Curved cutter stapler for the application of bronchial sutures in anatomic pulmonary resections: the clinical experience of 139 cases

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Abstract

OBJECTIVES: One of the fundamental steps in an anatomical pulmonary resection is the main and lobar bronchus suture. Nowadays, two different types of staplers are on the market: the linear TA stapler for open surgery (Tyco Healthcare Group LP, Norwalk, CT, USA), which is based on a ‘guillotine’ mechanism, sewing, but not cutting the bronchus, and the endoscopic linear stapler which both cuts and sews. This study aimed to fill the void in the use of an instrument used to staple and cut at the same time in ‘open’ thoracic surgery, eliminating the need for a scalpel: the curved cutter stapler (Contour® Curved Cutter Stapler; Ethicon Endo-Surgery, Inc., Cincinnati, OH, USA).

METHODS: Between May 2009 and March 2011, the Contour® Curved Stapler (Ethicon) was used for the bronchus in 139 cases of non-small cell lung carcinoma (NSCLC)—29 females and 110 males ranging between 48 and 85 years (average 71.1)—and comprising 115 lobectomies (8 bilobectomies) and 24 pneumonectomies (8 on the right lung, 16 on the left lung).

RESULTS: All patients underwent a bronchoscopic check-up 30 days after they were discharged: in all cases, the bronchial stump was clearly within normal limits. No cases of bronchopleural fistulas were observed in the 139 patients.

CONCLUSIONS: On the basis of this study, the curved cutter stapler showed to be a satisfactory device for securing the bronchus during an anatomic resection (whether lobar or main), in ‘open’ thoracic surgery. However, even though there were no cases of fistula, we consider that our data is still too limited to be statistically significant.

Keywords: Curved cutter stapler • Linear stapler • Bronchopleural fistula

INTRODUCTION

One of the fundamental stages of an anatomic pulmonary resection is the main or lobar bronchus suture. The most serious complication of a bronchial suture is a bronchopleural fistula with the consequent risk to the patient’s life or permanent invalidity due to prolonged periods of hospitalization.

The bronchus can be closed manually or mechanically with the aid of staplers; however, there is still no absolute agreement among surgeons on which technique is better. Some surgeons showed a low percentage of fistulas using manual closure [1], whilst others [2] have showed the efficiency of mechanical staplers, which are currently the ones preferred by most surgeons. Nowadays, two different types of stapler are on the market: the linear TA stapler (Tyco Healthcare Group LP, Norwalk, CT, USA), based on a ‘guillotine’ mechanism not cutting the bronchus and the linear endoscopic stapler which both staples and cuts.

The purpose of this study is to report, for the first time, our positive clinical experience with the use of a curved cutter stapler in ‘open’ surgical bronchial sutures.

MATERIALS AND METHODS

Between May 2009 and March 2011, the Contour® Curved Stapler (Ethicon) was used in 139 cases (106 lobectomies, 9 bilobectomy, 8 right-lung pneumonectomy and 16 left-lung pneumonectomies) involving 29 female and 110 male patients ranging between 48 and 85 years old (average 71.1). A study proposal was finalized and approved by our institutional review board before initiating the study. Written informed consent was obtained from the participants. All of these patients were being treated for primitive lung cancer (NSCLC) which had been judged to be operable from both an oncological and a functional point of view; the need for intra-operative extemporary examination of bronchial recuperation was excluded following a bronchoscopy and a CT chest scan. In fact, all of the patients had undergone detailed clinical staging prior to surgery in the form of a full-body CT scan, a bronchoscopy and a thorough cardio-respiratory functional assessment.

In 32 cases, the surgical risk was judged to be greater due to the presence of comorbidities—diabetes in 11 patients and...
various types of cardiopathy in the other patients, albeit with good haemodynamic compensation.

The surgical access to the pleural cavity was either a posterolateral thoracotomy, sparing the serratus anterior muscle, or an anterolateral thoracotomy.

In all of these cases, the bronchus was the last hilum structure to be dealt with. In 64 cases, the concavity of the stapler was placed against the proximal portion of the bronchus, and against the distal portion in the remaining cases. The choice depended completely on the convenience of positioning the stapler according to the surgeon's technical requirements during the operation.

For both the main and lobar bronchi (except the middle lobe bronchus which has always been manually sutured), the green cartridge (2 mm) was always used, compressing the bronchus within the jaws of the stapler in an anterior-posterior direction.

After sectioning and suturing the bronchus, the suture-holding capacity was tested by introducing a saline solution into the pleural cavity and asking the anaesthetist to re-ventilate the lung.

All of the sutures perfectly resisted and no manual application to reinforce staples was necessary. In no cases was the bronchial stump protected with muscular or pleural/pericardial flaps.

At the end of the operation, two pleural drains were introduced for the lobar resections, and a single drain for the pneumonectomies.

RESULTS

The overall mean age of patients treated in this study was 71.1 years. In the case of the 24 pneumonectomies, the drains were removed on the second day; in 87 of the lobectomies and in the 8 bilobectomies, they were removed on the third or fourth day; whilst in the remaining 12 lobectomies, they were removed between the second and sixth week as a result of persistent losses in parenchymal areas. In these cases, it was necessary to insert a Heimlich valve after the patient had been discharged from hospital.

