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3,314,431 STYLET FOR INSERTION OF ENDOTRACHEAL CATHETER

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ABSTRACT OF THE DISCLOSURE

The stylet has a hollow shaft bifurcated at its distal end. An adjustably deflectable pilot has a central blade slidably mounted between the arms of the stylet shaft, and a pin extends between these arms and through an oblique slot in the pilot blade. An operating wire, secured to a bifurcated collar slidably mounted in the shaft and pivotally mounted to the pilot blade, extends through the hollow shaft to the proximal end where it is secured to a spring-loaded actuator. Manipulation of the actuator causes reciprocation of the operating wire and angular movement of the pilot.

This invention relates generally to a stylet to facilitate insertion of an endotracheal tube or catheter in a patient who is to be given intratracheal anesthesia. More particularly, this invention relates to a stylet for the aforementioned purpose having an adjustably deflectable tip or pilot at the distal end guiding the distal end of the endotracheal tube or catheter into the trachea and particularly adapted to accommodate situations wherein the angle between the entrance to the trachea and the preceding passageways is abnormal, or wherein there are growths adjacent the entrance to the trachea, or wherein the head of the patient cannot be tilted up, which stylet is provided at the proximal end with an actuator manipulable by one hand alone to control the angle of the deflectable tip or pilot.

Operations upon the thorax which allow the entrance of air into the pleural cavity will produce a collapse of the lung unless adhesions have formed between the lung and the chest wall. In these cases, a method of administration of the anesthetic must be used which does not depend upon respiratory movements. This is accomplished by the introduction of a woven or rubber endotracheal tube or catheter into the trachea after preliminary introduction of anesthesia. The proximal end of the endotracheal tube or catheter is then attached to another tube through which the anesthetic mixture is introduced at a pressure sufficient to distend the lungs and permit absorption of gases, there being provided on the outside of the endotracheal tube or catheter an inflatable cuff which, when inflated, provides a seal between the exterior of the endotracheal tube or catheter and the interior of the trachea.

The angle between the entrance to the trachea and the preceding passageways in most patients falls within a fairly narrow and known range. Even so, insertion of the endotracheal tube or catheter is a painstaking operation which, among other things, requires that the endotracheal tube or catheter traverse the vocal cords. The endotracheal tube or catheter must be inserted rapidly and in as atraumatic a manner as possible. The endotracheal tube or catheter in its most popular form being of soft rubber is not rigid and requires means to stiffen and guide the same to its final position. Such means as commonly used comprises a wire which is shaped into what is hopefully the proper angle or configuration by the anesthesiologist, inserted into the endotracheal tube or

catheter, and the ensemble is then inserted into the trachea. Frequently, more than one try is made, and the shape of the stiffening wire readjusted, before the ensemble enters the trachea and is moved to final position, after which the wire is withdrawn, leaving the endotracheal tube of catheter in position in the trachea for connection through another tube to the anesthetizing gas mixture. When a patient has a trachea with an abnormal angle between the entrance thereof and the preceding passageway (which ordinarily is not known beforehand), or where there are growths adjacent the entrance to the trachea, or where the patient's head cannot be tilted up, the problem of adjusting the wire to the proper angle to pass the ensemble into the trachea becomes more acute, particularly in view of the need for speed and atraumatic insertion.

It is apparent that the foregoing procedures require the use of both hands of the anesthesiologist and, to those who are aware of the problems of the operating room, there are other matters also requiring his attention and hands at the same time.

The present invention comprises a stylet having at the distal end an adjustably deflectable tip or pilot adapted to engage the distal end of the endotracheal tube or catheter through which the said stylet has been inserted, the proximal end of the stylet having an actuator which is manipulable by one hand alone to control the angle of the tip or pilot of the stylet, whereby the endotracheal tube or catheter is stiffened and can be positively guided into the trachea to final position, despite abnormal entrance angles to the trachea, growths adjacent the entrance to the trachea, or inability to tilt or straighten the head of the patient.

One of the objects of this invention is to provide a stylet to facilitate the insertion of an endotracheal tube or catheter.

Another object of this invention is to provide a stylet to facilitate the insertion of an endotracheal tube or catheter, which stylet has an adjustably deflectable tip or pilot at the distal end to guide the end of the endotracheal tube or catheter into the trachea.

Still another object of this invention is to provide a stylet to facilitate the insertion of an endotracheal tube or catheter, which stylet has an adjustably deflectable tip or pilot at the distal end guiding the distal end of the endotracheal tube or catheter, which stylet has at the proximal end means manipulable by one hand alone to control the angle of the deflectable tip or pilot.

Yet a further object of this invention is to provide a stylet to facilitate insertion of an endotracheal tube or catheter, which stylet is easily inserted into the endotracheal tube or catheter to stiffen the same, and which stylet is easily withdrawn from within the endotracheal tube or catheter.

