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Incisions & Approaches

Information for Patients, Written in Plain Words

1. Introduction

During any surgical operation, the "operator" (i.e. the *one leading* person out of a surgeons' team, the one who is actively in charge of *actually performing* a given surgical operation) needs to approach the anatomic region (or tissues or organs) that (s)he intends to operate on, in order to achieve the surgical goal. In general, such surgical "approaches" are carried out through "**incisions**" (usually linear openings or 'cuts,' one or more, each measuring from 0.5 up to quite a few cm). It is often that there are patients' enquiries about incisions preoperatively: **where** they will be located and **how** their postoperative appearance is expected to look like.

There are **three ways** of operatively exposing the *thoracic* organs for carrying out thoracic surgical operations:

- the "Open" approach
- the "thoracoscopic" approach or "VATS"
- the "robotic (-assisted) thoracic surgery" or "RATS"

The first part of this article is about most of the **Open** thoracic approaches and *explanatory drawings* are provided; after all, the open approaches deserve some extent, for a surgeon is supposed to be able to operatively (technically) achieve *any* surgical goal through them. *The last two chapters* of this article are about the approaches newly introduced to practice (VATS & Robotic approach).

In addition to this article's drawings, one can see real, actual *intraoperative* **Photographs** (taken during surgery) and short *intraoperative* **Videos**, displaying abnormal findings (as seen through an Open surgical approach) on the following Website:

www.icp-med.gr/engl/photos



2. Thoracotomies

"Thoracotomy" is an incision located at the *side* of the chest wall (either right or left side), below the "axilla" (armpit, underarm), in between two ribs and parallel to them. The vast majority (almost 80%) of all **Open** thoracic surgical operations are carried

out through a "**thoracotomy**" (the remaining 20% approximately of Open thoracic operations are undertaken through other approaches). Thoracotomies can be carried out more anteriorly or posteriorly and their length can also vary, depending on the different surgical goal of a given operation.

A thoracotomy can, therefore, be "mini," "limited," "muscle-sparing," "lateral," "posterolateral," "anterior," "anterolateral" or "extended," depending on the varying surgical goal to be achieved in individual cases.

2.a. Posterolateral thoracotomy

"Posterolateral" thoracotomy used to be considered as the *routine* or *standard thoracotomy*. It starts posteriorly at the midpoint between the thoracic spinous processes and the medial border of the scapula; the anterior end of the incision lies 2 cm below and 3 cm in front of the inferior angle of

the scapula, but it can be extended further to the front, to just below the nipple, if necessary. *Most* thoracic surgical operations can be performed through a posterolateral thoracotomy.

This thoracotomy, however, consists of a *significantly long* and *extensive* incision. In addition to the rather upleasant cosmetic result (due to the length of the final scar) of it, it can also be associated with some

postoperative functional disorders, related to the "latissimus dorsi" muscle (that needs first to be divided during the operation, then sewn, of course); this muscle acts whenever one combs one's hair or one does 'lat pulldown' Gym exercises (or also 'chin-up' exercises with a horizontal bar etc.)

2.b. Lateral thoracotomy

For the above-mentioned reasons, a thoracic surgeon usually tries to avoid a posterolateral thora-

cotomy approach. This article's author is all in favour of the "lateral thoracotomy," that consists of a *shorter* incision. This thoracotomy's largest part *lies hidden* below (or covered by) the patient's arm and this is considered as a *cosmetic advantage*. Any postoperative functional disorders related to it are also much milder or minor.

One can see *photographs* of Lateral thoracotomy *scars* on page 8 :

- Figure 1: five years post Right Lower *Lobectomy* for *lung cancer* (NSCLC, adenocarcinoma) in a *cured* 54–yo male patient's case.
- Figure 2: five years post-surgery for *Empyema thoracis*, caused by repeatedly inserting intercostal chest drains elsewhere for recurrent *pneumothoraces* in a 34yo male patient's case.







Whenever the goal of surgery happens to be demanding and challenging or it turns out to be proven most difficult or even unattainable through the short "lateral" thoracotomy, the latter is always feasible and easy to be afterwards extended into a "posterolateral" one, i.e. to be extended towards the back during the procedure.

