Problem to be solved by the Invention

[0006] As a method of estimating whether a tissue of an excitation-light-irradiated site is broken, whether an electric-conduction block is formed, and the like, there is known a method of leading a device such as a catheter having a detection means such as an electrode to an excitation-light-irradiated site, and performing estimation by using the catheter. However, because an irradiated site does not coincide with a potential-measured site precisely in therapy using a light, it is desired to provide means for estimating therapeutic effects more accurately in real time.

[0007] Embodiments ~~In view of the above mentioned circumstances, an object~~ of the present invention ~~is to~~ provide an estimating apparatus and an estimating method capable of estimating process of therapy using a laser catheter accurately in real time.

Means for solving the Problem

[0008] In a first aspect, there is provided an estimating apparatus for irradiating a tissue having absorbed photo-sensitive pharmaceutical, the photo-sensitive pharmaceutical absorbing an excitation light and emitting fluorescence, with the excitation light emitted from a tip portion of a laser catheter, comprising: a connector to/from which the laser catheter is capable of being attached/detached; a light source for outputting the excitation light to the laser catheter via the connector; and a detection unit for detecting intensity of the fluorescence, the fluorescence being entered from the laser catheter via the connector, to estimate whether the tissue has changed because of reaction between the excitation light emitted from the tip portion of the laser catheter and the photo-sensitive pharmaceutical absorbed in the tissue. ~~To attain the~~

~~above-mentioned object, an~~An estimating apparatus according to an embodiment of the present invention is an apparatus for irradiating a tissue having absorbed photo-sensitive pharmaceutical, the photo-sensitive pharmaceutical absorbing an excitation light and emitting fluorescence, with the excitation light emitted from a tip portion of a laser catheter, including a connector, a light source, and a

[0021] As a result, it is possible to inform a practitioner whether a tissue has changed in real time, based on the intensity of the fluorescence entered from the laser catheter. Note that to "output a signal" means to output a display instruction including display information to a display unit, or to output a sound output instruction to a speaker unit.

[0022] The controller may output a signal to prompt to change an irradiation condition of the excitation light, based on the estimated result.

[0023] As a result, it is possible to prompt a practitioner to change an irradiation condition of the excitation light in real time, based on the intensity of the fluorescence entered from the laser catheter.

[0024] The controller may obtain an electrocardiographic signal, and estimates whether the tissue has changed, based on a correlation between the electrocardiographic signal and the intensity of the fluorescence.

[0025] By calculating the correlation between the electrocardiographic signal and the intensity of the fluorescence, it is possible to determine whether a tissue has changed in real time.

[0026] In a second aspect, there is provided an estimating apparatus for therapy for atrial fibrillation, for irradiating a cardiac-muscle tissue having absorbed photo-sensitive pharmaceutical, the photo-sensitive pharmaceutical absorbing an excitation light and emitting fluorescence, with the excitation light emitted from a tip portion of a laser catheter, comprising: a connector to/from which the laser catheter is capable of being attached/detached; a light source for outputting the excitation light to the laser catheter via the connector; and a detection unit for detecting intensity of the

fluorescence, the fluorescence being entered from the laser catheter via the connector, to estimate whether the cardiac-muscle tissue is changed because of reaction between the excitation light emitted from the tip portion of the laser catheter and the photo-sensitive pharmaceutical absorbed in the cardiac-muscle tissue. An estimating apparatus for therapy for atrial fibrillation according to an embodiment of the present invention is an apparatus for irradiating a

result of the contact state.

[0031] The estimating apparatus may further include storage for storing the peak-estimated-result of the change of the cardiac-muscle tissue.

The controller may record the current-estimated-result of the change of the cardiac-muscle tissue in the storage, update, in a case where the current-estimated-result of the change of the cardiac-muscle tissue is equal to or larger than the peak-estimated-result of the change of the cardiac-muscle tissue recorded in the storage, the peak-estimated-result of the change of the cardiac-muscle tissue recorded in the storage with the current-estimated-result of the change of the cardiac-muscle tissue, and output a signal for simultaneously informing of the estimated result of the change of the cardiac-muscle tissue and the estimated result of the contact state, by displaying the current-estimated-result of the change of the cardiac-muscle tissue on the updated peak-estimated-result of the change of the cardiac-muscle tissue in an overlapped manner.

