

DESCRIPTION

NATURAL ORIFICE EXPANSION APPLICATOR

TECHNICAL FIELD

[0001] The present invention relates to a natural orifice expansion applicator.

BACKGROUND ART

[0002] It has become clear that cervical cancers are often due to infection of human papillomavirus (HPV). Furthermore, it is considered that smoking is also a dangerous factor for the cervical cancer.

[0003] As a standard treatment to cervical dysplasia, carcinoma in situ or micro invasive cancer that is a precancerous lesion of the cervical cancer, heretofore conical resection of a cervix has been known. According to the conical resection, fertility can be preserved. However, the cervix is shortened, and hence, there is concern that risk of abortion increases in postoperative pregnancy.

[0004] On the other hand, a photodynamic therapy (PDT) has been suggested which is a tumor specific therapy of treating tumor cells by a photochemical reaction while minimizing damage to normal cells by combined use of a photosensitizer having a high tumor affinity and low power laser irradiation.

[0005] In the conical resection of the cervix that has been the standard treatment hitherto, pain or bleeding is involved, but according to the PDT, there is hardly pain or bleeding during an operation, and hence, anesthesia is not required. However, long time is required for metabolism and excretion of the photosensitizer that has been used in a past PDT. Therefore, an inpatient treatment for shading from several days to about two weeks has been required as a photosensitivity measure.

[0006] Therefore, a PDT is also suggested in which a large amount of protoporphyrin IX (PPIX) that is a photosensitizer and a metabolite of amino levulinic acid (ALA) is accumulated in tumor cells, and target tumor cells are killed by active oxygen generated by irradiation with light having a specific wavelength (e.g., see Patent Literature 1).

[0007] According to the PDT described in Patent Literature 1, for amino levulinic acid, the shading for a short period of time is sufficient as the photosensitivity measure, thereby enabling an outpatient treatment. Furthermore, in Patent Literature 1, photodynamic diagnosis (PDD) is suggested in which PPIX is accumulated in the tumor cells, and fluorescence emitted from the tumor cells irradiated with light having a specific wavelength is measured, to diagnose the cervical cancer.

[0008] Here, when PDT or PDD is carried out, an applicator is required that is capable of opening a vaginal vault and a cervical canal and in which an optical fiber to transmit light and an endoscope can be arranged. As an applicator to be applied to a uterus, there has been known a cervical indwelling catheter including a main catheter in which a balloon and a plurality of paths are formed (e.g., see Patent Literature 2).

CITATION LIST

PATENT LITERATURE

[0009] PTL1: Japanese Patent Laid-Open No. 2011-01307

PTL2: Japanese Patent Laid-Open No. 1984-67969

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0010] However, in a cervical indwelling catheter described in Patent Literature 2, a balloon does not open a vaginal vault and a cervical canal, and a plurality of paths formed in a main catheter are not provided so that an optical fiber and an endoscope are arranged. Therefore, the catheter is not applicable to PDT or PDD.

[0011] Furthermore, a trumpet-shaped thin film provided in the catheter described in Patent Literature 2 covers a physically defective egg membrane. That is, the trumpet-shaped thin film is expanded radially to an axis of a main catheter. Therefore, the thin film cannot be made compact when inserting, has difficulty in reaching the vaginal vault and the cervical canal, and there is concern that a patient feels pain.

[0012] The present invention has been developed to solve at least a part of such a problem as described above, and an object thereof is to provide a natural orifice expansion applicator

that is capable of carrying out PDT or PDD and can be compact when contracted.

SOLUTION TO PROBLEM

[0013] The present invention provides a natural orifice expansion applicator comprising a balloon portion inflatable by a fluid to be introduced inside, and a connector to connect a first end portion of the balloon portion to a tube, wherein the balloon portion includes a plurality of corner portions extending from the first end portion toward the second end portion.