2.c. Other thoracotomies

This article's author attempts to carry out the vast majority of almost *all open minor / diagnostic*

procedures through a "**mini**" muscle-sparing thoracotomy and he considers it as *both* "minimally-invasive" *and* "open" *at the same time*. The very same incision can also be called "**axillary** thoracotomy," when it is undertaken higher up, immediately below the axilla. The author also uses this approach for treating cases of recurrent or persistent spontaneous pneumothoraces. The important *cosmetic advantage* of this exposure is the fact that the final scar is *covered* by the patient's arm and

hidden during ordinary 'naked-chest social activities' (e.g. walking by the sea side, swimming etc.).

Thoracotomies *less often* used are the following:

- "Anterolateral" thoracotomy; it is usually undertaken in *emer-gencies*, when an injury to the *heart* is suspected and, also, in cases of tumours and other pathologies located at the anterior part of the "Mediastinum" (the middle or central part of the chest, where the heart and major vessels normally lie).
- "Anterior" thoracotomy; it is a shorter variation of the anterolateral one. This incision is possible to be hidden below the breast in female patients.









3. Other Open approaches

"Anterior mediastinotomy" (introduced in 1965 by J. Chamberlain^{*} for the staging of lung cancer) is a short incision over the front part of the 2nd or the 3rd rib, usually on the left side. It allows visualization of the contents of the anterior mediastinum and *obtaining of biopsies*. There are terminology variations ("*parasternal* mediastinotomy" a.k.a. "*Chamberlain* procedure" and "*extended* mediastinotomy"), that do not alter the main fact that this is an approach mostly for diagnostic procedures. In clinical practice this approach is *still* undertaken *quite often* because of the great need for availability of *large-sized* bi-

opsy specimens (measuring $2 \times 1 \times 1$ cm at least), in order for *precise* histopathology diagnoses to be established of specific subtypes of lymphomas (both Hodgkin's and non-Hodgkin's lymphomas); such diagnoses often need additional immunohistochemistry and other specific stains (for oncogenes, mutations etc.), hence the *size* of the specimen must be adequate. Adequately large sizes of specimens *cannot* be obtained by needle biopsies (CT-guided) and similar methods.

"Median sternotomy" is usually used for operations to the anterior mediastinum (e.g. thymectomy or resection of the thymus gland and resection of mediastinal tumours), for operating on the upper lobes of both lungs at the same time or on the heart ("cardiac" surgery) etc. There is a small, but *ever-present risk* of

a postoperative *complication* called "**Osteomyelitis** of sternum" (in 1% approximately of the total sternotomies undertaken globally); if this complication occurs, then, of course, treating it should best be *only* attempted *by the very same* hospital's *department*, where the initial operation was carried out (for "*Continuity of Care*" reasons as well as for other medical ones). The treatment of sternal osteomyelitis can last *quite long* (for several months

usually) and it can consist of any combination of the following: administration of multiple antibiotics simultaneously, re-operation(s), applying VAC⁺ with or without irrigation of the infected wound with antiseptic solutions etc. **Any secretion or flow of liquid discharge** from the lowest part of a sternotomy wound (of a *non*-transparent colour, such as yellowish, or brownish, i.e. opaque-looking like "pus") for longer than 7 – 14 days postoperatively should be considered as a **sign suspicious** of postoperative osteomyelitis, even if other parts of the wound look already healed; a fully healed sternotomy wound *should be absolutely dry* and *nothing* should flow out of it; *the longer postoperatively* the flow of any discharge from the wound occurs or lasts, *the higher the suspicion* of osteromyelitis *is*. The attending physician usually can either confirm or rule out a suspected diagnosis of Osteomyelitis on the basis of laboratory investigations (e.g. ^{99m}Tc **three phase bone Scan** or scintigraphy, ⁶⁷Ga Bone Scan, ESR & CRP, CT scanning, cultures of the wound discharge etc.).