[0032] In a third aspect, there is provided an estimating method, comprising: irradiating a tissue having absorbed photo-sensitive pharmaceutical, the photo-sensitive pharmaceutical absorbing an excitation light and emitting fluorescence, with the excitation light emitted from a tip portion of a laser catheter; extracting the fluorescence corresponding to the irradiated excitation light via the laser catheter; and estimating whether the tissue has changed because of reaction between the excitation light emitted from the tip portion of the laser catheter and the photo-sensitive pharmaceutical absorbed in the tissue, based on intensity of the extracted fluorescence. An estimating method according to an embodiment of the present invention includes irradiating a tissue having absorbed photo-sensitive pharmaceutical, the photo-sensitive pharmaceutical absorbing an excitation light and emitting fluorescence,

electrocardiographic signal and the intensity of the fluorescence, it is possible to determine whether the tissue has changed because of reaction between the excitation light and the photo-sensitive pharmaceutical in real time.

[0038] In a fourth aspect, there is provided an estimating method using photo-sensitive pharmaceutical absorbing an excitation light and emitting a fluorescence, a laser catheter capable of emitting the excitation light from a tip portion, and an estimating apparatus including a connector to/from which the laser catheter is capable of being attached/detached and a light source for outputting the excitation light to the laser catheter via the connector, comprising: absorbing, in a tissue, the photo-sensitive pharmaceutical; leading the tip portion of the laser catheter to the tissue having absorbed the photo-sensitive pharmaceutical, the laser catheter being attached to the connector; irradiating the tissue having absorbed the photo-sensitive pharmaceutical with the excitation light emitted from the tip portion of the laser catheter, the excitation light being output from the light source; extracting the fluorescence corresponding to the irradiated excitation light via the laser catheter; and estimating whether the tissue has changed because of reaction between the excitation light emitted from the tip portion of the laser catheter and the photo-sensitive pharmaceutical absorbed in the tissue, based on intensity of the extracted fluorescence. An estimating method according to an embodiment of the present invention is an estimating method using photo-sensitive pharmaceutical absorbing an excitation light and emitting a fluorescence, a laser catheter capable of emitting the excitation light from a tip portion, and an estimating apparatus including a connector to/from which the laser catheter is capable of being attached/detached and a light source for outputting the excitation light to the laser catheter

via the connector.

In a tissue, the photo-sensitive pharmaceutical is absorbed.

The tip portion of the laser catheter is led to the tissue having absorbed the photo-sensitive pharmaceutical, the laser catheter being attached to the connector.

The tissue having absorbed the photo-sensitive pharmaceutical is irradiated with the excitation light emitted from the tip portion of the laser catheter, the excitation light being output from the light source.

The fluorescence corresponding to the irradiated

the change of the tissue recorded in the storage, the peak-estimated-result of the change of the tissue recorded in the storage with the current-estimated-result of the change of the tissue, and outputting a signal for simultaneously informing of the estimated result of the change of the tissue and the estimated result of the contact state, by displaying the current-estimated-result of the change of the tissue on the updated peak-estimated-result of the change of the tissue in an overlapped manner.

[0042] The estimating method may further include obtaining an electrocardiographic signal, and estimating whether the tissue has changed, based on a correlation between the electrocardiographic signal and the intensity of the fluorescence.

Effect of the Invention

[0043] According to embodiments of the present invention, it is possible to estimate process of therapy using a laser catheter accurately in real time, and to perform the therapy reliably.

Brief Description of Drawings

[0044] [Fig. 1] A schematic diagram showing a PDT apparatus according to a first embodiment of the present invention.

[Fig. 2] A schematic diagram showing a laser catheter inserted in a heart.