[0014] In this case, a valley portion may be formed between the adjacent corner portions. The balloon portion may expand linearly from the first end portion toward the second end portion. The balloon portion may expand linearly from the first end portion toward the second end portion, and contract toward the second end portion in a curved manner at a position closer to the second end portion than to the first end portion. The corner portion may be formed to be thicker than the valley portion between the adjacent corner portions. The thick corner portion may extend straight from the first end portion toward the second end portion. The thick corner portion may extend to a position at which an outer periphery of the balloon portion is maximum. The balloon portion may be formed with a light transmitting portion to transmit light, at the second end portion. The balloon portion may be formed with a light transmitting portion to transmit light, at between the first end portion and the second end portion.

BRIEF DESCRIPTION OF DRAWINGS

[0015] Fig. 1 is a configuration view showing a natural orifice expansion applicator according to a first embodiment.

Fig. 2 is a cross-sectional view taken along the A-A line of Fig. 1.

Fig. 3 is a perspective view showing a balloon portion.

Fig. 4 is a side view showing the balloon portion.

Fig. 5 is a cross-sectional view of the balloon portion of Fig. 4.

Fig. 6 is a front view of the balloon portion seen from a tip portion side.

Fig. 7 is a front view showing a state where the balloon portion is contracted as seen from the tip portion side.

Fig. 8 is a side view showing a balloon portion according to a second embodiment.

Fig. 9 is a front view showing the balloon portion according to the second embodiment seen from a tip portion side.

Fig. 10 is a front view showing modifications of a connector.

DESCRIPTION OF EMBODIMENTS

[0016] (First Embodiment)

Hereinafter, description will be made as to a natural orifice expansion applicator according to an embodiment of the present invention with reference to drawings. In the respective drawings, the same or corresponding parts are denoted with the same reference signs and described. Note that the natural orifice expansion applicator of the present invention is an applicator that opens a vaginal vault and a cervical canal and in which an optical fiber that radiates light and an endoscope are arranged, so that PDT or PDD can be carried out.

[0017] Fig. 1 is a configuration view showing a natural orifice expansion applicator according to a first embodiment, and Fig. 2 is a cross-sectional view taken along the A-A line of Fig. 1.

As shown in Fig. 1, a natural orifice expansion applicator 100 comprises a balloon portion 10, a catheter (tube) 20, and a connector 30 (see Fig. 2) that connects the balloon portion 10 and the catheter portion 20.

[0018] The balloon portion 10 is provided with a cylindrical support 12 having an elliptical cross section integrally at a base end portion (a first end portion) 11, and a light transmitting portion 14 to transmit light is formed at a tip portion (a second end portion) 13. The balloon portion 10 is made of silicon rubber, and provided inflatable by a fluid that is a liquid or a gas to be introduced inside.

[0019] The catheter portion 20 is formed of silicon rubber in a tubular shape, and has one end connected to the balloon portion 10 via the connector 30. The catheter portion 20 is constituted of a fluid conveying tube 21 that conveys fluid, an optical fiber tube 22 in which an unshown optical fiber is to be inserted, and an endoscope tube 23 in which an unshown

endoscope is to be inserted.

[0020] As shown in Fig. 2, the connector 30 is formed of silicon rubber in a columnar shape having an elliptic cross section, and incorporated in the support 12 of the balloon portion 10. The connector 30 is formed with a first through hole 31, a second through hole 32, and a third through hole 33 having a greater diameter than the first through hole 31 and the second through hole 32. An end of the fluid conveying tube 21 of the catheter portion 20 is inserted and held in the first through hole 31, an end of the optical fiber is inserted and held in the second through hole 32 through the optical fiber tube 22, and the endoscope is inserted and held in the third through hole 33 through the endoscope tube 23. Consequently, the connector 30 is provided to connect the base end portion 11 of the balloon portion 10 to the catheter portion 20.