^{*} Chamberlain JM. Discussion. J Thorac Cardiovasc Surg 1965; 49: 20. Also:

McNeill TM, Chamberlain JM. Diagnostic anterior mediastinotomy. Ann Thorac Surg 1966; 2(4): 532-9

⁺ VAC: "Vacuum-Assist Closure" system, applying sub-atmospheric pressure to the sternotomy wound through a polyurethane foam dressing and sponges

"Thoracolaparotomy" or "thoraco-abdominal" incision (*left-sided* only) can be carried out for diseases affecting organs of both the 'chest' ("thoracic" cavity) and the abdomen ("peritoneal" cavity), e.g. for treating cancer of the (o)esophagus or of the (o)esophago-gastric junction. It is a *very long* incision, often associated with postoperative functional disorders (e.g. respiratory failure requiring mechanical ventilation with a respirator in an ICU for usually a day or two). It is sometimes feasible to avoid the thoraco-abdominal approach by performing *two separate* incisions instead; e.g. an "*lvor–Lewis approach*," consisting of right thoracotomy + median supraumbilical laparotomy.

A "clamshell incision" can be used instead of median sternotomy: the two approaches share similar

indications (often for transplantation cases), but they have also some technical differences. The clamshell incision does not require availability of a saw. Some may consider it better than sternotomy from a cosmetic viewpoint, as its final scar can be hidden below the breasts in female patients. A somehow smaller or shorter variation of it is the "hemiclamshell" incision, involving one only hemithorax (half of chest: either right or left): hemiclamshell is the combination of an anterolateral thoracotomy and a median sternotomy.

The "anterior transcervical-thoracic approach," described in 1993 by P. Dartevelle*, or simpler the "Dartevelle approach," is an L-shaped cervicotomy (extended under the internal half of clavicle into the deltopectoral groove) with removal of the medial half of clavicle. It is used for approaching tumours and

other pathologies, that are wedged in the "superior sulcus" (the narrow "apex" or very top of the interior of the chest cavity or thoracic inlet) such as "Pancoast tumours" (Pancoast type bronchial or bronchogenic carcinomas) etc. This approach always results into postoperative significant cosmetic and functional defects of the pectoral girdle (due to the removal or half of the clavicle): some disturbance in shoulder girdle function and instability of the pectoral girdle. The latter could even be considered as some mild form of disability. A surgeon only uses this approach **out**

of necessity: it offers *excellent exposure and visualization* of the cervicothoracic region, and, therefore, *adequate access to* and *control of* the most important major structures (vascular, neural etc.), invaded by tumour. An altogether different, *posterior* approach used once to be the standard for the superior sulcus: it was the "high paravertebral posterolateral thoracic approach," described by Shaw & Paulson †: it only offered *restricted* access resulting into high rates of *incomplete* resections as well as *high* surgical *morbidity* and *mortality*: with that posterior approach there was not even mere inspection or visualization of the major mediastinal vessels behind large-sized tumours, let alone any feasibility of adequate control of them during a possible intraoperative haemorrhage. Finally, the









^{*} Dartevelle PG, Chapelier AR, Macchiarini P, Lenot B, Cerrina J, Ladurie FL, Parquin FJ, Lafont D: Anterior transcervical-thoracic approach for radical resection of lung tumors invading the thoracic inlet. J Thorac Cardiovasc Surg 1993, 105(6):1025-34

[†] Shaw RR, Paulson DL, Kee JL, Jr. Treatment of the superior sulcus tumor by irradiation followed by resection. **Ann Surg** 1961; 154: 29 - 40.

extremely *narrow* space of the thoracic inlet, where the superior sulcus tumours are usually wedged in, does *not* usually allow a successful application of thoracoscopic (VATS) approach.

"Anterior cervical-transsternal approach," described by Peter Goldstraw in 1999*, is undertaken *instead of* the Dartevelle approach for tumours (and other pathologies) of the superior sulcus and the

supraclavicular region, such as neural tumours and Pancoast type lung cancer. It consists of a cervicotomy (extended over proximal sternum in midline) with an L-shaped limited upper sternotomy (over the manubrium, extended below second costal cartilage). There is *no removal of clavicle* and, consequently, the approach itself postoperatively causes *neither* disability *nor* deformity of the shoulder and pectoral region. The final scar is cosmetically much better accepted. This approach admirably combines all the benefits of offering the excellent exposure of a Dart-



evelle approach without any of its functional and cosmetic disadvantages. Goldstraw's approach has truly been a most significant *Contribution*! When one has gained adequate experience of successful applications of the Goldstraw's approach, then one is absolutely certain that this approach is superior to (and successfully replaces) any other approach for the superior sulcus.

This article's author feels both honoured and privileged by Prof. P. Goldstraw's *foreword* at the beginning of "The Right To The Truth" book **†**.