All patients underwent a bronchoscopic check-up 30 days after they were discharged: in all cases, the bronchial stump was clearly within normal limits. Bronchial fistulas have not so far appeared in any of the patients of this study.

DISCUSSION

The development of bronchopleural fistulas secondary to bronchial stump dehiscence following anatomic pulmonary resection is an extremely serious complication [2]. In recent years, their incidence has drastically decreased, not only as a result of the patient being properly prepared for surgery, but also because of improvements in suturing equipment and materials. These improvements include linear staplers, which deliver a double row of staggered staples and have assumed particular importance.

The staples are positioned in two staggered rows, thus guaranteeing valid aerostasis and haemostasis and allowing nutrition to reach the margins of the sectioned area.

The cartridge is brought close to the anvil and when the stapler is fired, the open staple located in the loader is forced towards the recess of the anvil, where it is shaped into an upper-case letter ‘B’ (see Fig. 1). This ‘B’ shape enables blood to be supplied to the margins of the sectioned area and thus facilitates healing whilst at the same time preventing necrosis of the bronchial stump. We consider main and lobar bronchi similar in terms of thickness; therefore, in our study, we always used the green cartridge. The middle lobe bronchus has been excluded from the use of a stapler because of its small size and has always been manually sutured.

There are two types of staplers currently being used by most thoracic surgeons for bronchial sutures. Both staplers are in the category of so-called ‘linear staplers’ according to the guidelines of Péterffy and Calabrese [4] in 1979, who stated that the suture line should be parallel to the remaining bronchus. These staplers are: firstly, the TA, used in ‘open’ surgery, which only sutures and does not cut the bronchus after applying stitches therefore obliging the surgeon to use the blade in a restricted field with low visibility. The second type is the endoscopic linear stapler which has the same characteristics of applying stitches and is also able to cut the bronchus.

At the Thoracic Surgery U.O.C. of San Paolo Hospital in Bari, Italy, the efficacy of a new curved staple for bronchial suturing was verified, comparing it to the linear staplers currently used. This stapler is characterized by similar features to the linear staplers and it had been only used (until our experience reported in this study) in rectal surgery [5]. The reason why we chose this stapler was to find a suturing device for ‘open surgery’ on the bronchus that is able, on one side, to safeguard the criteria of affixing staples in the same way as linear staplers and, on the other side, to enable ‘cutting’ operations (unlike TA models, as stated before, requiring the manual use of scalpels for sectioning the bronchus). In order to avoid this limitation when using the TA, some surgeons have also used endoscopic linear staplers in ‘open’ surgery procedures. In fact these ‘staple and cut’ but are less effective than ‘open’ linear staplers when it comes to compression action on the bronchial structures. In the ‘open’ type, the compression force enabling the cartilaginous arch of the bronchus to be brought closer to the pars membranacea and necessary for the section and the application of ‘B’-shaped staples is distributed across all of the staples making their application uniform (Fig. 2). With endoscopic staplers, the compression force is greater in those staples nearest to the mechanical joint between the two jaws, but gradually decreases as the distance grows from the joint, thus not permitting the uniform application of staples that represents, in these cases, the best way of achieving a perfect bronchial suture (NOTE: in our experience, we have frequently verified the need to reinforce the bronchial suture through manual stitches). In addition to this basic principle of physics, which seems to favour the curved cutter stapler compared with linear endoscopic staplers, we should not overlook the advantage of the fact that the curved stapler has a greater surface area than linear staplers. Indeed, if pressure may

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**Figure 1:** Linear stapler: applies a double row of staggered staples, allowing vascularization of the margins of the sectioned area. The thickness of the tissue affects the size of the staples to be applied.
be defined physically as a force per unit of area, because of its greater surface area (Fig. 3), the curved stapler, at an equal compressive force per unit of area, will exert less force on the tissue and the compression will be distributed over a wider area.

Moreover, compared with the 15 staples delivered by the TA-45, the curved stapler delivers a total of 46 staples. It also has a longer handle, and this facilitates access to the rib cage.

In our clinical experience, of the 139 applications using the curved cutter stapler on the bronchus in anatomic pulmonary resections (lobectomies/pneumonectomies), the only difficulty found was the initial insertion of the stapler between the hilum structures; this was easily solved after the first few experiences.

In addition, we found no difference in efficiency if the stapler was positioned with the concavity in a proximal or in a distal direction (Fig. 4); the direction was decided by the surgeon depending on the most anatomic approach to the bronchus. So far, with the curved cutter stapler, we have not observed bronchopleural fistula.

However even though we had no cases of fistula, we consider our data still too limited to be statistically significant. However, the aim of our work is to show the efficiency and potential strength of the curved stapler as a new device now on the market for the bronchus suture in thoracic surgery.

In terms of cost analysis (in our hospital), we report the prices as follows: TA-45 linear stapler is 96 euros, the endoscopic linear stapler is 270 euros and curved stapler is 220 euros.

In conclusion, on the basis of our clinical study, the curved cutter stapler is a safe, effective and reliable option of treatment for thoracic surgeons to suture the bronchus.

The contour curved stapler obtained CE authorization and it has been just mentioned in the IFU for thoracic surgery use.

Conflict of interest: none declared.

REFERENCES