Yet another object of this invention is to provide a stylet to facilitate the insertion of an endotracheal tube or catheter, which stylet is comparatively simple in construction, efficient, easy to use and economical to manufacture.

Other and further objects of this invention will become apparent during the course of the following description and by reference to the accompanying drawing and the appended claims.

Referring now to the drawing, in which like numerals represent like parts in the several views:

FIGURE 1 represents a view in elevation, partially diagrammatic, in respect to the patient's head, showing the stylet and the surrounding endotracheal tube or catheter (in phantom) as it is being inserted into the trachea.

FIGURE 2 represents an enlarged longitudinal view,

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partially in section, of the manipulating handle at the proximal end of the stylet, showing in phantom the endotracheal tube or catheter secured to the hose clamp.

FIGURE 3 represents a longitudinal view of the distal end of the stylet, showing the deflectable tip or pilot in undeflected position, to a larger scale than FIGURE 2.

FIGURE 4 represents a view of the distal end of the stylet taken along the line 4—4 of FIGURE 3 and to the same scale as FIGURE 3.

FIGURE 5 represents an enlarged transverse section in elevation taken along the line 5—5 of FIGURE 3.

FIGURE 6 represents a view of the distal end of the stylet, showing the tip or pilot in maximum deflected position, to a larger scale than FIGURE 3.

Stylet 1 comprises substantially rigid tubular shaft 2, and has a proximal end 3 and a distal end 4. Tubular shaft 2 is hollow and smooth on both its interior and exterior surfaces. Operating wire 5 extends through tubular shaft 2 for a purpose which will be described hereinafter.

Manipulating handle 6 comprises tubular member 7 with plug 8 secured thereto at one end in any suitable manner. Plug 8 has longitudinal bore 9 through which tubular shaft 2 extends. Tubular shaft 2 is secured in any suitable manner, as by brazing, to plug 8. Plunger 10 is slidably mounted in the other, open, end of tubular member 7, and has a bore 11 running longitudinally therethrough. It will be noted that tubular shaft 2 terminates well before plunger 10, and operating wire 5 extends on past the end of tubular shaft 2, the end of operating wire 5 being secured, in any suitable manner, as for instance by threading, in collar 12. Collar 12 is mounted in bore 11 of plunger 10. Screw 13 passes through longitudinal slot 14 in tubular member 7 and is threaded into plunger 10 and through one side of bore 11 to firmly press collar 12 against the opposite side of bore 11 and thereby to secure collar 12 to plunger 10. It will be noted that screw 13 and plunger 10 can reciprocate longitudinally of tubular member 7 by an amount equal to the longitudinal dimension of slot 14, the end of tubular shaft 2 being outside the inmost extent of travel of plunger 10, and that operating wire 5, being secured to plunger 10 by collar 12 and screw 13, can also reciprocate relative to tubular member 7 by the same amount. Coil spring 15 is mounted within tubular member 7 around tubular shaft 2 and operating wire 5, and is adapted to bear against shoulder 16 of plug 8 and shoulder 17 of plunger 10 so as to urge plunger 10 to its outermost position, the engagement of screw 13 with the outermost edge of slot 14 determining the outer limit of movement thereof and preventing the plunger 10 from being pushed entirely out of tubular member 7.

At that end remote from manipulating handle 6, tubular shaft 2 is provided with two spaced arms 18, most clearly shown in FIGURE 4. Smooth, round-nosed tip or pilot 19 has blade 20 which is adapted to slidably fit between arms 18. Obliquely extending slot 21 is provided in blade 20, as shown in FIGURES 3 and 6. Pin 22 extends through arms 18 and slot 21 of blade 20. That end of operating wire 5 remote from manipulating handle 6 is secured, in any suitable manner, to collar 23 having spaced ears 24. Blade 20, adjacent its free end, is rotatably mounted between ears 24 by means of pin 25. It will be apparent that, as operating wire 5 is reciprocated in tubular shaft 2, pin 22 cooperating with slot 21 will cause the angle of pilot 19 to tubular shaft 2 to vary. The parts of this apparatus are so proportioned that, with plunger 10 urged to its outermost position by coil spring 15, pilot 19 will be aligned with the adjacent portion of tubular shaft 2, and pilot 19 can be deflected any degree to the maximum by depressing plunger 10 against the force of coil spring 15.

Tubular shaft 2 is, adjacent its central portion, preferably formed into an arc of 104° on a 5 inch radius, according to standards promulgated by the American Society of Anesthesiologists. Pilot 19 lies outside one side

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of this arc, and manipulating handle 6 lies outside the other side of this arc by a distance sufficient to permit hose clamp 26 to be interposed between the said arc and the said manipulating handle 6. It will be noted that the plane of angular deflection of pilot 19 lies in the same plane as this arc.