⁺ I.C. Papachristos "*The Right To The Truth*." One can get the **book** via its webpage: www.papa-christos.eu/righttothetruth



^{*} Ladas G, Rhys-Evans P.H., **Goldstraw P.** Anterior cervical-transsternal approach for resection of benign tumors at the thoracic inlet. **Ann Thorac Surg** 1999; 67: 785-789. Also:

Vanakesa T, Goldstraw P. Antero-superior approaches in the practice of thoracic surgery. Eur J Cardio-thorac Surg 1999; 15: 774 – 780.

4. The Thoracoscopic approach or V.A.T.S.

The thoracoscopic or "VATS" approach (Video-Assisted Thoracoscopic Surgery) is the exposure ob-

tained by watching a monitor, receiving video images from a camera inserted inside the patient's chest cavity. Thin, long surgical instruments (usually disposable & *expensive* ones) are inserted through small '**holes**' (or "thoracoports" or short incisions) in the chest wall.

There are usually 3 holes (holes' number generally between 1 - 4), but a "*utility incision*" (measuring 4 - 8 cm^{*} or even 10 cm[†]) is often added to the holes, to facilitate removal of larger-sized speci-



mens. This procedure is also referred to as '**keyhole** surgery' (colloquial term). Many thoracic surgical operations can technically be carried out thoracoscopically.

VATS is neither '*new*' nor '*modern*,' as usually implied — sometimes *silently* — by its supporters, since it was described for the first time in **1910** by **H.C. Jacobaeus**[‡], despite the fact that it had already been undertaken in **1866** by Sir Francis Richard **Cruise**, according to an article published in that same year by S. Gordon §. Since the 1970s–1980s there has been overenthusiasm and zeal for a revival of this approach by using "cold light" sources and monitors receiving video data. Adopting this approach has steadily been ever–increasing as if it were somehow '*trendy*' or 'fashionable,' sometimes though up to a degree of *exaggeration*, unfortunately. Using VATS 'always and on every single case' like some kind or "*panacea*"** (or just *telling* others that one uses VATS *so*) starts being considered as 'politically correct.'

VATS has become extremely *popular* and, in my opinion, *overpublicized* (or excessively *promoted*) by the media and by the press as supposedly 'Superior' to the open approach with four <u>arguments</u> <u>in its favour</u>: (i) VATS allegedly leaves 'smaller' incision scars, that are 'better-looking' than a thoracotomy incision, (ii) VATS causes 'less' postoperative pain, (iii) a shorter and faster postop recovery is usually the case post VATS than post open operations, (iv) VATS offers magnification of the images captured by camera.

‡ Jacobaeus H.C. Über die Möglichkeit die Zystoskopie bei Untersuchung seröser Höhlungen anzuwenden [The Possibilities for Performing Cystoscopy in Examinations of Serous Cavities]. **Münch Med Woch** (Münchner Medizinischen Wochenschrift) **1911**; 57: 2090

** Ancient Greek word "πανάκεια," meaning a kind of almost magical "universal remedy"

^{*} Demmy T, Dexter E. Overview of video-assisted thoracoscopic surgery (VATS). **UpToDate** Website as on Nov 16, 2015: <u>www.uptodate.com/contents/overview-of-video-assisted-thoracoscopic-surgery-vats</u>

[†] Flores RM. Video-assisted thoracic surgery (VATS) lobectomy: focus on technique. **World J Surg** 2010 Apr; 34 (4): 616-620, doi: 10.1007/s00268-009-0340-8 . PMID: 20082195 [PubMed - indexed for MEDLINE]. Link: <u>http://www.ncbi.nlm.nih.gov/pubmed/20082195</u>

[§] Hoksch B, Birken-Bertsch H., Müller JM. Thoracoscopy before Jacobaeus. **Ann Thorac Surg 2002**; 74(4): 1288-90. Also:

Gordon S. Clinical reports of rare cases, occurring in the Whitworth & Wardwicke Hospitals: most extensive pleuritic effusion rapidly becoming purulent, paracentesis, introduction of a drainage tube, recovery, examination of interior of pleura by the endoscope. **Dublin Q J Med Sci 1866**; 41: 83-90

