Emergency Tracheal Access

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When a patient is no longer breathing, tracheal intubation fails and also the patient's lungs cannot be ventilated (by facemask or other airway such as the laryngeal mask) then emergency tracheal access is needed [1]. After the induction of general anaesthesia this can occur and its incidence is about one in 10,000 cases [2] the reason for the patient not breathing is either airway obstruction or neuromuscular blocking drugs. Predicting a difficult intubation or difiiculty with mask ventilation may reduce some of these cases [1]. In the Accident and Emergency Department the indication for emergency tracheal access in the UK is simply failed tracheal intubation. In Minneapolis over three years there were 1362 tracheal intubations and 48 cricothyrotomies giving an incidence of one in 40 intubations [3]. However, cricothyrotomy is more frequent in the USA, the 9 cases of potential cervical spine injury and 5 cases of clenched teeth would probably have been intubated in the UK.

Cricothyrotomy is preferred to tracheostomy in an emergency as it is faster and easier to perform. the surface landmarks are easier. less neck extension is needed which can be useful as hyperextension can cause airway obstruction in cases of stridor The complications are fewer and less serious than tracheostomy as it is less vascular and the lamina of the cricoid can protect the gullet from perforation [4]. A few anatomical points are worth mentioning regarding cricothyrotomy. The cricothyroid ligament is immediately subcutaneous in the midline between the strap muscles. The cricothyroid ligament was found to be on average 8 mm below the skin in 55 cadavers (range 3-14) [5]. In the adult the cricothyroid membrane is 9-10 mm high and 22-30 mm wide, medially it is ligament only and laterally there is also cricothyroid muscle. The vocal cords are 10 mm above the lower border of the thyroid cartilage. The cricothyroid artery is a branch of the superior thyroid artery and mainly supplies the cricothyroid muscle, it crosses the superior margin of the cricothyroid membrane as it joins its opposite number in the midline. Fatal airway haemorrhage has been caused by severing this artery [6]. Subcutaneous veins can be severed if an incision ventures too far from the midline [3].

Emergency cricothyrotomy can be percutaneous with either a small intravenous type cannula (less than 2 mm ID) or a large cannula designed for this purpose (4 mm or more ID). Cricothyrotomy can be surgical with insertion of a 6 mm ID cuffed tube.

The small cannula is easy to insert. The 14 G cannula (2 mm ID) is often chosen [7] it is inserted, with a 10 ml syringe attached. in the midline at the inferior border of the cricothyroid ligament pointing caudally at an angle of between 30 and 45 degrees so that the incidence of kinking is reduced [8] once through the ligament air is aspirated to confirm placement before advancing the cannula and withdrawing the needle. Capnography through a 3 way tap can be used for identification of the airway in addition to aspirating air and is still positive in apnoea [9]. Most of the complications with this device do not come from insertion but from ventilation [7,10]. kinking of the cannula occurs in 20%, emphysema in 10%. there are problems with exhalation in 14% and pneumothorax has been reported. Inspiration needs high pressure oxygen and the flow

varies with that pressure. With a 16 G cannula 500 ml in one second occurs with 400 kPa pipeline pressure] [11. Inspiratory flow through a 14 G cannula with commonly. available pressure sources and circuitry has been investigated [12,13,14]. A jet injector at 400 kPa can give 800 ml/sec [121. A low flow regulator from a cylinder or wall mount at 400 kPa can give 400 ml/sec (flow set to 15 L/mm) [I 21. Oxygen flush from most anaesthetic machines has a blow off valve at 32 kPa and can give 200 ml/sec [13,141. An anaesthetic circuit with a bag can provide a pressure of 60 cmH_2O (6 kPa) and gives only 80 ml/sec. When the glottis is open any pressure source lower than 400 kPa cannot inflate the lungs. where as the high pressure source gives a massive tidal volume with entrainment of air of up to 50% of this volume which reduces oxygen concentration [12]. With a closed glottis there is a problem with exhalation as this cannot occur through a 14 G cannula. Time for exhalation of 500 ml is 32 seconds through a 2 mm ID cannula. 8 seconds through a 3 mm cannula and only 4 seconds through a 4 mm cannula [15]. Extreme caution must be used with jet ventilation as over inflation can easily occur with resulting barotrauma. Another problem is that capnography cannot be used as exhaled gas does not come through the cannula therefore misplacement of the cannula may be difficult to detected resulting in cervical emphysema. It is often suggested that insertion of another 14 G cannula (with an ID of 2 mm) would allow exhalation, however, as lamina flow is proportional to the radius to the power of four. sixteen 14 G cannulars (2 mm ID) would be needed to give the same expiratory flow as a cannula with 4 mm ID. The circuitry necessary for this type of ventilation must be available in an emergency', 39 anaesthetists were asked to assemble equipment to ventilate through a 14 G cannula [14]. All but 2 assembled some sort of circuit that could do this and took a median time of 90 seconds (range 20-365), 2 produced a jet ventilator (8 suggested it). 10 assembled a circuit with oxygen tubing and connectors and 25 an anaesthetic circuit with a bag. Availability of such equipment could pose a problem in an emergency. [14].

