SUCKING WOUND PLUG AND CHEST ASPIRATOR


Filed: Jan. 8, 1971
Appl. No.: 104,960

U.S. Cl.................. 128/278, 128/349 BV
Int. Cl.................. A61m 1/00
Field of Search............. 128/349 B, 349 BV, 128/350, 344, 1, 246, 276-278

References Cited

UNITED STATES PATENTS

565,386 8/1896 Meengs ................. 128/349 B
2,457,244 12/1948 Lamson ................. 128/1
3,211,150 10/1965 Foderick ............... 128/349 BV
3,253,594 5/1966 Matthews et al .......... 128/1
3,509,884 5/1970 Bell ................... 128/246
3,511,228 5/1970 Lundgren et al ........... 128/25

Primary Examiner—Charles F. Rosenbaum
Attorney—George R. Douglas, Jr. and Keith Misegades

ABSTRACT

A unique inflatable bag catheter is provided having a pliable elongated bag disposed generally at the distal end thereof. A cylindrical end portion of the distal end may be formed with a plurality of apertures for the passage of fluids into the catheter from a space immediately adjacent the distal end. A terminal-most portion of the distal end of the catheter may be formed with a cushioning device to prevent damage to delicate internal portions of the body such as the lungs. A hand pump portion of the catheter may be threadedly and removably engaged with an inflatable balloon portion of the catheter. One-way valves may be provided in both the inflatable balloon portion of the catheter and the hand pump portion of the catheter to insure that fluids sucked in from the distal end of the catheter will travel only away from the distal end toward the proximal end of the catheter. One one-way valve may be disposed on either side of the hand pump which may comprise an elastomeric bulb. A conduit may be connected with the inflatable balloon for directing inflating fluids thereto. The free terminal end of the conduit may be fitted with threading corresponding with threading on the inflatable balloon portion of the catheter. Because of this arrangement, the hand pump may be attached initially to the conduit for inflating the balloon and then may be removed to be reconnected with the inflatable balloon portion of the catheter for evacuating fluids from within a body cavity. When the hand pump is threadedly engaged with the conduit for inflating the balloon, another one-way valve may be threadedly engaged within a free end portion of the elastomeric bulb portion of the catheter to convert the pump from a suction device to one for pressurizing of the inflatable balloon.

In one alternative embodiment, a valved face mask may be provided to require a user to forcefully exhale so as to increase the compression force on internal drainage fluids which force, in turn, permits the expulsion of undesirable internal fluids through the catheter by the pumping action of the chest wall.

13 Claims, 4 Drawing Figures
SUCKING WOUND PLUG AND CHEST ASPIRATOR

BACKGROUND OF THE INVENTION

The invention relates to means for simultaneously sealing off atmospheric leaks into the chest and blood escaping from chest, sucking wounds of various irregular shapes, and for draining off fluids leaking into the intrathoracic space from the infected chest wall. More particularly, the invention relates to an inflatable bag catheter which may be installed within a body perforation by one unskilled in medical practices, and which then may be manually or automatically operated without fear of overpressurizing the internal spaces adjacent the sucking wound.

In view of the high casualty rate of severely wounded men in Indo-China, and in view of the possibility of future conflicts among nations which may result in vast numbers of wounded men who might be saved if immediately and properly treated, it is imperative that continuing efforts be made to improve the medical tools available for preserving the lives of such victims.

In war and at accident scenes, the medical expertise necessary to treat a large sucking wound is, too often, not available. Such wounds, as a large irregular perforation of the chest wall, can mean death to the victim if not sealed and drained within a very short period of time. If the wound is not sealed, the victim may, of course, die due to a loss of blood. If the natural vacuum of the intrathoracic space, surrounding the lungs, is not promptly restored, the victim's breathing may be severely curtailed.

Therefore, surgical apparatus must be advanced for providing a simple and inexpensive means for simultaneously sealing and draining such a wound as a perforation of the chest wall. Such apparatus must be operable by one having no medical training and must, itself, not present any hazards to the life of the victim.

The cannula has been previously known in the surgical arts, and has been utilized for withdrawing fluids from internal body spaces. For example, the catheter has long been used for draining fluids contained within internal organs. More specifically, inflatable bag catheters have been used commonly by physicians for many years to drain the internal organs of patients. Such catheters are comprised of thin walled, flexible, hollow drainage tubes provided with one or more lateral openings in the distal end thereof to permit the passage of fluid contained within an internal organ, into which the catheter has been inserted, to be drawn into the hollow tube and expelled at the proximal end of the tube. The catheter is provided, adjacent the distal end thereof, with a bulbous shape which may be inflated to retain a catheter in operational position once the catheter has been inserted into the internal organ to be drained. The inflatable bag is inflated through an inflation tube which connects with the inflatable bag and may extend to the proximal end of the catheter.