4.a. Disadvantages of the VATS approach

I am afraid that, in addition to its advantages, VATS has also got <u>ten</u> *disadvantages*:

i. VATS only allows examination of the intrathoracic organs by Inspection alone and it deprives the operator of the ability to carry out **Palpation** in order to detect and locate deep intrapulmonary lesions or infiltration by tumour or fix-

ation of mediastinal vessels (or other structures). A distinguished, renowned and respected pro-VATS colleague was publicly asked at a scientific meeting about *how* this technique attempts *to compensate* for the *Lack* of any "*Intra-operative* findings" provided *by palpation* (e.g. compensation by using intra-op Ultrasonic or other equipment); he dared reply that he *solely* relied on <u>Pre-operative Laboratory</u> findings *alone* during VATS surgery and that, in his opinion, there is supposedly "*no need for*" consideration of any "*Intra-op*" findings as long as 'good Preop' Investigations were carried out (he maintains an *a priori* underestimation of any possible *Intra*op findings during surgery, thought by him as *inferior* to *Pre-op Lab* findings from *PET*/CT scanning etc.).

This article's author does think there is a matter of *gross Violation* of fundamental scientific <u>Principles</u> here; "Intra-op Clinical findings" are *per se* an entity altogether different from "**Pre-op Lab** findings," the latter being notoriously known for (false positive / negative) *Errors* etc.

- ii. VATS *necessitates* the use of stapling devices in most cases (even for the simplest pulmonary resection), therefore carries *a higher Cost* than conventional surgical techniques of manually sewing (suturing).
- iii. The entire matter of VATS scars being 'better-looking' by aesthetics' standards remains based on purely Subjective and personal considerations: One has not been convinced that having four scars (1½-cm-long each) in multiple regions of the chest plus/minus an ad-

ditional 4-cm or even 10-cm utility incision scar is superior to having just one (1) scar alone, measuring ~ 5½ cm (a 'mini' thoracotomy's scar) and below the axilla (armpit, hidden or concealed by the arm). Please see figures 1 & 2 on this page (right), displaying scars of an even longer thoracotomy (scars of a "Lateral" thoracotomy, whose length measures longer than a "Mini" thoracotomy; more clinical details are explained at the bottom of page 2).

iv. Each and every thoracoport of VATS (each 'hole') is usually located at a different interspace (or intercostal space); it can, therefore, cause irritation of a different intercostal nerve; so, if four thoracoports are used in a VATS case, then no less than four whole intercostal nerves may well become irritated (and 'sore'): four times (4 ×) more inter-

costal nerves than in an Open thoracotomy (the latter is only carried out through one single interspace). It is, therefore, likely that VATS can cause *Pain* (of a neuropathic nature, originating from multiple intercostal nerves' irritation) *equally strong* or even *more intense* than an open approach







(through a single interspace alone), despite the — often heard of — claim of VATS being allegedly a 'less painful procedure.'

- v. VATS *deprives* the operator *of any "Stereoscopic or 3D vision with field depth"* information (1 thoracoscopic camera alone inside the chest only). However newer equipment is starting to become commercially available by the lucrative VATS instruments' industry to overcome this problem.
- vi. For the reasons already mentioned in paragraphs (i) & (v) above combined, there is a *high degree of difficulty* in absolutely and wholly achieving the surgical goal (or the *full completion* of this goal is more difficult) by the VATS-approach; this is implicitly or indirectly admitted even by VATS-supporters, whenever they refer to 'learning curves.' According to learning curves lessons learnt, the surgeons *only* become capable of achieving the surgical goal within an acceptably short duration of surgery *after a given, specific number* of VATS procedures; this might probably be the reason of the steadily *Worsening Mortality rates* after VATS-Pneumonectomies *for 2 consecutive years* in the whole of Japan*. The high degree of difficulty is, of course, associated with both:
 - a. a *Longer* duration of VATS procedures (at least for throughout the period of time that a given surgeon needs to become *fully familiarised* with this technique)
 - b. a risk of technically *Failing to fully and absolutely achieve* the surgical *goal* (e.g. during an operation for a *malignant* tumour, palpably 'hard' nodules may be *missed* or *undetected*, therefore they may be left "in situ," or inside of the patient, resulting into an oncologically <u>Incomplete</u> <u>Resection</u>).
- vii. Even if VATS is finally "Converted" into an open thoracotomy, it will still continue to offer an exposure, that is both limited and restricting the surgical manoeuvres. This occurs because the conversion is actually undertaken by uniting two 'holes' (out of the total 4 holes or "thoracoports") into one single incision; the VATS holes are, however, always located at 'lower' interspaces (or intercostal spaces located more "caudad," to prevent the long instruments' sword-fighting with each other); hence, the holes' lower location results into an equally 'Lower' thoracotomy : lower than a selective thoracotomy that would originally have been planned in order to achieve a given and specific surgical goal. Therefore, a converted thoracotomy is inevitably, out of necessity and forced to always be carried out both hastily (or in a hurry, in a rushed manner or urgently †) and Lower than the desirable higher interspace ("more cephalad"), that would have been the proper one to offer the best possible exposure. So, the surgical manoeuvres are more difficult than the ones through a lateral thoracotomy selectively planned from the very beginning via the best intercostal space.

