

Historical Article

The history of percutaneous tracheotomy

L. W. ERNEST VAN HEURN*, PETER R. G. BRINK†

Abstract

Percutaneous tracheotomy is a surgical procedure for inserting a tracheal cannula into the tracheal lumen without a large incision, without extensive dissection of pretracheal tissue and without exposure of the trachea. Ciaglia's report on the procedure a decade ago led to this technique gaining popularity, although its origin is much older.

Key words: History of Medicine; Tracheostomy, percutaneous

Conventional tracheotomy

In the Roman era tracheotomies were performed using a large incision, and the warning of Antyllus', a 4th century Roman physician, that 'it is dangerous to divide the whole trachea' gives us an impression of the extent of the operation (Grant, 1961).

During the Renaissance most surgeons were reluctant to use the operation, even after the Italian Antonio Musa Brasavola's (1500–1570) report of a successful tracheotomy (Brasavola, 1546) (Figure 1). Extensive surgery was performed without adequate anaesthesia and with only a small chance of success (Figure 2). Johannes Heurnius (1543–1601), a professor at Leyden, well conveyed the opinion of tracheotomy in his day: 'if some physicians claim that they can perform the operation without pain, we are fully satisfied' (Heurnius, 1604).

The first step towards percutaneous tracheotomy was made by the famous Italian anatomist and surgeon Fabricius of Aquapendente (1537–1619). This teacher of William Harvey (1578–1657) and Johannes Heurnius was the first to describe a tracheal cannula (Fabricius, 1617). The cannula was small, straight and short, thus preventing contact with the posterior wall of the trachea and allowing the surgeon to make smaller incisions than before and percutaneous insertion.

Sanctorius

The Italian surgeon Sanctorio Sanctorius (1561–1636) was probably the first surgeon to describe percutaneous tracheotomy (Sanctorius, 1626). Like Fabricius, Sanctorius was professor at the University of Padua, at that time the most prestigious university

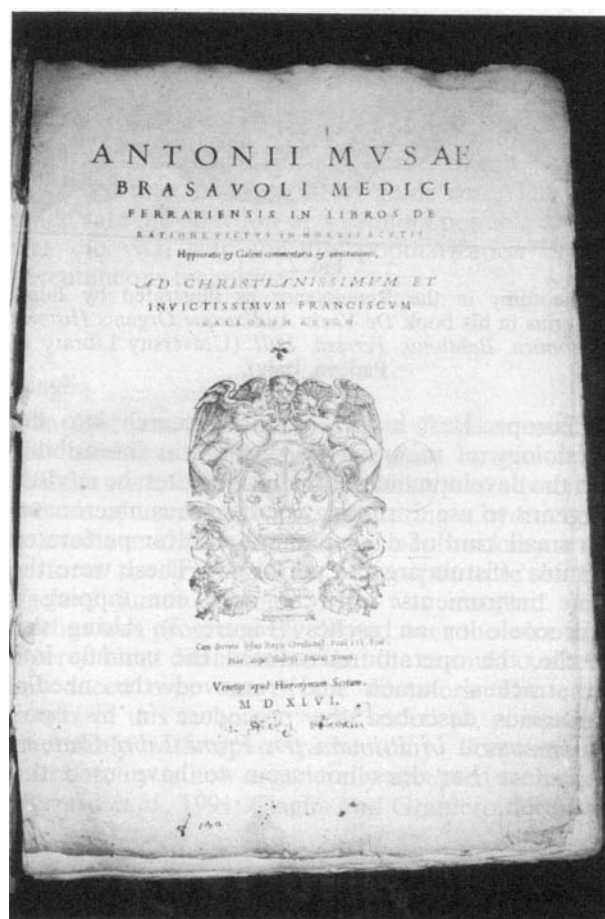


FIG. 1

The title page of Brasavola's book '*Libris de Ratione Victus in Morbis Acutis, Hippocratis et Galenii Commentaria et Annotationes*'. (University Library of Bologna, Italy).