In operation, endotracheal tube or catheter 27 is secured to hose clamp 26, as shown in FIGURE 2, the said hose clamp 26 and endotracheal tube or catheter 27 each having a bore slightly larger than the outside diameter of tubular shaft 2. Then, with pilot 19 undeflected, the stylet 1 is inserted into hose clamp 26 and endotracheal tube or catheter 27 until pilot 19 is adjacent the distal end of the endotracheal tube or catheter 27. The ensemble is ready for insertion into the trachea indicated diagrammatically as 28 in FIGURE 1. With one hand around manipulating handle 6, and with his thumb on plunger 10, the anesthesiologist inserts the distal end 4 of the stylet 1 into the mouth of the patient and, by exerting the desired degree of pressure on plunger 10, controls in situ the deflection of the pilot 19 to guide the distal end 4 of stylet 1 into trachea 28. After stylet 1 has entered trachea 28 and has been advanced to the desired position, stylet 1 is withdrawn from endotracheal tube or catheter 27 by holding hose clamp 26 with one hand and pulling manipulating handle 6 away with the other hand. This leaves only endotracheal tube or catheter 27 remaining in place in the trachea 28. Then, the tube from the source of anesthetising gas mixture can be connected to endotracheal tube or catheter 27 by means of hose clamp 26 and the external cuff on the said endotracheal tube or catheter 27 inflated as is known to the art.

It can be seen from the foregoing that the present invention permits an endotracheal tube or catheter to be inserted into a trachea for intratracheal anesthesia in a rapid and substantially atraumatic manner and readily accommodates situations wherein the entrance angle to the trachea is abnormal, where there are growths adjacent the entrance to the trachea, or where the patient's head cannot be tilted up, and other similar circumstances.

It will of course be understood that the materials of construction of the present apparatus should be selected with a view to the circumstances under which the apparatus is to be used. The use of a good grade of stainless steel wherever practicable is to be preferred.

While I have shown the best embodiment of my invention now known to me, I do not wish to be limited to the exact structure shown and described herein, and my invention is to be constructed as covering modifications, substitutes and equivalents as are embraced within the scope of the specification, claims and drawing.

I claim:

1. A stylet adapted to insert an endotracheal catheter into a trachea, comprising:

- (a) a hollow shaft having a first end and a second end,
- (b) a pair of spaced arms secured to the first end of said hollow shaft,
- (c) a pilot having a central blade along its longitudinal axis, said central blade being slidably mounted between said pair of spaced arms,
- (d) a slot extending obliquely to the longitudinal axis of said pilot formed in said central blade,
- (e) a pin extending through said pair of spaced arms and through said slot,
- (f) an operating wire in said hollow shaft and having a first end and a second end,
- (g) a collar secured to the first end of said operating wire and having a pair of spaced ears, said collar being slidably mounted within said hollow shaft,
- (h) a second pin extending through said pair of spaced ears and through said central blade to pivotally mount said central blade to said pair of spaced ears,
- (i) manipulating handle means mounted to the second end of said hollow shaft and operatively con-

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nected to the second end of said operating wire, said manipulating handle means being adapted to be operated by one hand alone to move said operating wire longitudinally in said hollow shaft and thereby vary the angular deflection of said pilot relative to said hollow shaft,

- (j) said hollow shaft and said pilot being adapted to be removably inserted in said endotracheal catheter.
2. A stylet adapted to insert an endotracheal catheter into a trachea, comprising:
 - (a) a hollow shaft having a first end and a second end,
 - (b) a pair of spaced arms secured to the first end of said hollow shaft,
 - (c) a pilot having a central blade along its longitudinal axis, said central blade being slidably mounted between said pair of spaced arms,
 - (d) a slot extending obliquely to the longitudinal axis of said pilot formed in said central blade,
 - (e) a pin extending through said pair of spaced arms and through said slot,
 - (f) an operating wire in said hollow shaft and having a first end and a second end,
 - (g) a collar secured to the first end of said operating wire and having a pair of spaced ears, said collar being slidably mounted within said hollow shaft,
 - (h) a second pin extending through said pair of spaced ears and through said central blade to pivotally mount said central blade to said pair of spaced ears,
 - (i) said hollow shaft and said pilot being adapted to be removably inserted in said endotracheal catheter,
 - (j) spring-loaded manipulating handle means mounted to the second end of said hollow shaft and operatively connected to the second end of said operating wire, said spring-loaded manipulating handle means normally urging said pilot towards one angular position relative to said hollow shaft, said spring-loaded manipulating handle means being adapted to be operated by one hand alone to vary the angular deflection of said pilot towards another angular position relative to said hollow shaft.
3. Apparatus as in claim 2, said spring-loaded manipulating handle means comprising:
 - (k) a plunger operatively connected to said second end of said operating wire,
 - (l) spring means biasing said plunger in one direction.
4. Apparatus as in claim 2, said spring-loaded manipulating handle means comprising:
 - (k) an elongated member having a first end and a second end and providing a hand grip,
 - (l) attachment means securing said hollow shaft to the first end of said elongated member,
 - (m) a plunger slidably mounted to the second end of said elongated member, said plunger being secured to the second end of said operating wire,
 - (n) spring means interposed between said attachment means and said plunger.
5. Apparatus as in claim 2, said spring-loaded manipulating handle means comprising:
 - (k) an elongated member having a first end and a second end and provided with a bore, said elongated member providing a hand grip,
 - (l) plug means in said first end of said elongated member secured to said hollow shaft,
 - (m) a plunger slidably mounted in the second end of said elongated member and secured to the second end of said operating wire,
 - (n) a coil spring in the bore of said elongated member surrounding said operating wire and interposed in compression between said plug means and said plunger.
6. A stylet adapted to insert an endotracheal catheter into a trachea, comprising:
 - (a) a substantially rigid hollow shaft having a first end and a second end and curved along an arc,