The percutaneous insertion of a large specially designed cannula with an ID of 4 mm or more would appear to offer several advantages. Insertion can be simple but depends on the design of the cannula. confirmation of tracheal placement can be made with the aspiration of air. Ventilation can be with the anaesthetic circuit already attached to the anaesthetic machine as the bag can generate enough inspiratory pressure for a good tidal volume and the cannula allows exhalation in about 4 seconds [15] allowing a respiratory rate of about IO- 12 per minute. The capnograph should already be attached to the circuit and gives a constant confirmation of correct placement and also a guide to ventilation. Tracheal suction of secretions and blood is possible. There are very few series of emergency cases using these cannulars in the literature but they have highlighted a problem with the insertion of the Minitrach II a device actually designed for sputum aspiration rather than an emergency airway. but because they are commonly available they are frequently used in an emergency [7]. Failure to insert in 17%, multiple attempts in 20%, pneumothorax in 8%, emphysema in 8% and severe bleeding in 7% [7]. In cadavers untrained Accident Unit doctors failed to cannulate the trachea in 5 of 15 attempts [16]. The old Minitrach II was difficult to insert as the introducer often did not find the stab incision in the cricothyroid ligament and would slide off and be placed in a para-tracheal position [16] the newer Minitrach II has a seldinger wire for more accurate but more time consuming insertion. The Cook device also with a Seldinger technique performed better in a limited series of 11 cases with three complications of insertion [7]. The Quicktrach (VBM Medical) is becoming a popular device with 4 mm

ID with a cannula over needle technique and a detachable guard to prevent laceration of the posterior wall of the airway, the only study in the literature investigates its insertion in 55 cadavers [5]. Quicktrach is inserted faster when a prior incision is used, the study found an incidence laryngeal damage of 18% [5]. In a battlefield situation cricothyrotomy is the technique of choice for airway problems and the Army Medical Services have elected to use Quicktrach initially with conversion to a 6 mm ID tube when the patient has settled [17].

Surgical cricothyrotomy provides a more definitive airway than the other methods. Although it is easier and faster to perform than a tracheostomy it does require a degree of surgical expertise. The complications are mainly of insertion rather than ventilation. In 38 emergency surgical cricothyrotomies 13% were inserted either directly into the trachea or through the thyrohyoid membrane, the failure rate was 8%, and there was severe bleeding in 6% requiring ligation of vessels, the overalicomplication rate was 40% [3]. The long term complications are subglottic stenosis and dysphonia. Subglottic stenosis occurs in 4% and is more likely in those with laryngeal injury or previous long term intubation and in those cases that have a cricothyroid tube left in for more than seven days [18]. Dysphonia is more likely if the cricothyroid tube is left in for more than three days or a tube with a outside diameter of more than 8.5 mm is used [18,19]. The surgical technique is to make a 3 cm midline incision in the skin, a horizontal stab incision in the inferior part of the cricothyroid ligament. This is spread horizontally by opening scissors and spread vertically with large forceps and then a 6 mm ID cuffed tracheal tube is inserted [3,4].

Survival of these patients after emergency cricothyrotomy is related to their coexisting condition. Pre-hospital cases have a survival of about 25% [20,21]. Emergency room cases have a survival of about 50% [3,22]. Hospital cases have a survival of 75% [6]. In these series none of these patients died from the procedure itself apart from failure, emergency cricothyrotomy is a life saving procedure with a complication rate of about 40%. Further management should include the insertion of an orogastric or nasogastric tube in cases of a full stomach. Most cases of emergency cricothyrotomy should proceed to a formal disection tracheostomy once the patient is stable. Most cases will have laryngeal damage or post obstruction pulmonary oedema and requiring ventilation on the Intensive Therapy Unit.