From the Departments of Surgery, University Hospital*, Maastricht and De Wever Hospital†, Heerlen, the Netherlands.
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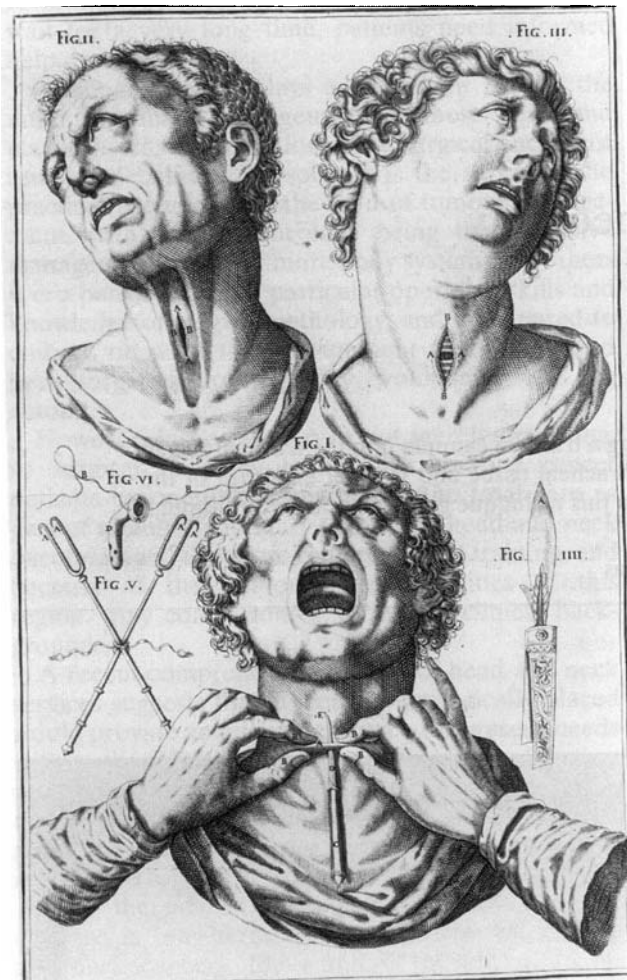


FIG. 2

Tracheotomy in the Renaissance as illustrated by Julius Casserius in his book *De Vocis Auditusque Organis Historia Anatomica*. Baldimus, Ferrara, 1601 (University Library of Padova, Italy).

of Europe. Best known for his research into the physiology of metabolism (*perspiratio insensibilis*) and the development of the thermometer, he advised surgeons to use a 'ripping needle' (*acus mucronata*) – a small kind of dagger – and a 'silver perforated cannula' (*fistula argenta perforata*). These were the same instruments as were used for tapping a hydrocoele or an ascites (Figure 3). Using this needle, the operator introduced the cannula into the tracheal lumen and removed the needle. Sanctorius described the procedure in his book *Commentaria in Primam fen Primi Libri Canonis Avicennae* but does not seem to have used this invention.

Dekkers

Frederik Dekkers (1648–1720), a professor at Leyden, tells of a man who nearly suffocated as result of angina (Dekkers, 1695). Dekkers intended to perform tracheotomy with the help of an 'unusual technique' (*non vulgari methodo*), one that he had never seen used before. He shows his instruments, a small straight cannula with little holes at the tip and a

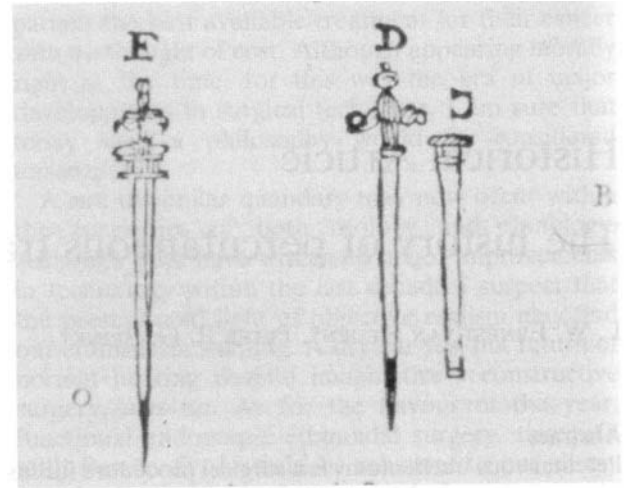


FIG. 3

The instruments Sanctorius proposed to perform percutaneous tracheotomy in his book *Commentaria in Primam fen Primi Libri Canonis Avicennae* (Marciana Library, Venezia, Italy).

pointed trocar (Figure 4). These instruments were similar to those of Sanctorius and without doubt Dekkers was on the point of performing the first percutaneous tracheotomy. However, the patient's relatives were unenthusiastic and he successfully tried a method of oral intubation, abandoning his attempt to introduce a cannula percutaneously.



FIG. 4

Dekker's instruments for tracheotomy and 'oral intubation' in his book *Exercitationes Practicae* (University Library of Leiden, The Netherlands).