[0021] In the natural orifice expansion applicator 100, the balloon portion 10 is inflated by the fluid conveyed by the fluid conveying tube 21, and laser light propagated by the optical fiber is transmitted through the light transmitting portion 14 of the balloon portion 10 to irradiate an affected part, so that the affected part can be visually recognized through the light transmitting portion 14 with the endoscope.

[0022] Hereinafter, description will be made as to the balloon portion 10 in further detail.

Fig. 3 is a perspective view showing the balloon portion, Fig. 4 is a side view showing the balloon portion, Fig. 5 is a cross-sectional view of the balloon portion of Fig. 4, Fig. 6 is a front view of the balloon portion seen from a tip portion side, and Fig. 7 is a front view showing a state where the balloon portion is contracted as seen from the tip portion side. Note that Fig. 3 to Fig. 6 show a state where the balloon portion 10 is not inflated by filling with the fluid or the like, that is, a state where a pressure in the balloon portion 10 is equal to an ambient pressure.

[0023] As shown in Fig. 3, the balloon portion 10 has eight corner portions 15 extending from the base end portion 11 toward the tip portion 13. The balloon portion 10 includes a mountain fold-like shape folded along linearly extending corner portions 15, and a valley portion 16 as a curved surface having a parabolic cross section is formed between the

adjacent corner portions 15, 15.

[0024] As shown in Fig. 4, the balloon portion 10 is formed to have an area A1 on a base end portion 11 side expanding linearly from the base end portion 11 toward the tip portion 13, and an area A2 on a tip portion 13 side contracting in a curved manner toward the tip portion 13 at a position closer to the tip portion 13 than to the base end portion 11. Consequently, the corner 15 also extends straight from the base end portion 11 toward the tip portion 13, and has a shape curved from the position closer to the tip portion 13 than to the base end portion 11 toward the tip portion 13. Consequently, the balloon portion 10 is formed to have a maximum outer periphery at a boundary between the area A1 that linearly expands and the area A2 that contracts in the curved manner.

[0025] As shown in Fig. 5, the balloon portion 10 and the support 12 according to the present embodiment are formed with the same uniform thickness. Consequently, when an interior of the balloon portion 10 is filled with fluid and entirely inflated in a spherical shape, the corner portions 15 also expand into a curved surface.

[0026] The light transmitting portion 14 formed at the tip portion 13 is formed in a planar shape being flush with a front end of the valley portion 16 that is also a front end of the area A2. By having the light transmitting portion 14 formed in a planar shape, the laser light propagated by the optical fiber can be irradiated uniformly. Note that in the present embodiment, the light transmitting portion 14 is formed at the tip portion 13, however because the balloon portion 10 is entirely formed of the same material and has the same thickness as the light transmitting portion 14, the laser light propagated by the optical fiber can also be transmitted at portions on the balloon portion 10 other than the light transmitting portion 14, such as the corner portions 15 and the valley portions 16. That is, the laser light can also be transmitted in a direction vertical to an extending direction of the catheter portion 20 via the corner portions 15, the valley portions 16, and others and so that ALA-PDT and ALA-PDD can be performed.

[0027] As shown in Fig. 6, the balloon portion 10 has the eight corner portions 15 project in a mountain manner, and the valley portion 16 between the corner portions 15, 15 is curved

toward a center of the balloon portion 10, when seen from the tip portion 13 side.

Consequently, when the fluid in the balloon portion 10 is drawn outside, as shown in Fig. 7, the balloon portion 10 contracts so that the corner portions 15 and the valley portions 16 come close to the center of the balloon portion 10, and the outer periphery of the balloon portion 10 decreases. At this time, by having the corner portions 15 maintain their bent shape, and also the valley portions 16 are curved, the balloon portion 10 can have a strength increased in a direction that passes the base end portion 11 and the tip portion 13, that is, a direction in which the natural orifice expansion applicator 100 is inserted in the vaginal vault and the cervical canal. When the corner portions 15 and the valley portions 16 come close to the center of the balloon portion 10, a distance between the base end portion 11 and the tip portion 13 increase.