Anaesthetic Departments should consider formal training of anaesthetists in failed intubation drills and cricothyrotomy, 60% have failed intubation protocols but only 14% provide formal training in cricothyrotomy although 74% do so informally [6]. A mannequin for cricothyrotomy practise is useful (Adam Rouilly £250) and a frozen pig's larynx and trachea with overlying skin can also be purchased. The best training is in the mortuary on cadavers about to undergo a Hospital post-mortum examination with the permission of a friendly pathologist, it is usually allowed as the incision for the post-mortum goes through this area.

Equipment must be available at all sites where anaesthesia is given and in the Accident Unit. At Gloucestershire Royal Hospital we use the Quicktrach and have IO at various sites at £62 each. They have a 5 year shelf life and approximately one is used each year leaving one or two each year that becomes out of date to be used for training purposes on the mannequin or in the mortuary.

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Cricothyroidotomy with the 'Quicktrach' device.

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Evaluation of the Cricothyroidotomy Instrument "Quicktrach"

Summary

Percutaneous cricothyroidotorny may be a lifesaving procedure for airway obstruction, which cannot be relieved by endotracheal intubation and can be performed with specially designed instruments. A new device, the "Quicktrach", was evaluated by an anatomical preparation, flow and resistance measurements, and puncture of the cricothyroid membrane in 55 corpses. The size of the parts of the instrument (needle, plastic cannula, depth gauge) in relation to the size of the larynx is adequate, thus there is little likelihood of perforation of the posterior wall of the larynx. Resistance of the plastic cannula is sufficiently low to allow for adequate ventilation. The duration of time until the cannula is positioned properly in the trachea is significantly shorter, when an incision prior to the puncture is done (83 ± 88 seconds without incision versus 35 ± 4 1 seconds with incision; mean ± SD). The "Quicktrach" is easy to apply even by unexperienced persons. The incidence of damage to the larynx (lesions including fractures of the thyroid, cricoid and 1 . tracheal cartilage in 18 %; soft tissue injury in 9 %) is relatively high, however considering the live saving character of the procedure these numbers appear to be acceptable. Technical problems which occur with the use of the device are discussed and suggestions for improvement are made.

Zusammenfassung

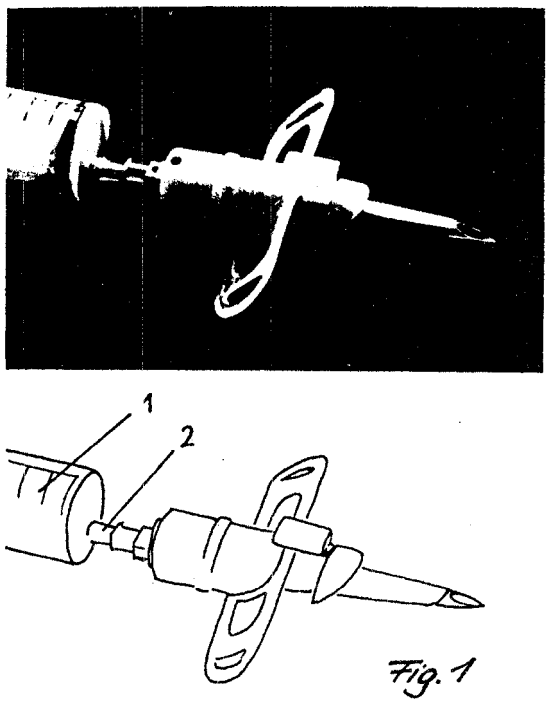
Die perkutane Krikothyreotomie als lebensrettende Maßnahme bei vollständiger Atemwegsobstruktion kann mit speziell dafiir entwickelten „Instrumenten" durchgeführt werden. Wir untersuchten das „Quicktrach"-Besteck auf dessen praktische Verwendbarkeit anhand einer anatomischen Präparation, Flow- und Widerstandsmessung der Plastikkanüle und Punktionsversuchen an 55 Leichen. Bei korrekter Handhabung ist die Größe der Einzelteile (Metallnadel, Plastikkaniile und Stopper) so bemessen, daß eine Perforation der Hinterwand des Larynx unwahrscheinlich ist, und daß die Plastikkaniile am Ende der Punktion frei im Lumen der Trachea liegt. Dank des sehr niedrigen Strömungswiderstandes der Quicktrach-Plastikkanüle sollte eine Beatmung eines Patienten problemlos sein. Die Zeit, die benötigt wurde, um die Plastikkaniile korrekt zu plazieren, war, bedingt durch den hohen Hautwiderstand, relativ lang (83 ± 88 Sekunden; Mittelwert ± Standarddeviation) und konnte signifikant verkürzt werden durch vorausgehende Inzision mit einem Skalpell (35 ± 41 Sekunden). Die Häufigkeit von Verletzungen (Knorpelverletzungen inkl. Fraktur des Schildknorpels, Ringknorpels und des 1. Trachealknorpels in 18 %, Weichteilverletzungen in 9 %) ist relativ hoch, erscheint aber angesichts des lebensrettenden Charakters der Maßnahmen als akzeptabel.