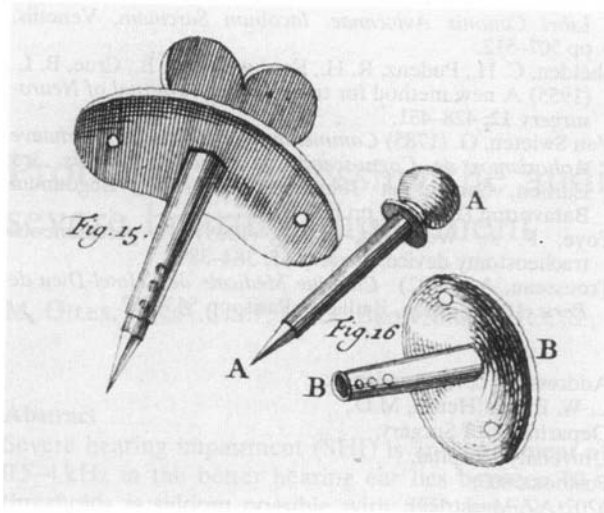


FIG. 5

The cannula and trocar Heister described in *Institutiones chirurgicae* (University Library of Leiden, The Netherlands).

Heister

The German surgeon Laurentius Heister (1683–1758), pupil of Dekkers and a professor with a European reputation, introduced the term tracheotomy into the medical literature in 1718. He described three different techniques for inserting a tracheal cannula: open tracheotomy, with complete exposure of the trachea, tracheotomy done in one stroke with a double-edged scalpel and percutaneous tracheotomy with the use of a ‘Troicar’ (Heister, 1750). Heister described the technique that he had learned from Dekkers clearly. ‘Using this peculiar instrument the cannula is introduced into the middle of the trachea with one stroke (uno ictu). After the troicar has been removed the cannula is left in the wound, so that the patient is able to breathe easily’. He reported it as a fast method of tracheotomy that could be performed with a minimum of pain. Although Heister was one of the very few surgeons who successfully performed tracheotomy before 1800, he probably used the open method.

Bauchot

In 1748 the French physician Bauchot used a ‘bronchotome’ for inserting a cannula into the tracheal lumen. This was a special instrument for bronchotomy or laryngotomy, as tracheotomy was commonly called (Goodall, 1934). The cutting edge of the bronchotome fitted into the lumen of a flat silver cannula that was designed to be put between two tracheal rings. Bauchot reportedly used this technique successfully on a man of 23 and a woman of 72, and he seems to be the first to have performed percutaneous tracheotomy (Goodall, 1934).

Van Swieten

Gerardus van Swieten (1700–1772), pupil of Herman Boerhaave (1668–1738), and physician of Maria Theresia, Empress of Austria gave in his *Commentaria in Hermannii Boerhaave Aphorismos de Cog-*

noscendis et Curandis Morbis his opinion on percutaneous tracheotomy: ‘I have used this method on a large number of cadavers and living animals, but I consider the technique to be extremely difficult and not without danger, if the instruments used do not improve. Therefore I use the old method which is preferable and probably superior’ (Van Swieten, 1785). Armand Trousseau (1801–1867), the famous French surgeon who popularized tracheotomy in the 19th century, referred to Van Swieten’s experience, when he advocated a large incision (Trousseau, 1902). The open technique was standardized by Jackson in 1909.

Shelden, Toye and Weinstein

In 1955, Shelden reintroduced a method to introduce a tracheal cannula percutaneously (Shelden *et al.*, 1955). He was the first to use the term percutaneous tracheotomy. To minimize the risk of damaging vital structures next to the trachea, Shelden first introduced a slot-needle into the tracheal lumen. He loaded the cannula onto a cutting trocar, slid it along the slot and then introduced it into the tracheal lumen.

Twelve years later, Toye and Weinstein used a Seldinger wire as a guide (Toye and Weinstein, 1969). The wire was introduced into the tracheal lumen through a cannulated needle. The cannula, mounted on a bougie – apart from the shape, it was little different from Sanctorius’ trocar – was advanced into the lumen over guide wire. The wire made safe introduction of a cannula possible and so was the vital step towards popularization of the percutaneous technique.

Ciaglia

In 1985, the American surgeon Ciaglia described his modification of percutaneous tracheotomy (Ciaglia *et al.*, 1985). Like Sanctorius, who advocated the use of instruments for puncturing a hydrocoele, he used a modified percutaneous nephrostomy set to perform the tracheotomy. After puncture of the tracheal lumen a guide wire was installed. The trachea was progressively dilated over the wire with tapered blunt dilators, so that the cannula could be introduced over one of the dilators. The early results of this technique were excellent, comparing favourably with open tracheotomy. Percutaneous tracheotomy is now a generally accepted technique (Hazard *et al.*, 1991; Ciaglia and Graniero, 1992).

Conclusion

More than three hundred years have passed since Sanctorius invented percutaneous tracheotomy. Recent modifications of the instruments used have made this old technique suitable for modern surgery and percutaneous tracheotomy has become a technique that is frequently used.

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Address for correspondence:

L. W. E. van Heurn, M.D.,
 Department of Surgery,
 University Hospital,
 Postbox 5800,
 6202 AZ Maastricht,
 The Netherlands.

Fax: 043-3875473.