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Published in:
European Journal of Cardio-Thoracic Surgery

DOI:
10.1093/ejcts/ezz064

Publication date:
2019

Document version:
Accepted manuscript

Citation for published version (APA):
Bendixen, M., Kronborg, C., Jørgensen, O. D., Andersen, C., & Licht, P. B. (2019). Cost-utility analysis of minimally invasive surgery for lung cancer: a randomized controlled trial. *European Journal of Cardio-Thoracic Surgery*, 56(4), 754-761. <https://doi.org/10.1093/ejcts/ezz064>

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1 **Cost Utility Analysis of Minimally Invasive Surgery for Lung Cancer: A randomised controlled trial.**

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12 Trial registered at www.Clinicaltrials.gov (NCT01278888)

13 Word count: 5196.

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1 **Visual Abstract**

2

3 **Key question**

4 Is lobectomy by video-assisted thoracoscopic surgery cost-effective compared with thoracotomy?

5

6 **Key findings**

7 VATS lobectomy resulted in lower costs and better Quality Adjusted Life Years

8

9 **Take-home message**

10 Lobectomy by VATS is cost-effective compared with thoracotomy.

11

12

1 **Summary**

2

3 **Background**

4 Minimally invasive video assisted thoracic surgery (VATS) was first introduced in the early 1990's. For
5 decades numerous non-randomized studies demonstrated advantages of VATS over thoracotomy with lower
6 morbidity and shorter hospital stay but only recently did a randomized trial document that VATS result in
7 lower pain scores and better quality of life. Opposing arguments for VATS have always been increased costs
8 and concerns about oncological adequacy. In this paper we aim to investigate cost-effectiveness of VATS.

9

10 **Methods**

11 The study was designed as a cost-utility analysis of the first twelve months following surgery and was
12 performed together with a clinical randomized controlled trial of VATS versus thoracotomy for lobectomy of
13 stage 1 lung cancer during a six-year period (2008-2014). All health related expenses were retrieved from a
14 national database (Statistics Denmark) including hospital readmissions, out-patient clinic visits, prescription
15 medication costs, consultations with general practitioners, specialists , physiotherapists, psychologists, and
16 chiropractors.

17

18 **Results**

19 One hundred and three VATS patients and 103 thoracotomy patients were randomized. Mean costs per
20 patient operated by VATS were 103108 Danish kroner (Dkr) (€ 13818) and 134945 Dkr (€ 18085) by
21 thoracotomy, making the costs for VATS 31837 Dkr (€ 4267) lower than thoracotomy ($p<0.001$). The
22 difference in Quality Adjusted Life Years (QALY) gained over 52 weeks of follow-up was 0.021 ($p=0.048$,
23 95% CI -0.04 to -0.00015,) in favour of VATS. The median duration of the surgical procedure was shorter
24 after thoracotomy (79 versus 100 minutes; $p<0.001$). The mean length of hospitalization was shorter
25 following VATS (4.8 vs. 6.7 days; $p=0.027$). The use of other resources was not significantly different
26 between groups.

27 The costs of resources were lower in the VATS group. This difference was primarily due to reduced costs of
28 readmissions (VATS 29247 Dkr. vs. Thoracotomy 51734 Dkr; $p<0.001$) and costs of outpatient visits
29 (VATS 51412 Dkr vs. Thoracotomy 61575 Dkr; $p=0.012$).