^{*} Tsubota N. Is pneumonectomy using video-assisted thoracic surgery the way to go? Study of data from the Japanese Association for Thoracic Surgery. **Gen Thorac Cardiovasc Surg** 2014; 62 (8): 499–502, doi: http://dx.doi.org/10.1007/s11748-014-0400-3

⁺ Some *complication* or similar *incident* or *event* must definitely have had occurred, in order for conversion (of VATS into thoracotomy) to have been decided.

viii. VATS carries the risk of being potentially attempted to be exploited by some colleague either as a vehicle of common Vanity (as a glory field) or for reasons of professionally showing off too much, in order to financially obtain some 'surplus value' of the fees charged for (supposedly 'modern') services rendered. One watches the literature with *increasing* concern, worrying, distress and, finally, *dread*, for there are in it patients' cases reported <u>in retrospect</u> and always from a safe point in timeline, in terms of having first secured a favourable outcome; these are cases of patients who have 'successfully undergone VATS,' despite that VATS was **contraindicated** in them: e.g. re-operations with adhesions' presence or gigantic-

sized tumours and similar cases. Some colleagues decide to risk their patients' life solely for they find it '*challenging*' to strive to achieve a most difficult goal *through VATS* (instead of through an Open approach); *then*, of course, they *only* report *the successful* cases *alone*, so that they become themselves renowned and 'established' (as highly skilled); in case of a failure outcome, there is



obviously *no* attempting to report that! One wonders *whether or not* the unfortunate patients were truly, frankly and sincerely *informed* to an *adequate* extent about the increased risks?! Are some patients or not *deliberately* left with the *false* impression that they undergo a supposedly 'standard' or 'routine' procedure, unanimously and wholly 'accepted' by all clinicians?! Is there a possibility of patients' role being *abused* as in keeping with a role of *'human guinea pigs'*?! It is a *wonder* or concern for this article's reader to think about!

- ix. The specialist-training of young colleagues focuses more and more on teaching them the VATS operative techniques; they continuously lack familiarity with conventional sewing (suturing) techniques etc. They risk being minimally skilled and capable to complete a procedure that needed to be "converted" into an open one. Similar deleterious effects may also occur in case of a possible lack of disposable staplers (e.g. in an Emergency or if a 'cutting-costs-saving-money' policy is imposed by the employer).
- x. VATS is more and more criticized and increasingly blamed—as being too 'conventional' or even an 'obsolete' approach—by the supporters of robotic surgery. They also claim there's the additional disadvantage of *dizziness and vertigo*, caused to operating surgeons by watching the video resulting from an unsteady intrathoracic camera, hand-held by human assistants (with inadvertent and unintentional motions of hand, due to narrow-range trembling, as well as to the human pulse). They are adamant that the latter cannot be matched against the superior, *outstanding*, high-resolution and most *stable* video displayed on their Console, resulting from stable robotic arms inside the patients' bodies.

