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The Digital Chest Drain "Innovation in Thoracic Surgery that is here to Stay"

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Introduction

Thoracic surgery is a medical specialty, which could be considered one of the branches of General Surgery of more recent creation, born of a need, at the beginning of the 20th century. The Tuberculosis epidemic that affected much of the world, caused doctors who were in direct contact with these types of sick patients, to deal and treat various complications caused by TB. Physiotherapists, who require giving attention to these patients, acquire skills to solve these diverse problems, such as purulent drainage of the chest and more complex surgical procedures, such as pulmonary resections, thoracoplasties, tumors of the thorax, etc.

When effective medical treatments appeared for the treatment of tuberculosis, there was a decline of the requirements of surgery in such a disease, but at the same time there was an increase of other infectious and inflammatory diseases of the chest, such as rheumatic fever, bronchiectasis, among others, that gave way to some general surgeons to acquire surgical skills to deal with intra thoracic organs.

Thus, the emergence of cardiothoracic surgery. Many years later, due to advances in the diagnosis of intra thoracic diseases and the increase of other less frequently encountered diseases at the beginning of the century, such as Lung Cancer, which might require doctors to work full-time within the chest.

This is how perhaps unconsciously cardiothoracic surgeons are opting to specialize more in the heart area and others specialize in the rest of the intra thoracic organs pathology.

In summary, we can say that chest surgeons currently are a product of the needs of the pathologies of Pulmonology, which initially were attended by the own pulmonologists, aided by general surgeons at the time, subsequently absorb the cardiovascular field and with the increase of knowledge of intra thoracic diseases, the number of technological advances for both diagnostic and treatment, create the need for the branch of thoracic surgery.

This brings us to the present situation where we have cardiovascular surgeons, general surgeons and surgeons for the thorax separate from the cardiac surgeons.

Present thoracic surgery is a medical specialty that has presented considerable progress in the last three or four decades. Initially considered a very high complex surgery due to the problems of intraoperative anesthesia, of ventilation management and the difficulties in controlling the postoperative period, by the type of drainage that is needed. These patients require much resources, such as long stays in intensive care units, long hospital stays, high requirements for analgesia for post-surgical incisions, which brought as a result less compliance by the patient in his recovery, in the mechanical ventilatory rehabilitation and increased incidence of lung infections and wound infections in the hospital, which resulted in higher patient morbidity and mortality.

The last 25 Years have generated many technological advances, almost always derived from abdominal surgery. The application of technology from endoscopic surgery in the chest has created a revolution in this field. Since acquiring the necessary skills, many of the thoracic surgical procedures that formerly required approaches that were very traumatic, have begun to be made with these minimally invasive techniques.

One of the points that have helped the optimization of the procedures of the thorax is the growing supply of chest drains that even though initially they were based on a simple water seal, have evolved extensively.

Currently we have available the digital technology for both objective measurement and quantification of the pulmonary air leak, as well as, the amount of pleural fluid that occurs inside the cavity of the thorax.

The review objective is to assess the evolution of thoracic digital drainage systems, since its appearance in the market, making a review of the literature and objective results of studies published by different authors and also discuss the advantages and disadvantages offered by these systems.

Thoracic Drainage

Since the beginning of the intra thoracic surgical procedures, it has been necessary to alter the intra thoracic natural Physiology of the lungs for proper surgery, which should move through inspiration and exhalation.

To prevent lungs collapsing, there must be negative pressure inside the chest, which under normal conditions does not allow the lungs to collapse. When this stability is distorted by a surgical procedure and the lung collapses, the lung requires the placement of drainage that communicates the pleural cavity to the outside of the body.

By placing a drain into a container with liquid, it prevents outside air from re-entering the pleural space, with each breath the lung insufflates and expels the residual air that remains in the intra pleural space, fluid from the container form a barrier, known as a water seal.

Subsequent to this water seal, the container could adapt to a source of external suction, which eliminate extracting air from the pleural space rapidly.

Digital Chest Drain

In the year 2006, product of a pilot study of 204 patients in Austria

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[1,2], the placement of a device "AIRFIX", capable of measuring the amount of air the patient expelled via the thoracic drainage at bedside. It measured the air in ml/min, after performing a cough forced Valsalva maneuver. These measurements, could be downloaded to a computer for an evaluation, it could be concluded that if the patient expelled less than 20 ml/min of air, the chest drain could be removed without risk of leaving a pneumo thorax remnant within the thoracic cavity.