1

2 **Conclusion**

3 VATS is a cost-effective alternative to thoracotomy following lobectomy for stage 1 lung cancer.

4 Economical outcomes as measured by QALYs were significant better and overall costs were lower for

5 VATS.

6

1 **Keywords**

2 Cost-utility analysis, lung cancer, surgery, VATS, thoracotomy,

1 **Introduction**

2 Patients with stage 1 non-small cell lung cancer (NSCLC) are best treated surgically by lobectomy [1].
3 Surgical approach varies between thoracotomy and video-assisted thoracoscopic surgery (VATS). Although
4 thoracotomy is still the most widely used approach, VATS has been increasingly used over the last two
5 decades because it is claimed to be less invasive and subsequently causes less postoperative morbidity.
6 Opposing arguments against VATS are the costs and oncologically adequacy of the procedure [2, 3].
7 Numerous studies have compared the two techniques but the vast majority are observational or non-
8 randomised studies with subsequent risks of selection bias. Only five small randomised controlled trials
9 (RCT) have been conducted in the last 25 years[3-8]. Kirby et al. showed fewer complications after VATS,
10 but no difference in pain or length of stay in hospital[3]. In a Japanese population Sugi et al. found similar 5-
11 year survival rates between VATS and thoracotomy [4]. Leaver et al. showed in a Scottish population a
12 significantly lower cytokine level after VATS compared with thoracotomy which suggested a lower surgical
13 stress-response[5]. Long et al. showed, in two papers from the same population, a significantly better quality
14 of life and lower pain levels following VATS compared to thoracotomy[6, 7]. In the largest and most recent
15 trial[8] we found that patients who underwent VATS lobectomy had significantly lower postoperative pain
16 and better self reported quality of life during the first year after surgery compared with anterolateral
17 thoracotomy[8]. This suggests that VATS should be the preferred surgical approach for lobectomy in stage 1
18 NSCLC.

19 Costs of VATS compared with open surgery have been analysed in two studies [9, 10]. None
20 of these, however, include a full economic evaluation in which both costs and benefits of the two alternatives
21 were compared. Thus, it remains unknown whether VATS is a cost-effective treatment alternative for
22 patients with NSCLC. The aim of this study was to determine the cost-effectiveness of VATS compared to
23 thoracotomy by reporting on an economic evaluation that was conducted alongside the fore mentioned
24 patient-observer blinded randomised controlled trial that compared VATS with anterior thoracotomy for
25 stage 1 NSCLC [8].

26
27

1 **Methods**

2 The study was designed as a cost-utility analysis and used data collected as an integrated part of a previously
3 published trial [8]. Briefly, the trial was performed at Odense University Hospital, Department of
4 Cardiothoracic and Vascular Surgery, Denmark during a six-year period (2008 - 2014). Following informed
5 consent, a total of 206 eligible patients with stage 1 NSCLC were randomised 1:1 between VATS and
6 anterior thoracotomy. We used a 4-port VATS technique as described by McKenna et al.[2] The four
7 specialist surgeons were all experts in both VATS and open lobectomy and the staff in the operating theatre
8 were the only ones aware of the surgical technique used. Patients, nurses and doctors in the ward were
9 blinded to this information, we used identical surgical dressings in all patients. The surgeon was allowed to
10 see the patient, but not allowed to make any clinical decisions regarding pain management, chest-drain
11 removal or time of discharge. Both groups received identical follow-up procedures in the surgical out-patient
12 clinic.

13 This trial was approved by the local ethical committee (reference id s-20080085) and the Danish Data
14 Protection Agency (journal number 18/33565), and registered at www.Clinicaltrials.gov (NCT01278888).

15
16 **Overview of the cost-utility analysis**

17 The cost-utility analysis compared the costs and outcomes associated with VATS versus thoracotomy. The
18 outcome measure was quality-adjusted life-years (QALYs) that combine quality of life and length of life.

19 The perspective of the analysis was that of the Danish health care sector.

20 Costs were calculated in 2010 Danish Kroners (DKK). Conversion to Euros (€) was done with an exchange
21 rate of 7,4617 (December 5th 2018). The time horizon was one year, which was the same as that of the trial.

22 Extrapolation beyond one year was not undertaken because the trial was designed as a one-year follow-up
23 after surgery.

24 Since the time horizon was one year, discounting was unnecessary except for the calculation of the cost of
25 the VATS equipment.

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1 **Quality-of-life and quality-adjusted life-years**

2 To estimate quality-adjusted life-years (QALYs) we used the three level EuroQol questionnaire (EQ-5D-3L)
3 to collect information about the patients' quality of life at baseline prior to surgery, and after 2, 4, 8, 12, 26,
4 and 52 weeks postoperatively.

5 EQ-5D-3L is a generic quality of life questionnaire that comprises five questions, each with three possible
6 answers. The five questions refer to various dimensions of health-related quality of life: mobility, self-care,
7 usual activities, pain, and anxiety/depression, respectively. Each question is answered with either "no
8 problems", "some problems", or "severe problems". [11] [12] In this way the EQ-5D-3L described the
9 patient's health state at a particular point in time.

