A medical access system includes a cannula (10) and a plurality of access tubes (18) positioned in the cannula, each access tube including a proximal opening (20), a distal opening (22) and a collapsed section (24) between the proximal and distal openings. The collapsed section is moveable to an expanded position in response to passage of an instrument into the lumen. The tubes are provided with a variety of cross-sectional 'diameters, allowing a user to elect to use a combination of tubes appropriate for the procedure being carried out. The collapsible nature of the tubes allows the cannula body to contain a collection of tubes having cross-sections that, in combination, exceed the available space within the cannula body.
MULTI-LUMEN CANNULA

Inventors: William L. Athas

5 RELATED APPLICATIONS:

This application claims priority to U.S. Provisional Application No. 60/971,905, filed September 12, 2007, which is incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

10 The present invention relates to the field of cannulas providing conduits for receiving medical instruments that are to be used in performing surgery in a body cavity.

BACKGROUND

Surgery in the abdominal cavity is typically performed using open surgical techniques or laparoscopic procedures. Each of these procedures requires incisions through the skin and underlying muscle and peritoneal tissue, and thus results in the potential for post-surgical scarring and/or hernias. Laparoscopic procedures, while less invasive than open surgical techniques, require multiple small incisions or ports to gain access to the peritoneal site using the various instruments and scopes needed to complete the procedure. Further developments have lead to systems allowing procedures to be performed using only a single port.

Systems and techniques in which access to the abdominal cavity is gained through a natural orifice (so-called "NOTES" procedures) are advantageous in that incisions through the skin and underlying muscle and peritoneal tissue may be avoided. Use of such systems can provide access to the peritoneal cavity using an access device inserted into the esophagus, stomach or intestine (via, for example, the mouth, vagina, or rectum). Instruments are then advanced through the access device into the peritoneal cavity via an incision in the wall of the esophagus, stomach or intestine.

In single port surgery ("SPS") and NOTES procedures, it is useful to employ an overtube or access cannula having multiple channels so that each channel can accommodate a different instrument during the procedure. Unfortunately, a multi-lumen cannula or overtube having a selection of channel sizes that works well for one procedure might not
work well for another procedure, since different procedures will require different combinations of instrument sizes. Even within a given procedure different combinations of instruments will be needed at different times, complicating the task of finding multi-lumen overtube or cannula that will accommodate the tools needed throughout the procedure.

The present application describes a multi-lumen cannula, suitable for use in SPS and NOTES procedures, that is adaptable to changes in the combinations of required instrument sizes that may occur during the course of a single procedures or from procedure to procedure.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a multi-lumen cannula;

Figs. 2A and 2B are perspective views of one of the cannula tubes of Fig. 1 in the collapsed position and the expanded position, respectively.

Fig. 3 is a cross-section view taken along the plane designated 3-3 in Fig. 1 in an embodiment having an optional seal within the cannula.

Fig. 4 is a cross-section view of a modified form of the port which includes sealing mechanisms.

DETAILED DESCRIPTION

Fig. 1 illustrates a multi-lumen cannula 10. The cannula includes a cannula body 12 having a proximal opening 14 and a distal opening 16. The cannula body may be an elongate overtube positionable to extend from a natural body orifice into a body cavity within which a procedure is to be performed. Alternatively, the cannula body 12 may be an access cannula that extends through an opening in the abdominal wall for single port surgery or laparoscopic procedures.

A plurality of collapsible tubes 18 extends through the cannula body 12. Each of the collapsible tubes 18 includes a proximal instrument port 20 positioned outside the proximal end of the cannula body 12 and a distal opening 22 positioned distal to the distal opening 16 of the cannula body 12. An intermediate section 24 extends between the proximal and distal ends.
The intermediate section 24 of each tube is collapsible as shown in Fig. 2A. The collapsible nature of the tubes allows the cannula body 12 to contain a collection of tubes having cross-sections that, in combination, exceed the available space within the cannula body. For example, five collapsible tubes having diameters of 3mm, 5mm, 5mm, 10mm and 15mm might be positioned within a cannula body 12 having a diameter of 25mm or less.

The tubes 18 are constructed such that they will expand to the expanded position (Fig. 1A) when an instrument is inserted into the instrument port 20 and advanced to the distal opening 22. In a preferred configuration, the instrument port 20 and distal opening 22 do not significantly collapse, but instead retain their open shape when the intermediate section 24 is in the collapsed position. This facilitates insertion of the instruments into the instrument ports 20, and also minimizes binding of the tubes as instruments are advanced towards the distal openings.

Suitable materials for the tubes 18 include thin walled or highly flexible polymeric materials. The tubes may include a lubricious lining to facilitate advancement of instruments through the collapsed tubes. The shapes of the instrument port 20 and distal opening 22 may be reinforced using resilient rings embedded in the tube material, or by thickened regions of the tubing material.

If the system is to be used during a procedure in which the body cavity will be insufflated, the cannula will preferably include a seal sealing the gaps between the tubes 18. In one embodiment, the seal may be a membrane 26 (Fig. 6) extending between each of the tubes 18 and circumferentially connected to the walls of the cannula 12. A preferred membrane will be constructed to give play between the tubes such that movement of tube (e.g. from movement of an instrument shaft within that tube) does not cause others of the tubes to move. For this purpose, the membrane can include loose/excess membrane material 28 between the tubes, or it may be highly elastic, or formed with pleats or bellows type structures 30 that allow for an increase in distance between adjacent tubes or between tubes and the surrounding wall of the cannula.