4.b. Contraindications of VATS

There are well known and specific *Contraindications* for VATS as much as for any other surgical operation (or even medical procedure in general):

- A *sizeable* (or large-sized) tumour or other abnormality
- *Respiratory unfitness* preventing a patient from withstanding *one–lung* ventilation during surgery (by using either a double–lumen endotracheal tube or a bronchial blocker)

- Presence of *Adhesions* inside the side of the chest, that will be operated on:
 - o Re-operation (or 're-do' or "repeated" operation) in the same side of chest
 - o Previous pleurodesis (e.g. talc, chemical or surgical pleurodesis)
 - o Empyema thoracis
 - o Past Medical History of either:
 - Tuberculosis
 - Pleural effusion (or 'collection of fluid inside the chest' or pleurisy)
 - Pneumonia

4.c. Conclusive verdict

During the XI annual National Congress of The Hellenic Society of Thoracic and Cardiovascular Surgeons (in Thessaloniki, Greece, on Nov. 15th, 2016), I was invited to contribute in a *Debate* discussion with a *lecture* on: 'Lobectomy: How should it be undertaken? Through an *Open* approach ?' The debate was 'open approach versus VATS.' One may be interested to download and read the handouts of that lecture, listed as #27 on the Lectures' link: www.icp-med.gr/engl/scientific/#scie4

When all the above-mentioned various aspects are together, all at once, counter-balanced and taken into account, a final *conclusion* is reached that VATS *does have* indeed a *rightful place* in the thoracic surgical armamentarium, but *only if* it is carried out *When* properly *indicated* and *in moderation* (reasonably, sensibly, within limits); then VATS may be precious and extremely valuable, as this article's author has noticed by applying it in cases it was indicated for, as a reader can see by looking at the following *intraoperative* photographs of one of the author's clinical cases:

www.icp-med.gr/engl/photos/sarcomamyofibroblastic/

Forthcoming improvement of VATS with further advancement, evolution and sophistication of its capabilities is expected to occur by newer and better equipment. Such advancement will—most certainly—allow any disadvantages to be overcome. For instance, intra–operative ultrasonography (echogram) could partly compensate for the loss of the valuable palpation (without a whole "utility incision" for insertion of few fingers through it). *In the future,* this improvement will be achieved; the VATS–approach will gain ground and will become *most widely* accepted and appreciated by all.

Excessive Exaggerations of <u>overusing</u> VATS *in all* cases *indiscriminately*, even in cases on which VATS is contraindicated, are *not* in keeping with either medical *Ethics* or even *Common Sense*; such Exaggerations consist themselves the VATS method's <u>worst true enemy</u>, far scarier and far more dangerous than this method's strictest *'bona fide* criticizer' (scarier than this method's strictest *'good faith* criticizer').

5. Robotic Thoracic Surgery or R.A.T.S.

Robotic surgery is the use of a surgical robot (Da Vinci®) under which the patient is anaesthetised and

"docked"; an "assistant surgeon" stands at the patient's side in order to assist with suction, lavage, retraction or introduction of different devices and change of instruments. The actual surgeon sits at a robotic cold and lifeless "Console," that fully controls the surgical robot in real time.

The **rationale** behind the whole concept of robotic surgery, was initially the *provision of expert surgical services* to unfortunate patients, who may happen to be <u>far away</u>,

in **remote** areas (e.g. in Antarctica, on a [space-]ship, in a poor or developing country etc.), where there would be doctors but *no highly skilled* ones in surgical subspecialties, such as neurosurgery, thoracic surgery etc.

There have been some rather *serious Safety considerations*^{*} about *Remote* robotic surgery, that led into the nowadays *nonsensical*, yet *common* practice of the actual surgeon <u>sitting Aside</u>, away from his patient, despite their being both physically present inside the very same operating theatre !

The human surgeon is, therefore, *utterly deprived* of any "*palpable*" or even "*tactile*" *intra*-operative findings (e.g. infiltration or fixation of mediastinal major vasculature by tumour, deep intrapulmonary nodules etc.) during his manoeuvres.

The *lucrative* robotic surgery industry *supports* the use of this *extremely Expensive* technique (cost of an average robotic thoracic procedure \in 50000 approximately, to be compared against \in 15000_through VATS or \in 4000 through Open approach) for the theoretical *benefits* of: *a.*– high-resolution binocular view, *b.*– wrist-like action of the instruments (exceeding the natural range of motion of the surgeon's own human hand) and *c.*– ease of fine dissection in a confined space; I would add that a *Sitting* surgeon gets definitely *less tired* than a *Standing* one !