10 In order to obtain a measure for the quality of life, each EQ-5D-3L health state was assigned a single index
11 score anchored at 0 for a state equivalent to being dead. The maximum index score is 1 for full health. The
12 index score is less than 0 for health states regarded as worse than being dead [12-14]. The index score is
13 calculated using a formula that attaches weights to each of the levels in each dimension based on valuations
14 by the general Danish population [14]. The Danish valuation set is based on the time trade-off technique
15 [14].

16 Based on all seven quality of life scores, each patient's health profile was determined assuming a linear
17 relation between each data point assuming a straight-line relation. QALYs for each patient were calculated as
18 the area under the health profile curve.

19 The EQ-5D-3L questionnaires were sent by mail to the patients during the follow-up period
20 Details on the quality of life aspects of this study, other than the QALY's used for this cost-utility analysis,
21 are reported elsewhere[8].

22

23 **Costs**

24 Costs were defined as use of any resource item multiplied by a unit cost. We used a marginal cost concept.
25 That is, we limited the cost measurement to resource items that differed between the two procedures whereas
26 costs that were unaffected by treatment procedure were not included in the analysis. The latter included
27 administrative costs, buildings, electricity, heating, and water.

28 For each patient, we calculated the cost of surgery, inpatient hospital stays and outpatient hospital visits,
29 consultations with general practitioners, and use of prescription drugs during 52 weeks following surgery.

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1 The surgical time use was based on all 206 randomised patients individually, Length of stay was counted
2 from date of surgery to discharge on all randomised patients.
3 Information on the use of healthcare after discharge was collected from the Danish National Patient
4 Register[15], The National Health Service Register and The Danish National Prescription Registry[16], all
5 administered by Statistics Denmark. Information was retrieved from 12 months prior to surgery and for the
6 entire observational period (2008 - 2015). The information retrieved from the Danish National Patient
7 Register was readmissions to hospital including date of admission, length of stay, admission diagnosis and
8 allocated diagnosis-related-group (DRG) tariff. For the out-patient clinic visits the date, type of contact
9 (phone consultation, standard consultation, cancer related consultation, administration of out-patient
10 treatment, blood tests, same-day surgery) and DAGS-tariff were acquired. From the National Health Service
11 Register the date of contact, type of contact (general practitioner, physiotherapist, psychologist,
12 chiropractor), and the overall price for the visit were acquired. The Register of Medicinal Product Statistics
13 included information about the date of purchase, type of medicine (ATC-codes), and cost for the contact.
14

15 *Unit Costs.*

16 Resources used during surgery were based on a standard surgical setup. This included two scrub-nurses, two
17 surgeons, one anaesthesia-nurse, and one anaesthesiologist. Identical anaesthesia procedure was used for
18 both surgical techniques. To estimate the unit cost of the two surgical procedures, we collected data on
19 resource use during all lobectomy procedures, both VATS and thoracotomy, during a period of 16 weeks in
20 2008. The scrub-nurses registered information on time use of staff before, during and after the surgical
21 procedure, consumables and operating rooms. The surgeons were not aware of registration. Information
22 included number of scrub-nurses, operation time, time the patient spent in the operating theatre, re-usable
23 utilities, single-use utilities including swaps, sutures, dressings, cover sheets, staplers, chest tubes,
24 containers, etc. Use of dressings was identical in the two groups as the study was blinded for patients and
25 ward staff. Unit cost was also reported from the hospital's finance department. Equipment and surgical
26 instrument prices were given by the manufacture as purchase offer, or from the hospital department's
27 economic administrator. Staff costs were obtained from the hospital's finance department, as average hourly
28 salary. Expenses were recorded during 10 consecutive interventions with each surgical technique and
29 calculated average costs for each surgical procedure.

1 Estimation of true cost of the endoscopes used for the VATS-technique was calculated by
2 recording the total number of procedures the equipment was used for divided by total numbers of
3 procedures. This gave a unit cost for the equipment. The equipment was not only used for VATS
4 lobectomies alone.