Additionally, valves may be positioned within the tubes 18 so as to maintain insufflation pressure within the abdominal cavity during use of the system 10. For example, each port 20 may be equipped with a sealing system having a first seal providing for self-sealing of the port in the absence of a medical instrument within the port, and a second seal
that creates a seal against the shaft of instruments passed into the port. For example, an annular seal 32 may be positioned most proximally, with a flap- or duckbill valve 34 located distal to the annular seal. During use, duck-bill valve remains closed when there is no instrument in the port 20. Instruments passed through the port 20 will pass between the flaps of the valve, thus releasing the seal provided by the valve. However, this will not result in appreciable loss of sealing, since insertion of the instrument into the port 20 causes the annular seal to make sealing contact with the instrument shaft. Alternatively, collapse of the tube 18 may be relied on (in place of a duck bill) to seal the tube when it is not in use.

During use of the system 10, the tubes 18 are placed within the cannula body 12 and the cannula body is placed such that the distal opening 16 is within a body cavity and the proximal opening 14 is positioned extracorporeally. The surgeon will select an instrument needed to perform a procedure within the body cavity, and s/he will insert that instrument into the instrument port 20 of a tube 18 having an appropriate diameter, causing expansion of the tube as described above. The tubes 18 may have color coding or other markings allowing the surgeon to easily determine which of the tubes is most appropriate for the selected instrument. Additional instruments are selected and likewise advanced through the most suitable ones of the tubes. As instrument changes are made throughout the procedure, different combinations of the tubes 18 are utilized. Following the procedure, the instruments are removed from the tubes 18 and the cannula body 12 is removed from the body.

It should be recognized that a number of variations of the above-identified embodiments will be obvious to one of ordinary skill in the art in view of the foregoing description. Accordingly, the invention is not to be limited by those specific embodiments and methods of the present invention shown and described herein. Rather, the scope of the invention is to be defined by the claims and their equivalents.

Any and all applications referred to herein, including for purposes of priority, are hereby incorporated herein by reference.
I claim:

1. A medical access system, comprising:
   a cannula; and
   a plurality of access tubes positioned in the cannula, each access tube
   including a proximal opening, a distal opening, a collapsed section between
   the proximal and distal openings, and a lumen extending from the proximal
   port to the distal opening, and the collapsed section moveable to an expanded
   position in response to passage of an instrument into the lumen.

2. The medical access system of claim 1, wherein a first one of the access tubes
   has a diameter smaller than a diameter of a second access tube.

3. The medical access system of claim 1, wherein at least one of the proximal
   sections includes a port biased in an open position.

4. The medical access system of claim 1, wherein at least one of the distal
   openings is biased in an open position.

5. The medical access system of claim 1, further including a seal between the
   access tubes.

6. The medical access system of claim 5, wherein the seal comprises a
   membrane extending between the access tubes.

7. The medical access system of claim 1, wherein at least one of the access tubes
   includes a sealing system including a first seal positioned to seal against an
   instrument positioned in the lumen, and a second seal positioned to seal the
   lumen in the absence of an instrument within the lumen.
8. The medical access system of claim 7, wherein the first seal is an annular seal positioned in a proximal portion of the access tube.

9. The medical access system of claim 7, wherein the second seal is a flap valve positioned in a proximal portion of the access tube.

10. The medical access system of claim 7, wherein the second seal comprises the walls of the access tube when the tube is in the collapsed position.

11. A method of accessing a body cavity using medical instruments, comprising:

   positioning an access cannula in an opening accessing a body cavity, the access cannula including a plurality of access tubes, each comprising an elongated tube having a lumen and a collapsed section disposed between a proximal opening and a distal opening;

   inserting a first medical instrument into the proximal opening of a first one of the access tubes and advancing the first instrument into the body cavity via the distal opening, causing the first access tube to expand from the collapsed position to an expanded position;

   inserting a second medical instrument into the proximal opening of a second one of the access tubes and advancing the second instrument into the body cavity via the distal opening, causing the second access tube to expand from the collapsed position to an expanded position; and

   performing a procedure within the body cavity using the first and second medical instruments.

12. The method of claim 11, wherein the method includes selecting as the first access tube an access tube having a lumen with a diameter proportioned to fit the first medical instrument, and selecting as the second access tube an access tube having a lumen with a diameter proportioned to fit the first medical instrument, wherein the lumens of the first and second access tubes have different diameters.
13. The method of claim 11, further including the step of insufflating the body cavity.
A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B17/34
ADD. A61M39/06 A61M39/08

According to International Patent Classification (IPC) onto both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61B, A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>WO 00/57937 A (HARKRIDER WILLIAM W JR) [US]) 5 October 2000 (2000-10-05) figures 1-8 page 5, line 19 - page 10, line 2</td>
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<td>WO 01/52754 A (PHILLIPS PLASTICS CORP [US]) 26 July 2001 (2001-07-26) figures 1-13 page 2, line 10 - page 3, line 13 page 4, line 11 - page 8, line 22</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search: 20 November 2008

Date of mailing of the international search report: 01/12/2008

Name and mailing address of the ISA:
European Patent Office, P.B. 5816 Patentlaan 2 NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Fax (+31-70) 340-3016

Authorized officer: Przykutta, Andreas
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This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. **X** Claims Nos.: 1-1-3 because they relate to subject matter not required to be searched by this Authority, namely:
   
   Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery

2. **☐** Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. **D** Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

1. **☐** As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. **☐** As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. **☐** As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 

4. **☐** No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 

**Remark on Protest**

- **☐** The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- **☐** The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- **☐** No protest accompanied the payment of additional search fees.
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