Introduction

Complete obstruction of the upper airway is a seldomly observed complication in anesthesia or emergency medical care. If the doctor does not expect it or is unprepared, bad cerebral damage may follow, or even the death of the patient. Fibreoptic intubation or emergency tracheostomy have no place in therapeutic measures, because too little time available and the complication rate is too high *(Greene, 1975).* The potential in current cases for life saving cricothyroidotomy can, by means of the insertion of a needle or a catheter (*DeLisser*, 1981; *Cote*, 1988), together with a Jet System (Smith, 1974), be carried out. Further there are different improvisation techniques, for example, a plastic needle from an infusion instrument can be fitted to a connector from an endotracheal tube and be recommended as a cricothyroidotomy device *(Fisher, 1979; Carlton,* 1980). Available finally, on the market, there are products developed, especially for this purpose (Weiss, 1983; *Helms*, 1985; *Toye*, 1986; *Ravlo*, 1987). Following requirements, a particular instrument would be provided: available immediately, simple to use, problem free connects to an available oxygen source and the chances are slim of damage to surrounding organs (thyroid cartilage, cricoid cartilage, back wall of the larynx, as well as the oesophagus, thyroid gland). The aim of this work is to ascertain the named requirements for the 'Quicktrach' cricothyroidotomy device for anatomical preparation, resistance gauging in the laboratory, as well as puncture attempts on 55 corpses.

Method

The 'Quicktrach' cricothyroidotomy device can be split into 4 individual parts (fig 1 and 2). The plastic cannula is 35 mm in length and has an inner diameter (ID) of 5mm. It is held firmly in position with a fixation plate and a 15 mm connector. The introduction of the plastic cannula is made possible with the metal needle. In order to prevent too deep an insertion, a distal stopper is



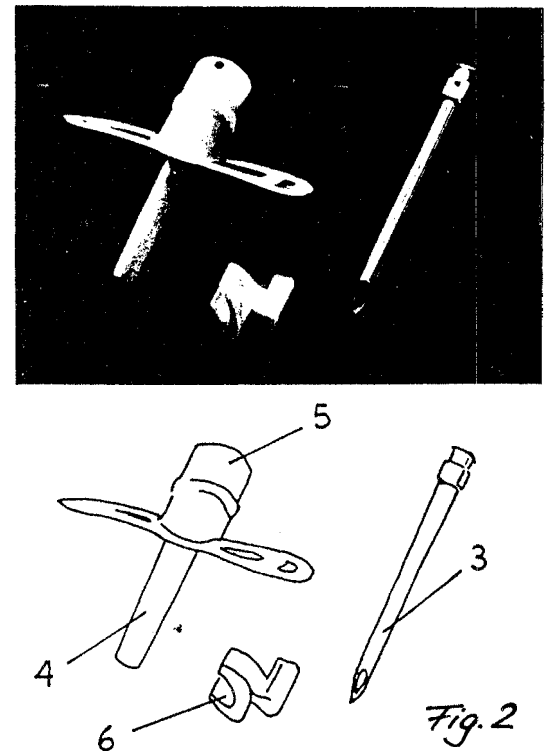


Fig 1 and 2 The 'Quicktrach' cricothyroidotorny, current model, without syringe (I), with syringe (2), metal needle with an added conical syringe (3), plastic cannula with an inner diameter of 5mm and a 15mm connection (5) and stopper (6).

attached to the fixation plate. The correct positioning of the needle can be checked by air aspiration. For this purpose, a special 10ml syringe is included in the set. The application of the 'Quicktrach' (cricothyroidotomy) recommended by the manufacturer is shown in tab. 1.