5 For all reusable surgical instruments we estimated a unit cost pr. procedure for the
6 instruments. For this we used information on purchase prices, given by the manufacturer. This was given as a
7 price for each individual instrument in each container. We used two different instrument container systems,
8 either a VATS container or a thoracotomy container. Repairs and maintenance expenses were divided
9 between total number of procedures the instruments and equipment were used for. Life expectancy of
10 instruments and equipment was taken into account to estimate an equivalent annual cost for equipment [17].

11 We used a discount rate of 5%. Life expectancy was estimated to 5 years for endoscopes, 10 years for video-
12 equipment for endoscopes, and 25 years for surgical instruments. Sensitivity analyses was performed with
13 discounting rates of 0%, 3% and 5% and life expectancies of 2, 5, 7, 10, 15, 20, and 25 years.

14 Costs of consultations with general practitioners, specialist consultant, physiotherapy, psychologist, and
15 chiropractor were defined as expenses the Regional provider had with each contact to the healthcare system.

16 Costs of readmissions were obtained from the diagnosis-related-group tariff associated with the admission.

17 For out-patient clinics a similar system (DAGS-tariff) was used and provided the costs for each visit.

18 Medicine costs were based on the listed market prices according to The Register of Medicinal Product
19 Statistics.

21 **Statistical analysis.**

22 We used STATA (release 10.0, StataCorp, TX, USA) for all statistical analysis. All data was analysed
23 according to the intention to treat principle. Follow up ran from randomisation to either death or end of
24 follow up.

25 Sample size was determined to being able to detect a 20% difference in pain between the two
26 groups. With a power (β) of 0.8 and a 5% significance level, we calculated 103 patients were needed in each
27 group. Multiple imputation (MI) with 10 iterations was used to impute all missing values for the quality of
28 life. We used 4 cycles of imputed data, and the variables used were the EQ-5D-3L index-scores. We did not
29 attempt to estimate missing data in the analysis of the five QoL dimensions, when looking at them

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1 separately. All patients, including those with missing values, were included in the analyses with the data
2 available.

3 We used Student's t test to compare means, the Mann-Whitney test to compare medians, and
4 Chi-squared tests for categorical data to compare proportions. To take into account of the longitudinal nature
5 of the data, we used ordinary regression with STATA's cluster option. To estimate precision for differential
6 costs and QALYs we used a non-parametric bootstrapping method (1000 replications) including 95%
7 confidence intervals to account for the possibility of skewed data,.

8 The incremental cost-effectiveness ratio (ICER) was calculated as difference in costs divided
9 by the difference in QALYs between the two groups. We used bootstrap analysis to produce a cost-
10 effectiveness plane, where each quadrant indicates whether the VATS was more or less costly and more or
11 less effective compared to thoracotomy. Furthermore, we estimated cost-effectiveness acceptability curves
12 (CEACs) to illustrate the uncertain nature of determining cost-effectiveness of VATS compared to
13 thoracotomy. The CEAC shows the probability that VATS is cost-effective compared to thoractomy, for a
14 range of threshold values for willingness to pay per additional QALY.

15

16

17

1 **Results**

2 A total of 206 patients (103 VATS and 103 thoracotomy) were randomised during the six years inclusion
3 period (see table 1 and figure 1). Nine patients died during the 52-weeks follow-up period (VATS n=3 and
4 thoracotomy n=6; p=0.29), two occurred within 30-days (One VATS-patient died from intra-abdominal
5 ischemia, one thoracotomy-patient died from cerebral stroke that led to cerebral incarceration).
6 As shown in table 2 we observed better quality-of-life after VATS but repeated measurements for the entire
7 observation period showed no significant differences regardless MI (p=0.47) or not (p=0.72). As a secondary
8 outcome we looked at the quality-of-life index-scores at each time-points during follow up (table 2). Looking
9 at these specific time-points of evaluation without MI, only 2 and 4 weeks showed significant difference
10 (p=0.025 and p=0.019 respectively). Using MI only 2, 4, and 52 weeks showed significant difference
11 (p<0.001 at all times).