[0028] The natural orifice expansion applicator 100 according to the present embodiment comprises the balloon portion 10 that is inflatable by fluid to be introduced inside, and the connector 30 to connect the base end portion 11 of the balloon portion 10 to the catheter portion 20, and the balloon portion 10 includes a plurality of corner portions 15 extending from the base end portion 11 toward the tip portion 13. Consequently, the balloon portion 10 has the decreased outer periphery when seen from the tip portion 13, and can have the strength increased in the direction that passes the base end portion 11 and the tip portion 13. This can obtain the natural orifice expansion applicator that can carry out the PDT or the PDD and that can be compact when contracted, and easy to reach the vaginal vault and the cervical canal, thereby making it possible for a patient to feel less pain.

[0029] (Second Embodiment)

Fig. 8 is a side view showing a balloon portion according to a second embodiment, and Fig. 9 is a front view showing the balloon portion according to the second embodiment seen from a tip side. Note that in the second embodiment, description will be made as to differences from the first embodiment, and the same configuration as in the first embodiment of the drawings is denoted with the same reference signs.

[0030] As shown in Fig. 8, configurations of thick corner portions 115 and a support 112 of

a natural orifice expansion applicator 200 according to the present embodiment, are different from those of the corner portions 15 and the support 12 of the first embodiment.

[0031] As shown in Fig. 9, the thick corner portions 115 is formed to be thicker than a valley portion 16 that is present in a position between adjacent thick corner portions 115, 115. As shown in Fig. 8, this thick corner portion 115 extends from a base end portion 11 toward a tip portion 13 only in a range of an area A1. That is, the thick corner portions 115 of a balloon portion 110 are formed to be thick to a boundary between the area A1 and an area A2, and in the area A2 that contracts in a curved manner, a corner 15 that is as thick as the valley portion 16 is formed in the same manner as in the first embodiment.

[0032] In the support 112, a reinforcing portion 112a on a base end portion 11 side of the balloon portion 110 is formed to be thick along an outer periphery of the support 112. The reinforcing portion 112a is connected continuously with the thick corner portions 115 of the balloon portion 110.

[0033] In the natural orifice expansion applicator 200 according to the present embodiment, the thick corner portions 115 and a part of the support 112 have an increased strength. Consequently, even if a fluid in the balloon portion 110 is extracted and made to be a compact state, the balloon portion 110 is hard to buckle, and therefore, it is easy to reach a vaginal vault and a cervical canal, thereby making it possible for a patient to feel less pain.

[0034] As above, embodiments of the present invention has been described, and the above described embodiments of the invention is to facilitate understanding of the present invention, and do not restrict the present invention. The present invention may be changed and modified without departing from the gist thereof, and the present invention includes equivalents thereto. Furthermore, in a scope that can solve at least a part of the above described problem or a scope that produces at least a part of an effect, any combination or omission of respective components described in claims and description is possible.

[0035] The connector 30 according to the above embodiment has a columnar shape including an elliptic cross section, but the present invention is not limited to this example. There are not any special restrictions on a configuration of the connector, as long as the

optical fiber and the endoscope are positioned and the fluid can flow through the configuration. For example, as shown in Fig. 10A, a connector 34 having a round cross section may be provided, in which a first through hole 31, a second through hole 32 and a third through hole 33 may be formed.

[0036] Furthermore, as shown in Fig. 10B, a connector 35 having a small-radius elliptic cross section only on one side may be provided. On a large-radius side, a second through hole 32 holding an optical fiber may be formed, and on a small-radius side, a third through hole 33 holding an endoscope may be formed. In an outer periphery of the second through hole 32, a first through hole 31 having a very small diameter to convey a fluid may be formed. At this time, as shown in Fig. 10B, the first through hole 31 may be formed along an optical fiber tube 22 in a tubular wall of the optical fiber tube 22, and may be formed in the connector 35 itself at a position between the second through hole 32 and the third through hole 33.