Anatomical Research

By means of laterally opening the front throat region, between the thyroid cartilage and the first tracheal ring, the anatomical conditions of the 'Quicktrach's' metal needle and plastic cannula are extensively documented. It is interesting to see the depth of insertion with and without the stopper, before and after the needle is taken out, regarding the front and back wall of the larynx., all of the 55 corpses researched, afterwards In addition the distance between the skins surface and the front wall of the larynx (H-V), as well as between the skins surface and the back wall of the larynx (H-H) was measured.

Resistance Gauging

In laboratory research, resistance measurements of the 'Quicktrach' plastic cannula were determined. The resulting values obtained were compared and measured with an Abbottcath-14-G-plastic cannula (ID 1.52mm, length 51mm) and with a Mallinckrodt endotracheal tube (ID 3, 4 and 5 mm and length 16, 21, 25cm). The trial arrangement consisted of a supplied tube, which was supplied with the 'Quicktrach' plastic: cannula and was connected to an endotracheal tube, 15mm in length. With the Abbottcath cannula, the distal end was directly connected to an endotracheal tube (ID 3mm). The pressure difference was measured through a side branch of the tube supplied, with a constant flow to the surrounding atmosphere by means of an aneroid manometer. The supplied gas consisted of 100% oxygen. The flows for the research objects were gauged by means of a spirometer (Haloscale Ferraris Development and Engineering Co. Ltd. London).

Usability

The usability of the 'Quicktrach' cricothyroidotomy device was tested by 25 different 'Testers' (students, anaesthesia and pathological assistents in training), on 55 'unstiff corpses. All of the 25 testers were completely informed about the technique of the puncturing in accordance with the details from the manufacturer (Tab. 1). The time is measured from the moment of puncturing until the cannula is in a definite place in the trachea. Technical problems during the puncturing are systematically registered. After the puncturing begins, the soft parts of the neck are taken away and after the opening of the oesophagus and trachea all possible injuries were documented. In particular, the back wall of the larynx was examined for any mucous lesions. If any were found, the oesophagus was inspected

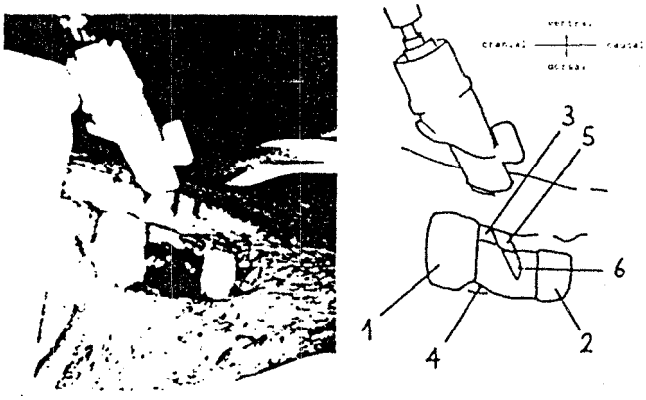


Fig 3. View from right side to the front neck triangle in the larynx region. The position of the 'Quicktrach' plastic cannula after the introduction of the device up to the stopper. 1 = Thyroid cartilage (Conus inferious reseziert), 2 = Cricoid cartilage, 3 = Front wall of the larynx, 4 = Back wall of the larynx, 5 = Plastic cannula, 6 = Tip of the needle. Plastic cannula, 6 = Tip of the needle.

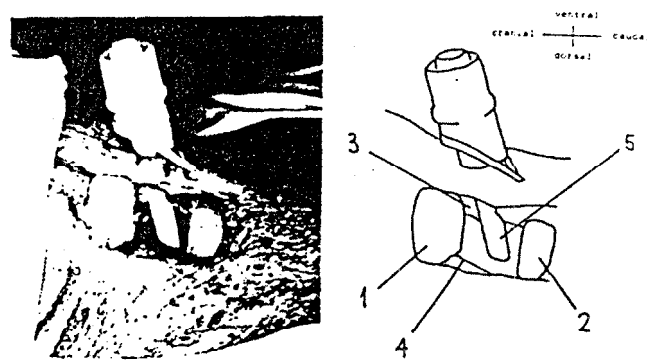


Fig 4. The same view as fig 3. The position of the 'Quicktrach' plastic cannula after the stopper is taken away, and the needle and complete introduction of the instrument into the trachea. Meaning of numbers is the same as for fig 3.

higher up, in order to enable inspect a possible previous perforation diagnosis.

After several pilot attempts, it was clear, that the perforation of the skin, in spite of the sharpness of the needle, because of the high skin resistance, could result in a considerable loss of time. Therefore, two groups were formed: 24 attempts were made without and 31 attempts were made with an incision of the skin.