In using such an inflatable bag catheter, the distal end of the catheter first is inserted into the organ to be drained. Then, the inflatable retention bag is inflated by introducing a required amount of inflating fluid, such as air or water. The inflating fluid is usually introduced through the use of a hypodermic syringe inserted through a plug in the inflation arm when a plug is used therein. When a valve is employed in the inflation tube, the bag may be inflated by means of a syringe provided with a tip capable of opening the valve. In view of the rather delicate operation involved, heretofore such an operation had to be performed by those skilled in the surgical arts. Also, when such devices were applied to perforated flesh wounds as opposed to natural cavities of the body, additional problems were encountered.

One attempt at providing an effective means for sealing a wound comprising a flesh perforation is evidenced by U. S. Pat. No. 3,283,944, issued to Matthews, et al, in 1966. Matthews, et al, disclose a cannula or catheter having an inflatable bag disposed at a distal end thereof. Although the Matthews, et al, patent shows that a catheter with an inflatable bag attached thereto may be used to seal a perforation in body flesh, the apparatus is rather crude and requires the use of washers and nuts for the installation thereof which may require or cause an enlargement of the wound opening. Also, if the perforation were in the chest cavity area, the Matthews, et al, apparatus makes no provision for removing gas and liquids draining into the intrathoracic space which maintains the vacuum which normally surrounds the lungs. This normal vacuum is of critical importance in that it permits natural unforced inhalation upon chest expansion.

It would, therefore, be advantageous if a combined apparatus were provided which performed the dual functions of effectively sealing a wound comprising a flesh perforation adjacent the chest cavity and which automatically withdrew fluids draining into the intrathoracic space in response to the natural movement of the chest during respiration.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a combined sucking wound plug and chest aspirator which solves many of the problems confronting the medical profession today.

It is another object of the present invention to provide a sucking wound plug and chest aspirator which may be installed by one who is not skilled in the surgical arts.

It is still another object of the present invention to provide a chest aspirator which may operate automatically in response to normal chest movement during respiration.

It is yet another object of the present invention to provide a sucking wound plug and chest aspirator having a hand pump which may be used to both inflate an inflatable bag portion of the catheter and to withdraw fluids draining into an internal space adjacent a perforated flesh wound.

It is still another object of the present invention to provide a simple means for sealing flesh perforations despite the permutations of irregular shapes and sizes of such perforations.

It is yet another object of the present invention to provide a sucking wound plug and chest aspirator which may be inserted through a flesh perforation of a human body without fear of damaging the internal organs thereof.

It is still yet another object of the present invention to provide a sucking wound plug and a chest aspirator having a hand pump which cannot be operated in a
manner that will place a damaging suction on an internal space adjacent a perforated wound. It is still yet a further object of the present invention to provide a sucking wound plug and chest aspirator which is more effective, inexpensive, and versatile than the plugs or aspirators heretofore known.

It is another object of the present invention to provide a valved face mask means which cooperates with the aspirator to cause fluids to be expelled from the intrathoracic space with relatively high force.

At least some of the above listed objects are carried out by the provision of a unique catheter having an inflatable bag at a distal end thereof and a hand pump disposed adjacent a proximal end thereof. One way valve means is provided for directing fluid passage only from the distal to proximal ends of the catheter. The catheter may comprise two portions. The first portion of the catheter includes the proximal end and the hand pump means which may be operatively engaged with the second portion including the distal end of the catheter for draining internal fluids, or with an inflation tube for inflating the inflatable bag.

In one independent feature of the invention, cushion means is provided at the terminal-most portion of the distal end of the catheter to prevent damage to internal organs and additional one-way valve means is provided for use with the hand pump means to convert the pump from a suction to a pressurizing apparatus.

In another independent feature of the invention, a face mask provides a resistance to exhalation which assistance, in turn, increases the force with which internal fluids are expelled.