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- (b) a pair of spaced arms secured to the first end of said hollow shaft,
- (c) a pilot having a central blade along its longitudinal axis, said central blade being slidably mounted between said pair of spaced arms,
- (d) a slot extending obliquely to the longitudinal axis of said pilot formed in said central blade,
- (e) a pin extending through said pair of spaced arms and through said slot,
- (f) an operating wire in said hollow shaft and having a first end and a second end,
- (g) a collar secured to the first end of said operating wire and having a pair of spaced ears, said collar being slidably mounted within said hollow shaft,
- (h) a second pin extending through said pair of spaced ears and through said central blade to pivotally mount said central blade to said pair of spaced ears,
- (i) said hollow shaft and said pilot being adapted to be removably inserted in said endotracheal catheter,
- (j) manipulating handle means mounted to the second end of said hollow shaft and operatively connected to the second end of said operating wire, said manipulating handle means being adapted to be operated by one hand alone to move said operating wire longitudinally in said hollow shaft and thereby vary the angular deflection of said pilot relative to the hollow shaft.
7. A stylet adapted to insert an endotracheal catheter into a trachea, comprising:
 - (a) a substantially rigid hollow shaft having a first end and a second end and curved along an arc,
 - (b) a pair of spaced arms secured to the first end of said hollow shaft,
 - (c) a pilot having a central blade along its longitudinal axis, said central blade being slidably mounted between said pair of spaced arms,
 - (d) a slot extending obliquely to the longitudinal axis of said pilot formed in said central blade,
 - (e) a pin extending through said pair of spaced arms and through said slot,
 - (f) an operating wire in said hollow shaft and having a first end and a second end,
 - (g) a collar secured to the first end of said operating wire and having a pair of spaced ears, said collar being slidably mounted within said hollow shaft,
 - (h) a second pin extending through said pair of spaced ears and through said central blade to pivotally mount said central blade to said pair of spaced ears,
 - (i) said hollow shaft and said pilot being adapted to be removably inserted in said endotracheal catheter,
 - (j) spring-loaded manipulating handle means mounted to the second end of said hollow shaft and operatively connected to the second end of said operating wire, said spring-loaded manipulating handle means normally urging said pilot towards one angular position relative to said hollow shaft, said spring-loaded manipulating handle means being adapted to be operated by one hand alone to vary the angular deflection of said pilot towards another angular position relative to said hollow shaft.
8. Apparatus as in claim 7, said spring-loaded manipulating handle means comprising:
 - (k) a plunger operatively connected to said second end of said operating wire,
 - (l) spring means biasing said plunger in one direction.
9. Apparatus as in claim 7, said spring-loaded manipulating handle means comprising:
 - (k) an elongated member having a first end and a second end and providing a hand grip,
 - (l) attachment means securing said hollow shaft to the first end of said elongated member,
 - (m) a plunger slidably mounted to the second end of said elongated member, said plunger being secured to the second end of said operating wire,

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(n) spring means interposed between said attachment means and said plunger.

10. Apparatus as in claim 7, said spring-loaded manipulating handle means comprising:

(k) an elongated member having a first end and a second end and provided with a bore, said elongated member providing a hand grip, 5

(l) plug means in said first end of said elongated member secured to said hollow shaft,

(m) a plunger slidably mounted in the second end of said elongated member and secured to the second end of said operating wire, 10

(n) a coil spring in the bore of said elongated member surrounding said operating wire and interposed

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in compression between said plug means and said plunger.

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