In the year 2007, a digital drainage DigiVentV® (Millicore, Sweden) proved to be effective in recording and studying intra pleural pressure curves, this in addition to measuring in ml/min the amount of air that was expelled by the drain, thus eliminating the inter observer subjective decision as to when you should withdraw the thoracic drainage with the confidence and security to not leave a residual pneumo thorax [3]. In 2008, the first comparative study [4] between a digital and a conventional device was performed, where it would demonstrate the usefulness of the digital device in decreased number of days for a thoracic drainage and a decrease in the length of days of hospital stay.

In the year 2007, this author commenced using drainage DigiVent® (Millicore, Sweden) and in 2008 commenced using Thopaz (Medela® Baar, Switzerland), performing the first prospective study comparison between two digital chest drainage systems and one conventional drainage system presently available at that time [5].

Results obtained were a significant decrease on the days requiring thoracic drainage and number of days of hospital stay. It demonstrated through surveys acceptance by the nurses and ease of use by the complete thoracic management team. Conclusions were that Digital Thoracic Drainage was easy and had good acceptance. The patient was found to be more comfortable for early mobilization and showed that the system was equally effective, as compared to conventional systems. Digital devices brought a great improvement in patient care due to their alarm systems for three very special circumstances: when the patient had obstruction of the system, ranging from the thoracic drainage, when it was accidentally disconnected and when there was a very high air leak. This work was presented in the European Society of Thoracic Surgeon (ESTS) conference in Poland 2009 and would be published in 2010. Also in 2010 you could find publications saying that not all patients undergoing pulmonary resections required continuous suction [6], which could be done using Thopaz Medela® (Baar, Switzerland), Digital drainage because the Thopaz is intuitive performing suction only when required and decreasing pulmonary suction or even removing suction if needed [7], to avoid the small micro barotraumas, product of small emphysematous bullae, which are commonly found in the residual lung that is left after pulmonary resection, Cancer or any other lung disease.

The usage of digital chest drains has been growing in recent years and we can find studies that speak on the usage of these devices for the patient who requires continuous suction and can be sent home under safe conditions, sometimes avoiding not only hospital admissions, but also surgical reinterventions [8,9].

There are currently study protocols underway which aim to expand the applications of the digital chest drain for controlling air leaks with proper placement for [10] bronchopleural fistulas end bronchial valves.

Ambulatory Thoracic Surgery

Since 1991, there are publications of the first series of thoracic outpatient procedures carried out in a systematic way [11]. There are multiple additional procedures that have been added to the current list of minimally invasive surgical procedures with current innovative technological elements, which make surgeries to be increasingly less invasive such as using a single access port to perform greater lung resections [12]. Recently the device (SILS)® Single-Incision Laparoscopy Surgery has been widely used in abdominal and transanal surgery, etc. After a prospective study comparing thoracic surgery for atypical pulmonary resections (pneumothorax or lung biopsies) and resection of tumors of the anterior mediastinum [13], we have seen that the uniportal with SILS® surgery is safe and at least as efficient in terms of days of drainage and length of stay in-hospital as compared with video thorascopy procedures using three ports and we have also been able to demonstrate that these patients benefit from the placement of digital chest drains such as the Thopaz Medela® (Baar, Switzerland), for the prompt withdrawal of the drainage and even for pneumothorax cases that require continuous pleural suction for at least 36 or 48 hrs to ensure a correct pleurodesis of the pleura, the patient may be discharged the same day of the operative event with digital drainage ensuring the right pleural suction.

Conclusions

The digital thoracic drainage has shown to reduce the days of required thoracic drainage and number of days of hospital stay, their alarm systems provide patient safety and are more effective than conventional devices. Integrated suction capacity and provide battery autonomy for several hours. Digital thoracic drainage devices allow the patient early ambulation and faster recuperation. In much selected patients, it is possible to send them home with the digital drainage without adversely affecting the safety of the patient. Although there are no specific cost-benefit studies that demonstrate that the uses of the digital drainages are more economic as compared to conventional drains, the reduction in length of days of patient hospitalization suggests that this is so.

Certainly studies that are underway with more cases and new lines of research, in addition to technical improvements will be implemented to the current digital devices which will yield results in the coming years showing greater usefulness of these drains.

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