BRIEF DESCRIPTION OF THE DRAWINGS

While the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification, a preferred embodiment is disclosed in the following detailed description, which may be best understood when read in connection with the accompanying drawings in which:

FIG. 1 is a partial axial sectional view of a distal end portion of an apparatus according to the present invention, properly installed within a chest wall perforation;

FIG. 2 is an axial sectional view of a first portion of the catheter, which may be connected with either a body fluid draining tube or an inflation tube of the second portion of the catheter;

FIG. 3 is an axial sectional view of a one-way valve which may be used in combination with the portion shown in FIG. 2 to convert a pump of the first portion from a suction apparatus to a pressurizing apparatus; and

FIG. 4 is a sectional view of a valved face mask which may be used in combination with the apparatus of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIGS. 1 and 2 show an inflatable balloon catheter assembly according to the present invention. The assembly includes a first portion 16 and a second portion 10 which is installed within a perforation 12 defined within a patient's chest wall 14. The portion 10 of the overall catheter will be referred to herein as the distal end portion of the catheter.

FIG. 2 shows the first portion 16 of the inflatable balloon catheter, which portion shall be referred to herein as the proximal portion. It can readily be seen, that the proximal portion 16 may be threadedly engaged with the distal portion 10 to form an operable apparatus by the engagement of the male threads 18 of portion 10 within the female threads 20 of the portion 16.

It will be noted that the distal portion 10 of the overall apparatus is provided with an inflatable bag 22, which may be of a very pliable elastomeric substance. The bag 22 may be formed with end walls 24 and 26, having areas which may be expected to be generally larger than the cross-sectional areas of a chest wall perforation to be sealed. In this manner, the generally cylindrical portion of the balloon 28 extending between the end walls 24 and 26 may fit snugly within the various irregular surfaces, e.g., surface 30, of the marginal edges of the chest wall 14, defining the perforation 12.

The terminal distal end of the catheter may be of a generally cylindrical configuration, having apertures 32 formed therein for the passage of body fluids from an intrathoracic space 34 surrounding the distal end into the internal passageway 36 of the overall catheter assembly. A very soft cushioning means 38 may be presented on the terminal-most edge of the distal end of the catheter to prevent damage to any delicate internal organs such as the lung 40.

An inflating tube 42 may be connected with the inflatable bag 22 for directing inflating fluid thereto. The tube 42 may be provided with a valve 44 and a threaded fitting 46 at a terminal free end thereof.

The second portion 16 of the catheter assembly may be formed with internal female threading 48 which corresponds with the male threading of the fitting 46 of the inflation tube 42. Through this correspondence of the various male and female threadings of the various members of the overall assembly, the hand pump, which, in the preferred embodiment, comprises an elastomeric bulb 49, may be operatively attached to the drainage tube portion of the catheter 10 by engaging threads 18 within threads 20 or may be attached to the bag inflating tube 42 by the engagement of female threads 48 of the catheter portion 16 with the male threading 46 of the inflating tube 42.

A unique arrangement of one-way valves is provided throughout the overall assembly. A one-way valve 50 is provided in the portion 16 of the catheter intermediate the terminal ends thereof. The valve 50 comprises two end plates 52 and 54, having axially aligned apertures 56 and 58, respectively, formed therein. A valve disc 60 is urged against the end plate 56 to seal the aperture formed thereby by means of a helical spring 62 which urges at its opposite end against the second end plate 54.

In operation, after the portion 10 of the overall catheter has been properly inserted within a flesh perforation 12 and after the inflatable bag 22 has been inflated by directing pressurized fluid through the tube 42, so that the inflatable bag firmly seals and adheres within all the various jagged portions 30 of the perforation 12, the normal action of the lung 40 in combination with the compression forces of the chest wall during exhalation will assert pressure against any fluids within the intrathoracic space 34. The overpressure applied to the fluids within the space 34 will then force the fluid in through the apertures 32 to the passageway 36 of the catheter and will simultaneously force the valve disc 60
to lift off the seat formed by the valve end plate 52. When the chest wall is restored to an expanded position, there is no longer an overpressure with respect to the spring 62 of the one-way valve, so that the valve disc 60 is urged against its seat 52 formed by end plate 56 and fluid cannot return through the catheter into the space 34 through the apertures 32. It can be seen that, through this operation, the normal breathing of a patient will cause the systematic and cyclic pumping of any fluid which has seeped into the intrathoracic space.