12 Analyses of surgical outcomes included duration of the surgical procedure, with median 79
13 minutes (IQR 60 – 101 minutes) by thoracotomy and median 100 minutes by VATS (IQR 80 – 115 minutes;
14 p<0.001). Use of resources in table 3, showed no significant differences between groups, apart from length
15 of stay in hospital (p=0.027), and surgical time-use (p<0.001). The costs of these resources shown in table 4
16 showed lower costs after VATS. This difference was primarily associated with costs of readmissions
17 (p<0.001) and costs of Out-Patient-Clinics (p=0.012). Cost of surgical admission was marginally lower after
18 VATS, but not significant (p=0.96). Also cost associated with prescription pain medication differed but not
19 significantly (p=0.51).

20 The mean overall costs per patient operated by VATS were 103108 Dkr (€ 13818) and
21 134945 Dkr (€ 18085) by thoracotomy, making the costs for VATS 31837 Dkr (95% CI 17133 to 46542.)
22 lower than thoracotomy (p<0.001) - a cost difference equivalent of € 4267. The difference in QALYs gained
23 over the 52 weeks of follow-up was 0.021 (95% CI -0.04 to -0.00015), as seen in table 4. This gives an ICER
24 of – 1516048 Dkr/QALY, which is best illustrated in the cost-effectiveness plan (CE-plan) in figure 2, which
25 demonstrates that 84.3% of the bootstrapped cost-utility pairs were located in the bottom right quadrant of
26 the CE-plan, meaning lower costs and more QALYs following VATS. Furthermore, 0.1 % of the bootstrap
27 resamples were in the top-left quadrant with higher costs and lower QALYs, 2% in the top-right quadrant
28 equivalent with higher costs and more QALYs, and 13.6% in the bottom-left quadrant with lower costs and
29 lower QALYs.

1 The cost-effectiveness acceptability curve seen in figure 3 indicates that the probability of
2 VATS being cost-effective compared to thoracotomy was 95% for ceiling ratios larger than 50000 DKK.
3 Thus, according to this study VATS was superior to thoracotomy more or less regardless of the willingness
4 to pay per QALY.
5 Sensitivity analysis was performed on cost of surgical equipment, instruments and single-use utilities. For
6 reusable surgical equipment it showed that because of the wide range of procedures the equipment was used
7 for, the unit cost pr. procedure accounted for less than 5% of the combined cost of the surgical procedure.
8 The majority of the costs were from single-use utilities. Whether or not to include the costs of the VATS
9 equipment, we found that the cost-difference between including and not including the equipment-costs was
10 440 DKK out of the total cost of the surgical admission of 14058 DKK.

11

1 Discussion

2 Our results demonstrate that VATS was less costly and resulted in better quality-of-life compared to
3 thoracotomy for surgical lobectomy of stage 1 lung cancer. The primary cost differences were associated
4 with expenses related to readmissions and visits in the out-patient clinic. This suggests superiority of the
5 VATS approach compared to thoracotomy and should consequently, from an economic viewpoint, not
6 discourage thoracic surgeons from implementing minimally invasive approach in their practice.

7 Quality-of-life evaluations are used increasingly in the thoracic community [18-21]. The
8 majority of studies report better QoL-scores after VATS although not all reach statistical significance [18-
9 21]. This corresponds well to what we found. When we looked at different time-points of our evaluation we
10 observed better index-scores in the VATS group at all evaluation points, some even significantly. But these
11 tendencies never reached significant values when using repeated measurements. Another problem with
12 looking at each index-score separately is the risk of mass-significance. Therefore conclusions should not be
13 drawn on the differences at each time-point, but rather on the repeated measurement evaluations instead. It is
14 difficult to compare our results, as there exists no consensus on which questionnaires to use, when to do the
15 evaluation, and how often during the follow up period.

16 In health-economics discussions always arise whether to perform a capital cost evaluation,
17 which includes all conceivable direct and indirect costs associated with the procedure, or a marginal cost
18 analysis, in which only direct costs associated with the procedures are included. Because we were interested
19 in the difference between two surgical techniques, and not the overall costs, we decided a marginal cost
20 analysis was the most accessible and best technique. The strength of our cost utility analysis is the degree of
21 detail in the estimated resource use during surgery, and the completeness of data delivered by Statistics
22 Denmark. This database contains all contacts to the healthcare system and the use of health services at a
23 patient level. The number of observations during the follow up period was also a strength, because it allowed
24 higher levels of detail when extracting the health states and QALYs. The limitation in the present health-
25 economics study was the small sample size, but the cost utility analysis was added as a sub-study to the
26 primary clinical randomised trial designed to investigate differences in pain and quality of life following
27 lobectomy.