[0037] Additionally, the optical fiber and the endoscope may be inserted in one cylindrical member. For example, as shown in Fig. 10C, an end itself of an optical fiber tube 22 to be inserted in a balloon portion 10 may be provided as a connector 36 having a small round cross section, in which a second through hole 32 holding the optical fiber may be formed. Furthermore, a first through hole 31 having a very small diameter to convey a fluid in a tubular wall of the optical fiber tube 22 may be formed along the optical fiber tube 22.

[0038] Furthermore, in the above embodiments, the catheter portion 20 does not extend through the balloon portion 10, but the present invention is not limited to this configuration. For example, a configuration may be provided in which a catheter portion extends through a base end portion and tip portion of a balloon portion, a light transmitting portion to transmit light may be formed on the balloon between the base end portion and the tip portion, and the light propagated through the optical fiber of the catheter portion may be radiated in a direction vertical to an extending direction of the catheter portion.

[0039] Additionally, in the above embodiment, the connector 30 is made of usually used silicon rubber, but the present invention is not limited to this. For example, the connector

may be formed using silicon rubber including a large number of fine bubbles as a sponge. By use of silicon rubber including the bubbles in the connector, the connector can be softer. Thus, the connector that connects the catheter portion and the balloon portion softens, and hence, the catheter portion is easy to swing to the balloon portion. Consequently, when the natural orifice expansion applicator is inserted in the affected part, it is possible for the patient to feel less pain.

[0040] Furthermore, in the above embodiment, the balloon portion 10 includes eight corner portions 15 extending from the base end portion 11 toward the tip portion 13, but the present invention is not limited to this. If the outer periphery of the balloon portion can decrease when seen from the tip portion and the strength in the direction that connects the base end portion and the tip portion can increase, the number of the corner portions may be, for example, four or the like, or another number.

REFERENCE SIGNS LIST

- [0041] 10 ... balloon portion
11 ... base end portion (a first end portion)
12 ... support
13 ... tip portion (a second end portion)
14 ... light transmitting portion
15 ... corner portion
16 ... valley portion
20 ... catheter portion (a tube)
21 ... fluid conveying tube
22 ... optical fiber tube
23 ... endoscope tube
30 ... connector
31 ... first through hole
32 ... second through hole
33 ... third through hole

100 ... natural orifice expansion applicator

110 ... balloon portion

112 ... support

112a ... reinforcing portion

115 ... thick corner portion

200 ... natural orifice expansion applicator

CLAIMS

1. A natural orifice expansion applicator comprising:

a balloon portion inflatable by a fluid to be introduced inside,
a support supporting a first end of the balloon portion,
a plurality of tubes, and

a connector for connecting the support and the plurality of tubes,

wherein the balloon portion is formed with a first area expanding linearly from the first end portion toward the second end portion at an opposite side and a second area contracting in a curved manner toward the second end portion at a position closer to the second end portion than to the first end portion, and includes a plurality of corner portions extending from the first end portion toward the second end portion;

wherein the corner portion is formed to include a thick portion being thicker than a valley portion between the adjacent corner portions in the first area, and is formed to be as thick as the valley portion in the second area; and

wherein the balloon portion is formed with a light transmitting portion to transmit light, formed in a planar shape being flush with the valley portion at the second end portion.

2. The natural orifice expansion applicator as claimed in claim 1, wherein the support having a reinforcing portion formed to be thick along an outer periphery of the support at a portion contacting the balloon portion.

3. The natural orifice expansion applicator as claimed in claim 1, wherein the connector is formed of silicon rubber including a large number of fine bubbles.

4. The natural orifice expansion applicator according to claim1, wherein the thick portion extends to a position at which an outer periphery of the balloon portion is maximum.