If the normal breathing action of the patient should be insufficient to operate the one-way valve 50, the portion 16 of the assembly may be connected to provide proper suction for draining fluids from the intrathoracic space. The installation of the portion 16 will not interfere with normal automatic chest aspiration due to respiration and, therefore, a single operator may take rest periods between periods of manual pumping. The portion 16 of the overall apparatus may comprise a relatively rigid tube 64, having the elastomeric bulb 49 formed integrally therewith. A second one-way valve 54 which may be installed with the tube 64 may be of the same configuration and structure as the last described one-way valve 50. The one-way valves 50 and 64 must be operable to pass fluid in the same direction when the female and male threadings 20 and 18 respectively, of the first portion and the second portion of the apparatus are connected. When the portion 16 is connected with the inflating tube 42 by means of female threads 48 engaging on the male threads 46 of the tube 42, a third one-way valve 68 may be installed within the portion 16 to convert the pump to a pressurizing device. FIG. 3 shows a tubular housing for the one-way valve 68, which housing is provided with male threading 70 at one end thereof for engagement within female threading 20 of the portion 16 of the overall assembly. The one-way valve 68 may be identical in configuration with the two other valves 50 and 64.

When it is desired to inflate the bag 22 by means of the elastomeric bulb 49, the female threads 48 are engaged within the male threads 46 to connect the hand pump with the tube 42 and the one-way valve 68 is attached to the other end of the portion 16, by engaging the male threads 70 within the female threads 20. With the hand pump attached in this manner, squeezing the hand pump aspirates air through the one-way valve 68 and forces air through the one-way valve 66 into the inflatable bag 22. When the bag is properly inflated, the valve 44 on the conduit 42 is closed to trap the pressurized fluid in the bag 22. Any suitable fluid may be used in inflating the bag 22.

FIG. 4 shows a face mask 100, which may be used in combination with the catheter portion of the present invention. The mask 100 may comprise an elastomeric substance such as natural rubber and may be held in an operational posture by conventional head straps 102 which may be connected with a portion of the mask by hooks 104 or the like. Valve 44 may offer pressure relief.

The mask 100 may be provided with a sealing ring 106 disposed about the marginal edge thereof. A flap valve 108 and a spring loaded valve 110 may be mounted generally centrally of the mask 100. The flap valve 108 comprises a cylindrical body 112 and a hinged valve member 114, which swings freely inwardly to permit ease of inhalation but closes when moved outwardly to prevent exhalation therethrough. The valve 110 is arranged to prevent inhalation therethrough and to permit only forced exhalation against the bias of the spring 116.

The overall effect of the valves 108 and 110 is to cause the user of the mask 100 to inhale freely but to exhale forcibly. The forced exhalation is operable to increase the chest wall pressure on fluids in the intrathoracic space to increase the force with which they are expelled through the catheter apparatus. Thus, it can be seen that the face mask 100 cooperates with the catheter apparatus in a synergistic manner to produce the new and improved functional result of expelling undesirable internal fluids utilizing the action of a patient's respiratory movement more efficiently than heretofore possible.

SOME ADVANTAGES OF THE PRESENT INVENTION

It can thus be seen that a combined sucking wound plug and chest aspirator has been herein provided which may be embodied and operated with skill in the surgical arts. The configuration of the inflatable bag 22 of the catheter apparatus is such as to provide a tight seal with the jagged marginal edges of a chest wall perforation. The distal end cushion 38 insures that the overall catheter may be inserted within a perforation without damaging internal organs such as the lung 40. Th first portion 10 of the overall assembly may function without any additional auxiliary equipment as an automatic pump whereby overpressure caused by the expansion of the lung on fluids within the intrathoracic space 34, force the cyclic opening and closing of the one-way valve 50 so as to expel fluids draining into the space 34. The face mask may be utilized to increase the resistance to exhalation which, in turn, increases the pressures in the intrathoracic spaces to aid the natural forces of respiration in the expulsion of fluids. If the natural respiratory action of the lung is insufficient to properly expel the unwanted fluids, the hand pump 49 may be attached by the threaded engagement of the male threads 18 with the female threads 20. Since the pumping action of the hand pump 49 is effected only when the elastomeric bulb is released to move from a contracted to an expanded condition due to the natural resiliency of the elastomeric material comprising the bulb, it is impossible for an excited or overzealous operator to exert too much pumping force on the internal space 34 of the patient.

Since the hand pump 49 may be utilized to either drain fluids from the intrathoracic space 34 or to pressurize the inflatable balloon 22, the overall apparatus is provided with more versatility than heretofore known. The interaction of the various parts of the overall assembly operate in a synergistic manner to simultaneously provide the dual functions of sealing perforated body wall and of draining harmful fluids developing within the intrathoracic space so as to restore proper breathing.