28 Whether or not one should include cost and maintenance of the VATS equipment is
29 controversial and often discussed when VATS is compared with thoracotomy [9, 22]. We analysed our data

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1 with and without the cost of the VATS equipment and found a higher cost-difference without the equipment
2 costs, although very small, and therefore a slightly higher ICER, when we included the equipment costs. This
3 resulted in a higher probability of cost-effectiveness at a given threshold value, meaning that no matter how
4 much an administrator is willing to pay extra pr. QALY, VATS remained the most cost-effective technique.
5 With our results at hand however, a comparison of cost without the equipment costs seemed obsolete, as the
6 costs were already lower in the VATS group, and therefore would only enhance the difference we already
7 see. Dealing with a negative ICER is a challenge, because the magnitude of a negative ICER has no
8 meaning[17]; therefore the CE-plan should be used to interpret the results, and not the ICER on its own. The
9 cost differences seen in table 3 were small except the costs associated with readmissions and out-patient
10 clinics. This suggests that the cost differences seen in patients in the thoracotomy group were primarily
11 related to the reasons for any readmission in the postoperative period and the number of visits in the out-
12 patient clinic. In a non-randomized study by Konge et al[23] patients who underwent thoracotomy were
13 readmitted more frequently than patients who underwent VATS. In our study the decision for readmission
14 was not taken by any of the surgeons involved but by healthcare professionals from other specialities in the
15 patients local environment. Analysis of costs of readmissions revealed that one patient was readmitted for a
16 liver-transplantation, one had a neurosurgical procedure, and two underwent extended intensive care
17 treatments. To eliminate "chance-outliers" we decided to disregard the 10 most expensive readmissions in
18 each group from the study for sensitivity analysis, and found that mean total costs were reduced but still
19 significantly different in favour of VATS ($p < 0.001$). This sensitivity analysis shifted the CE-plan down and
20 to the right according to figure 2, further enhancing the results towards VATS.

1 The tendencies seen in length of stay during primary admission correspond well to data
2 published by Farjah et al.[10], where longer admission-times were observed in the thoracotomy group.

3 Several studies have investigated costs associated with both VATS and thoracotomy, and
4 many studies have compared these costs[9, 10, 22]. However, none of these included a traditional CUA. In a
5 review from 2008 Walker et al. concluded that VATS lobectomy was not more costly than thoracotomy but
6 generated additional hospital beds due to shorter length of stay[22]. Casali et al. showed significantly lower
7 in-hospital cost in VATS compared to conventional thoracotomy[9], just as we found in our study. Swanson
8 et al. showed similar results and conclusions in their study from 2012, although they disregarded the initial
9 costs of the equipment for VATS[24]. In a retrospective database-review Rodgers-Fischl et al. found costs
10 associated with VATS did not vary significantly from thoracotomy, and therefore concluded that in their
11 institution VATS was equivalent to thoracotomy in terms of costs[25].

12 In conclusion: VATS is a cost-effective alternative to thoracotomy following lobectomy for
13 stage 1 lung cancer. Economical outcomes as measured by QALYs were significantly better and overall
14 costs were lower for VATS. This could help hospital administrators to implement the VATS technique as a
15 cost-effective alternative to traditional thoracotomy in surgery for lung cancer.

16

- 1 Figure legends:
- 2
- 3 Figure 1: Consort diagram.
- 4
- 5 Figure 2: Cost-Effectiveness-plane based on 1000 bootstrapped replicates.
- 6
- 7 Figure 3: Cost-effectiveness-acceptability-curve.

1 Table 1. Patient characteristics.

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		VATS (n=102*)	Anterolateral (n=99**)
		n (%)	n (%)
Age (median, years)		66 (range 41-83)	65 (range 48 - 85)
BMI (median, kg/m ²)		24 (IQR 23 - 27)	26 (IQR 23 - 29)
Sex	Female	52 (51)	52 (53)
	Male	50 (49)	47 (47)
Smoking status	Non-smoker	16 (17)	8 (8)
	Smoker	80 (83)	88 (92)

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* 1 patient excluded due to benign histology

** 3 patients excluded due to benign histology and one excluded due to T-cell Lymphoma.

Percentages are calculated for the whole population, irrespective of missing data.