Statistical Analysis

The necessary time taken until the plastic cannulae were correctly positioned were not evenly spread out. The comparison in this time with and without incisions were therefore compared with a Mann-Whitney Test. In the event of technical problems with the cricothyroidotomy with and without incisions, the Chi-Square Test was used for analysis.

Results

Anatomical Research

Figure 3 shows the correct position of the 'Quicktrach' device, between the cricoid and thyroid membranes, with the lowered stopper: The tip of the needle is about lcm from the back wall of the larynx. After taking away the stopper and pushing the plastic cannula over the needle until the flange touches the neck, the plastic tip of the cannula is close to the back wall of the larynx (Fig. 4)

Table 1

Step 1
Find the cricothyroidotomy membrane
- Firstly place a cushion or a piece of clothing underneath the shoulders of the patient
- Extend the neck by tilting back the head as far as possible
- Indentify the Adams apple with the fingers
- run the finger down the middle of the thyroid cartilage
- before the cricoid cartilage is reached, there is a dip. This is the correct site.

Step 2
Turn the 'Quicktrach' 45" so that the underside of the stopper shows, insert. Before insertion, check that the needle and the stopper are correctly positioned.
Important: When inserting the 'Quicktrach', hold only by the syringe.

Step 3
The outflow of air shows that an airway into the trachea has been made. Through easy in and outward movement, the syringe can also be made firm, so that the tip of the needle is in the trachea. Through further movements of the needle (min ½cm) until the stopper is inserted. Make secure, so that the plastic canula is completely in the trachea.

Step 4
Only when the stopper is taken away and the plastic cannula is pushed over the needle until the flange firmly lies on the throat. Only then take the syringe and needle away.

Step 5
Make the 'Quicktrach' secure with the neck tape. Add the conection tube with the 15mm connection and breathing through the mouth, with the respiration bag or a breathing machine can start.

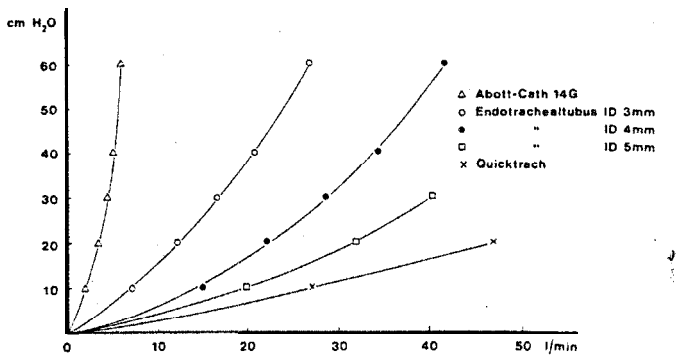


Fig 5 Resistance Gauging of the 'Quicktrach' plastic cannula in comparison with a I.V. cannula (Abbott-Cath 14 G) and Mallinckrodt endotracheal tube, with an inner diameter of 3, 4 and 5mm.

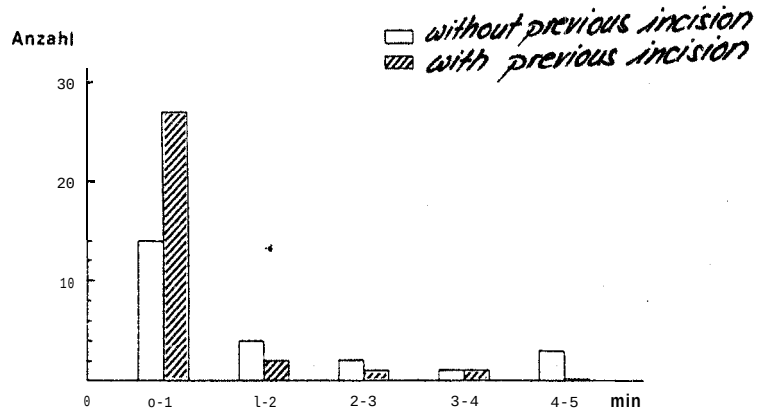


Fig 6 Time needed from the moment of puncturinmg until the plastic cannula is in the correct position in the trachea , with and without the incision with a scalpel.