SCOPE OF THE INVENTION

While what has been shown herein is the preferred embodiment of the present invention, it is, of course, understood that various modifications and changes may be made therein without departing from the invention. It is, therefore, intended to cover in the following claims all such modifications and changes as may fall...
3,777,757

within the true spirit and scope of the present invention.

What I claim is:

1. Apparatus comprising:
catheter means having a distal end and a proximal end; inflatable bag means disposed at said distal end of said catheter means;
inflating tube means for directing inflating fluid to said inflatable bag means;
cushioning means presented on a terminal-most portion of said distal end of said catheter means;
suction forming means for drawing fluid in through said distal end of said catheter means; and
first one-way valve means disposed in said catheter means and operable to pass fluid from said distal end of said catheter toward said proximal end of said catheter in response to overpressurization being transmitted thereagainst by fluid disposed within and adjacent said distal end.

2. An apparatus according to claim 1, wherein said inflatable bag means has end walls having areas generally larger than the cross-sectional areas of a chest wall perforation to be sealed and said inflatable bag means has a generally cylindrical portion extending between said end walls so that said generally cylindrical portion engages snuggly within various irregular surfaces of said chest wall perforation.

3. An apparatus according to claim 1, wherein said suction forming means comprises hand pump means; and
said hand pump means forms a portion of a continuous closed fluid passageway extending from said distal end to said proximal end of said catheter means.

4. An apparatus according to claim 3, wherein said hand pump means comprises an elastomeric bulb formed as a part of said catheter and disposed intermediate the terminal ends thereof.

5. An apparatus according to claim 4, wherein said first one-way valve means comprises one valve disposed on each side of said elastomeric bulb.

6. An apparatus according to claim 5, wherein a first portion of said catheter including said proximal end presents said elastomeric bulb and is detachably connected with a remaining second portion of said catheter which second portion includes said distal end.

7. An apparatus according to claim 6, wherein a first end of said first portion of said catheter is formed with a first female threading and a first end of said second catheter portion is formed with a first male threading corresponding with said first female threading;
a second end of said first portion of said catheter being formed with second female threading;
a first end of said inflating tube means being formed with male threading corresponding with said second female threading of said second portion of said catheter;
a second one-way valve means being removably engageable within said first female threading of said first portion of said catheter; and
whereby said first portion of said catheter may be initially threadedly engaged with said inflating tube means for directing fluid to said inflatable bag means with said second one-way valve means being engaged within said first female threading of said first portion of said catheter and may then be re-

8. A combined plug and chest aspirator for sealing wounds penetrating the chest wall cavity, comprising:
an inflatable bag catheter;
tube means for conducting fluid to said inflatable bag;
cushion means disposed at the terminal-most portion of a distal end of said catheter;
hand pump means provided on said catheter;
a first one-way valve disposed in said catheter between said hand pump means and a proximal end of said catheter;
a second one-way valve disposed in said catheter between said hand pump means and said distal end of said catheter; and
said first and said second valves operable to pass fluid from said distal end of said catheter toward said proximal end thereof.

9. A combined plug and chest aspirator according to claim 8, wherein said catheter comprises a first portion and a second portion;
said first portion having said hand pump and said first one-way valve;
said second portion having said inflatable bag and said second one-way valve;
a first end of said first portion being provided with female threading;
a first end of said second portion being formed with male threading corresponding with said last mentioned female threading;
a free end of said tube means for conducting fluid to said inflatable bag having male threading; and
said first portion of said catheter being formed with female threading at a second end thereof corresponding with said male threading formed on said tube means for conducting fluid to said inflatable bag.

10. An apparatus according to claim 8, wherein said inflatable bag comprises two generally radially extending end walls and a generally cylindrical surface extending therebetween; and whereby the outer periphery of said end walls extend beyond the peripheral extent of a body perforation and said cylindrical surface is operable to engage flush against an irregular surface of the marginal edges defining the perforation in response to the inflation of said inflatable bag.

11. An apparatus according to claim 9, wherein said hand pump means comprises an elastomeric bulb.

12. An apparatus according to claim 11, wherein each said one-way valve comprises two radially extending end walls having axially aligned apertures; and
a valve disc is spring biased against one of said apertures.

13. An apparatus according to claim 11, wherein a second one-way valve means is releasably engaged within said first portion of said catheter; and
whereby said elastomeric bulb may be converted from a suction forming to a pressure forming means.

* * * * *