According to a recent paper (dated Jul. 20, 2015 and made public by *MIT Technology Review* as well as by <u>BBC News</u>) **144 deaths**, **1,391 injuries** and 8,061 *device malfunctions* occurred between 2000 and 2013 in USA alone with surgical robots involved (*broken parts* of instruments falling into patients' bodies, electrical *sparks* causing *tissue burns* and system errors making surgery take longer than planned); please see the articles' links:

www.technologyreview.com/view/539521/robotic-surgery-linked-to-144-deaths-since-2000/

www.bbc.com/news/technology-33609495

One can watch "*The Bleeding Edge*" documentary (by Kirby Dick, on **Netflix**) to see some distressing complications of robotic surgery. Other cases are also highlighted, proving that "less invasive techniques" *aren't* necessarily better than open surgery :

www.netflix.com/title/80170862





^{*} Safety Considerations e.g.: **a.-** likelihood of *Loss of connectivity* between a surgeon's console and the docked patient / robot, **b.-** possibility of *haemorrhage* of other complication resulting into a need to "*Convert*" the robotic Op into an Open one.

The technological advancement, sophistication and evolution of the surgical robots is expected to occur in leaps and bounds; *in the near future*, they are to overcome any existing issues associated with some nonsensical ways of their use at present:

- A few obstacles had made Tele-robotic (*remotely* carried out) surgery impractical, yet overcoming them appears to be imminent by inventing *autonomous* surgical robots. The latter will probably operate autonomously, on their own—in other words without any supervision by human surgeons—and they're expected to do so faster, more precisely and better than human surgeons operate. Some success towards this end has already been published *, bearing the STAR abbreviation as its name: Smart Tissue *Autonomous* Robot. Please see also my invited commentaries during the 6th Multihospital Postgraduate lesson (organized by the Aristotle University Dept. of Cardiothoracic Surgery in 2016 in Thessaloniki, Greece), as well as during the 6th lesson in 2018, listed as numbers 5 & 11 of the "Invited Commentaries" Link: www.icpmed.gr/engl/scientific/#scie5.
- *Nano*-robots [†] will be able to enter the human body by being injected into the blood stream or by being inserted via alternative anatomical pathways. So, there won't be a need any longer for incisions, not even the tiniest ones.

The currently available equipment of Robotic Surgery will appear rather *primitive* and crude—or even droll—in the future, in a way similar to how outdated (or even ridiculous) last centuries' chloroforme inhalers (and *blood-letting knives* etc.) now seem! The future is expected to shine bright, amazing with unfathomable innovations and cutting–edge technologies: *We're looking forward* to it, even if that means our forthcoming replacement by surgical robots which will be faster, more precise and more skillful than human surgeons. If so, then a remarkable accomplishment will have *happily* been achieved "for the benefit of the sick"...

Note:

Double quotation marks ("") are used for *proper* and correct *medical* or *scientific terms* in the whole article above (e.g. "resection").

On the contrary, **Single** quotation marks ('') are used for *explanatory*, *plain* or *colloquial* <u>words</u> (e.g. 'removal').

Links inside the article are in **blue** colour.—

* Shademan A, Decker RS, Opfermann JD et al. Supervised **autonomous** robotic soft tissue surgery. Science Translational Medicine 2016: 8: 337 http://spectrum.ieee.org/the-human-os/robotics/medical-robots/autonomous-robot-surgeon-bests-human-surgeons-in-world-first

Would you trust a robot surgeon to operate on you? http://spectrum.ieee.org/robotics/medical-robots/would-you-trust-a-robot-surgeon-to-operate-on-you

This robot completes a 2-hour brain surgery procedure in just 2.5 minutes: https://futurism.com/this-robot-completes-2-hour-brain-surgery-procedure-just-25-minutes/

+ The tiny robots will see you now: http://spectrum.ieee.org/the-human-os/biomedical/devices/the-tiny-robots-will-see-you-now

More information can be retrieved by :

- Browsing the author's medical Website: www.icp-med.gr/engl
- Looking at *intraoperative* Photographs & Videos: www.icp-med.gr/engl/photos/
- Browsing the website's sub-page 'Information for patients': www.icp-med.gr/engl/info/
- Reading the same author's 'Thoracic Surgical Operations' article:

www.icp-med.gr/resources/document/thorsurgops.pdf

• Reading the author's 'The Right To The Truth' book:

www.papachristos.eu/righttothetruth



• Reading other books written by the same author on his *Writer's* Website: www.papachristos.eu



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