Table 2 Details about the 55 corpse studied

	Age (years)	Size (cm)	Weight (kg)	Distance (mm) from skin surface to front wall of larynx	Distance (mm) from skin surface to back wall of larynx
average	75	164	56	7.7	27.0
SD	13	9	13	2.9	6.3
min	34	146	26	3	15
max	92	184	86	14	46

Table 3

1. Cartilage Damage	
- Damage of the thyroid cartilage	2
- Fracturing of the thyroid cartilage	2
- Damage to the cricoid cartilage	4
- Fracturing of the cricoid cartilage	1
- Fracturing of the 1st tracheal cartilage	1
	10 (18%)
2. Damage to soft tissues	
- Infection of a vessel	1
- Mucous membrane damage of the back wall of the larynx	2
- Infection of the thyroidae isthmus	1
- Infection of a Lobus pyramidalis thyreoideae	1
- Perforation of the Oesophagus	-
	5 (9%)
3. Paratracheal Positions	2 (4%)
Total Complications and Iniuries	17(31%)

The distance measurements H-V and H-H produce a large individual variation (Tab 2). The average value for the H-V distance is 7.7mm, with the extreme values of between 3 and 14mm, and those for the H-H distance 27mm with the extreme values of between 15 and 46mm.

Resistance Gauging

The current resistance for the 'Quicktrach' cannula is lower than that for all other tested cannulae or endotracheal tubes (Fig 5). The highest resistance of the tube with the same inner diameter (5mm) is due to the length of the tube.

Usability

Fig 6 shows that in 87% (27 from 34) of the puncturing with the skin incision, less than 60 seconds **was** necessary to position the plastic cannula correctly, compared with 58% (14 out of 24) of puncturing without an incision. The difference in the time required between both

groups is statistically different (average time needed ± standard deviation with incision 35 ± 41 seconds, without incision 83 ± 88 seconds, $p < 0.01$).

In 11 cases the puncturing of the wrong place occurred: four times it occurred above the Ligamenturn cricothyreoideum with injuries (2 cases) as well as fracturing (2 cases) of the thyroid cartilage, and once through the crycoid cartilage, once through the first tracheal cartilage with the same fracture and 5 times between the crycoid and first tracheal cartilage. With this pierced once in the Isthmus thyreoideae and once through a Lobus pyramidalalis thyreoieae (Tab 3). Also worth mentioning is the 2 cases of mucous membrane on the back wall of the larynx was damaged and in no case was the oesophagus affected.

With the complications classified under 'Infection of a vessel', it dealt with an escaping of blood which does not clot in the area of the point of puncturing of the front wall of the larynx. In two cases was the paratracheal position of the plastic cannula only realised after the trachea was opened.

The technical problems which came from this are summarised in table 4. The main problem was with the high resistance of the skin in 19 of the 24 cases without incisions. The puncturing length in these 10 cases was on average 140 seconds. In five cases this was solved by the pulling back of the metal needle from the 'Quicktrach' device, and slipping it back on its own.Through a higher skin resistance, the angle of introduction was 45°, and the forced attempt was performed. with a higher pressure between the needle and the syringe and in five cases this lead to the breaking off of the syringe. In seven cases it was solved through the strong manipulation of the stopper device from the plastic cannula, and it then must be set up again. When all the technical problems are' added together, there are significantly more difficulties in the group without incisions ($p<0.05$).

Discussion

In adults, the membrane cricothyreoidea was in a trapezoidal form and measured approximately 2.7 to 3.2cm diagonally and 0.5 to 1.2cm between the cricoid cartilage and the thyroid cartilage (*Caparosa*, 1957). The relatively large fluctuation in the values concerning the distance between the skin surface and the front wall of the larynx (3 - 14mm) and the back wall respectively explains in part the large time difference in the introduction of the puncturing, because of the large distance to the front wall of the larynx, the thyroid and cricoid cartilages were more difficult to locate.

Table 4. Technical Problems with the post mortal puncturing with the 'Quicktrach'.

	Previous	Incision
	No	Yes
Number of punctures	24	31
1. Higher skin resistance	10	0
2. Slipping back of the needle	3	3
3. Breaking off of the syringe	3	3
4. Breaking of the stopper	2	5
Total Technical Problems	**18**	**10**

With impossible intubation different authors recommend the transtracheal insufflation of oxygen through a needle or a catheter which are introduced through the cricothyreoidea membrane (*DeLisser*, 1981). This method can save lives, but the disadvantage is that the larynx must be open for passive exhalation and that higher inspiration pressure must be produced so that the higher cannula resistance is overcome (fig 5). The plastic cannulas described in this work, with an inner dimension of 5mm and a 15mm connector, make possible both normal breathing (inspiration and exspiration) with a standard anaesthesia adaption as well as the suctionning of blood and secretions.