1 Table 2: Quality-of-life index-score from the EQ5D-3L questionnaire by time point.

2

	Without imputation					With imputation		
	VATS		Thoracotomy		p-value	VATS	Thoracotomy	p-value
	n	Mean (SD)	n	Mean (SD)		Mean (SD)	Mean (SD)	
preoperative	63	0.89 (0.13)	61	0.86 (0.15)	0.071	0.88 (0.14)	0.87 (0.15)	0.464
2	78	0.78 (0.17)	80	0.73 (0.14)	0.025	0.79 (0.17)	0.74 (0.13)	<0.001
4	78	0.82 (0.17)	73	0.75 (0.18)	0.008	0.81 (0.19)	0.76 (0.17)	<0.001
8	81	0.85 (0.16)	71	0.81 (0.13)	0.032	0.84 (0.17)	0.82 (0.13)	0.146
12	83	0.87 (0.14)	71	0.85 (0.14)	0.162	0.85 (0.15)	0.84 (0.14)	0.264
26	81	0.86 (0.18)	73	0.85 (0.14)	0.578	0.83 (0.21)	0.84 (0.16)	0.858
52	74	0.86 (0.16)	66	0.84 (0.18)	0.045	0.86 (0.19)	0.81 (0.19)	<0.001

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1 Table 3. Resources used pr. patient allocated to the two surgical techniques.

	VATS (SD)	Thoracotomy (SD)	Mean difference (95% CI)
Median time use for surgical procedure (minutes).	100 (IQR 82 - 117)	78 (IQR 60 - 101)	23.2 (18.5 to 27.9)
Mean length of stay in hospital (days.) (Surgical admission)	4.8 (3.7)	6.7 (7.6)	- 1.88 (0.22 to 3.55)
Number of combined outpatient visits	0.44 (0.16)	0.7 (0.31)	- 0.25 (-0.43 to 0.94)
Number of standard outpatient visits	2.06 (1.9)	1.7 (1.4)	0.36 (-1.17 to 0.46)
Number of bloodtest visits	0.05 (0.26)	0.03 (0.22)	0.02 (-0.09 to 0.05)
Number of rehabilitation treatments	1.2 (5.0)	0.74 (2.6)	0.50 (-1.6 to 0.61)
Number of other outpatient visits	0.78 (0.32)	0.82 (0.4)	- 0.04 (-0.97 to 1.05)
Number of Specialist consultations	3.96 (4.96)	4.1 (6.6)	- 0.14 (-1.48 to 1.76)
Number of GP consultations	40.98 (26.3)	39.6 (23)	1.4 (-8.3 to 5.4)
Number of out-of-hours GP visits	2.2 (4.5)	2.3 (5.3)	- 0.08 (-1.28 to 1.4)
Number of hospital readmissions	2.60 (2.2)	2.71 (2.1)	- 0.11 (-0.17 to 0.38)
Mean admission time for	8.46 (13.4)	10.31 (16.8)	- 1.85 (-0.11 to 3.80)

readmissions (days)			
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1 Table 4. Costs in Danish Kroner and QALYs

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	VATS Mean (SD)	Thoracotomy Mean (SD)	p-value	Mean difference (95% CI)
General practioner services, and private practising medical specialists services	7544 (5776)	6757 (4410)	0.030	787 (-1497 to -78)
Prescription medicine	847 (1767)	784 (759)	0.52	63 (-251 to 125)
Out-patient clinic	51412 (51035)	61575 (63209)	0.012	- 10163 (2261 to 18066)
Readmissions	29247 (60548)	51734 (86456)	< 0.001	- 22487 (12230,to 32745)
Surgical admission	14058 (6979)	14095 (15429)	0.96	- 37 (-1604 to 1679)
Total cost	103108 (90792)	134945 (120963)	< 0.001	- 31837 (17133 to 46542)
QALY	0,851 (0,16)	0,830 (0,13)	0.048	0.021 (-0,04 to -0,00015)

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