results showed that RVATS was almost $4,000 more costly than conventional VATS but also about $4,000 cheaper than open thoracotomy. After taking into account the amortised cost of employing the robot for each case, an additional $1,715 was required for each patient who underwent RVATS. The additional cost of RVATS versus conventional VATS occurred almost exclusively on the first day of hospitalisation – suggested reasons were additional robotic-related equipment required and increased likelihood of performing additional procedures such as bronchoscopy. The main factor in reducing the costs of VATS and RVATS compared to thoracotomy was the reduced length of hospitalisation.

The lead author of the above analysis, Dr Bernard Parks, recently issued an opinion on RVATS economics.\(^{19}\) He noted that two costs unique to RVATS (versus the comparator procedures) require consideration:

- Direct operating room (OR) costs for increased system setup time and increased operative time will likely decrease with refinement in techniques and increasing surgeon and team experience.

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\(^1\) An historical comparison of RVATS to open thoracotomy patients is likely to be comparing a different population of patients, which is likely to be reflected in effectiveness outcomes and therefore any cost analysis performed.
Costs of amortisation of the equipment are based on a large number of assumptions and therefore assigning a fixed additional amortised cost is ‘inaccurate’, for example, for the duration of use of a particular system (versus upgrades or replacements), total service costs, total capital costs and total number of cases.

Parks suggested two benefits to RVATS that also require thought: increased RVATS use could increase a hospital’s ‘market share’ (particularly important in a private health care system); and uptake of RVATS could encourage wider implementation of a potentially more cost-effective alternative, that is, minimally invasive lung resection instead of thoracotomy. He commented that ideally a cost-effectiveness analysis is required although clinical outcomes data are only available from low quality studies (case series).

Other considerations which impact on the costs associated with RVATS include increased operating room (OR) set-up times and increased operative times associated with the surgical learning curve. The cost of training staff to use the system should also be considered. While the price of the da Vinci device in Australia has not been publicly reported, reports in the popular media estimate a $3 million figure.\(^2\) The lifespan of the device may be demonstrated by one robot used in the public system that has assisted on more than 1,500 procedures since installation in 2004 and will soon require replacement.\(^2\) Other associated costs with the device are 10 per cent annual service contract costs, with reportedly high software costs and replacement of instruments used with the device after 10 to 20 uses.\(^4\,17\)

**Ethical, cultural or religious considerations**

Access to surgeons and surgical lists in the public sector may be a limiting factor, particularly given that the device is available publicly in three states only for assistance in other indications.

**Other issues**

A steep learning curve is associated with use of the procedure; standardised training and credentialing for surgeons or surgical teams have been suggested.\(^17\)

Anaesthesiologists must understand the ramifications of robotically-assisted surgery on anaesthetic management, for example, patient positioning (no changes once the robot is docked), duration of the procedure, development of hypothermia, haemodynamic and respiratory effects of the pneumoperitoneum, and occult blood loss.\(^4\)

Additional innovations to ease the work for the surgeon are being introduced for the da Vinci system: a robotic stapler to replace the need for staple insertion by a bedside assistant; a robotic vessel sealer that will allow the surgeon to go through
the fissure to seal and cut small pulmonary arteries and veins less than 7 mm and to seal the base of lymph nodes; a robotic suction irrigator; and a special robotic camera to allow fluorescence of tissue.\textsuperscript{17}

In addition to high prices, other disadvantages of the RVATS paradigm include:

- Bulky equipment that requires large amounts of precious OR space (not feasible for use in smaller or older ORs).
- Robot size: positioning of the robotic arms is extremely important in order to avoid collision with its own arms, assistants and/or the patient.
- Invasion of the anaesthetic work space, possibly impairing emergency access to the patient. Staff must be trained and prepared to quickly detach and remove the robot from the patient in the event of an emergency.
- Patients must be correctly positioned for surgery from the start since repositioning is almost impossible once the robot has been stationed.
- Current robotic systems lack tactile feedback from the instruments; surgeons must rely solely on visual cues to avoid organ damage.\textsuperscript{4}

Expert surgical care for rural and underserved communities may one day be realised with tele-robotic surgery; a successful remote robotic-assisted laparoscopic cholecystectomy was performed on a patient in Germany while the surgeons were 14000 km away in New York.\textsuperscript{4}

**Summary of findings**

RVATS for the surgical treatment of suitable lung lesions appears to be at least as safe as the surgical alternatives, VATS and open thoracotomy. However, effectiveness data are primarily based on limited observational studies. While the da Vinci device is currently available worldwide, assistance in thoracic procedures has been reported in only a few centres, primarily in the USA and Italy. There is a significant learning curve for surgeons and costs are a concern. The observation to date is that RVATS is cost-saving as compared with open thoracotomy (primarily due to reduced hospital stay) but more costly than VATS; however, some of the technical limitations of VATS have been overcome with RVATS.

**HealthPACT assessment**

Based on the limited availability of high quality comparative clinical and economic evidence, the HealthPACT recommended that the technology be monitored for 36 months.

**Number of studies included**

All evidence included for assessment in this Technology Brief has been assessed according to the revised NHMRC levels of evidence. A document summarising these levels may be accessed via the HealthPACT web site: [HealthPACT web site](#).
Total number of studies 3
Total number of level III-3 studies 2
Total number of Level IV studies 1

References


**Search criteria to be used**

Robotics/methods, robotics*, lung resection, Lung Neoplasms/surgery*