Lesions of the thyroid cartilage, the cricoid cartilage and the first tracheal cartilage occur in 18% (10 from 55) of the cases. In the long term such injuries can only be speculated on, in all cases must the expected late complications always be seen in the light of an intervention in a life threatening situation. From the literature, the study from *Brantigan* should be referred to. This reports the experience of 655 patients, who were 'chosen' to be tested with a 'standard tracheostomy tube' cricothyroidotomy and were checked after the 'de-cannulisation'. Unfortunately, five patients developed a bad case of narrowing of the organs, which meant that they required a further operation.

it is thought that the puncture of the thyroid gland movement (Istmus once and Lobus pyramidalis once) or the puncture of a vessel (once) with living patients causes haemorrhaging. It possibly happens in cases which are known to have plugging through saturated positioning in the cannula. The potentially most dangerous complication, the paratracheal positioning of the cannula, was found in two cases. In both cases the 'test person' gave the impression of being able to breathe, but first the section gave the diagnosis of a wrongly positioned cannula. In one case the syringe lay in the area of the emusculus sternohyoideus, in the other case in the thyroid gland. It is acceptable that, with living patients, this problem was discovered relatively early, through the impossibility of breathing or through the! production of lymph emphysems.

The stopper from the 'Quicktrach' device should prevent the puncturing of the back wall of the larynx and the oesophagus. In addition, in two cases lesions of the mucous of the back wall of the larynx occurred. Damage to the oesophagus could not be observed. The probability of an injury to the A.carotis communis, the V.juluaris interna or the N.phrenicus appeared to be low, as these vital structures are found laterally and dorsally on the back wall of the larynx.

With the discussion of the technical problems, it should be taken into account that all data about corpses was obtained but should consequently not be applied to without further application to the consequences of the living patients. On the other hand, the experiences of the living patients was difficult to obtain. In the centre was the great skin resistance, which meant, in spite of the very sharp and ideally formed needle, there was a time delay, a drop in the needle towards the caudal or lateral and can lead to a break in the body of the syringe. We can show that through having an incision with a scalpel in the place of puncturing, the time needed for this was significantly reduced. It is possible that this difference with the living patients is because of the higher skin swelling.

Above all when the puncturing is not successful on the first attempt, then the device must be withdrawn. Because of mistakes of the locking mechanism between the needle and the plastic canula only slides the needle back, and the plastic cannula must be seperately withdrawn.

The breaking off of the syringe body occurred in five cases and is above all unpleasant, because the broken part of 'Quicktrach' device remained inserted into the patient, so it is not simple to insert a new needle. Therefore a new puncture without a syringe must be carried out. That means without the possibility of air aspiration to control the correct intra-tracheal cannula positioning. A strengthing of this connection was therefore strived for.

A less damaging and avoidable problem is the falling away of the stopper with the movement. Here could a sort of locking mechanism be a substanitial improvement to the usability.

In spite of the described technical problems, in comparison with other systems, the 'Quicktrach' device is the simplest to handle. Research with live dogs, carried out with a comparable system, but whose implentation is more difficult (Nu-Trake-System), that with 11 punctures carried out, only two were successful in the first attempt. In 5 cases, 2-3 attempts were necessary. and in four cases more attempts were necessary (*Bjoraker*, 1987). Unfortunately in this study, no details about the necessary length of time needed for a puncture were given., On the other hand, reported in a clinical case, the introduction of the Nu-Trake-System, lasted for 30 seconds (*Kohler*, 1985).

In summary we can show, with reference to the anatomical studies, resistance gauging and puncturing of 55 corpses, that the 'Quicktrach' device is potentially suitable, but the system still needs to be improved through the carrying out of a cricothyroidotomy.

Addendum

The manufacturer of the 'Quicktrach' device (VBM Medizintechnik GmbH, D-72172 Sulz/Neckar) has in the meantime developed a modified system. The changes concern the inner diameter (new 4mm), the form (easy bent steel needle and plastic cannula) and the reinforcement of the stopper (fixed more firmly).

It can be said that the changes prove the usability, but in any case these assumptions must be checked again.

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Addition from the manufacturer:

As mentioned in the Addendum the product has already been improved since 1988.
It also has to be said that the 55 corpses were already 2-3 days old and therefore they already had a leather skin which caused the tester to use a scalpel.
New tests showed that due to the sharp tip of the metal needle an incision with a scalpel is not necessary.