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(54) **METHOD FOR MONITORING AND EVALUATING CARDIAC ANOMALIES**

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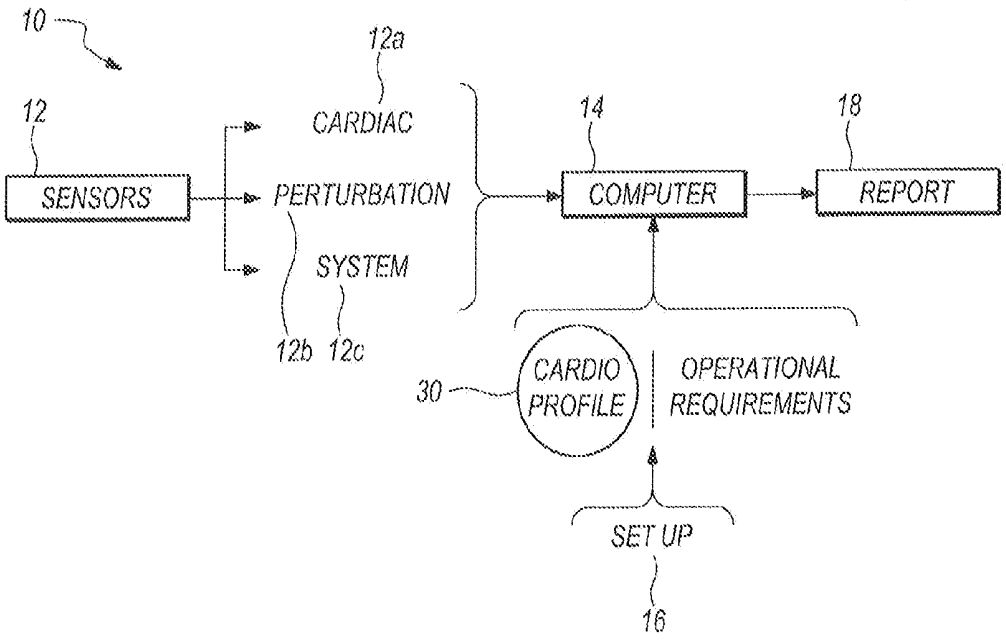
(57) **ABSTRACT**

The present invention pertains to methods for monitoring and evaluating a patient's heart muscle function. For the present invention this requires simultaneously detecting both cardiac signals (i.e. an EKG) and perturbation signals caused by the environmental and physical factors that are influencing the patient. In particular, when a cardiac signal is not compliant with a predetermined cardio-profile, an anomaly results. The resultant anomaly, and the perturbation causing the anomaly are then evaluated to determine whether an appropriate action is required.



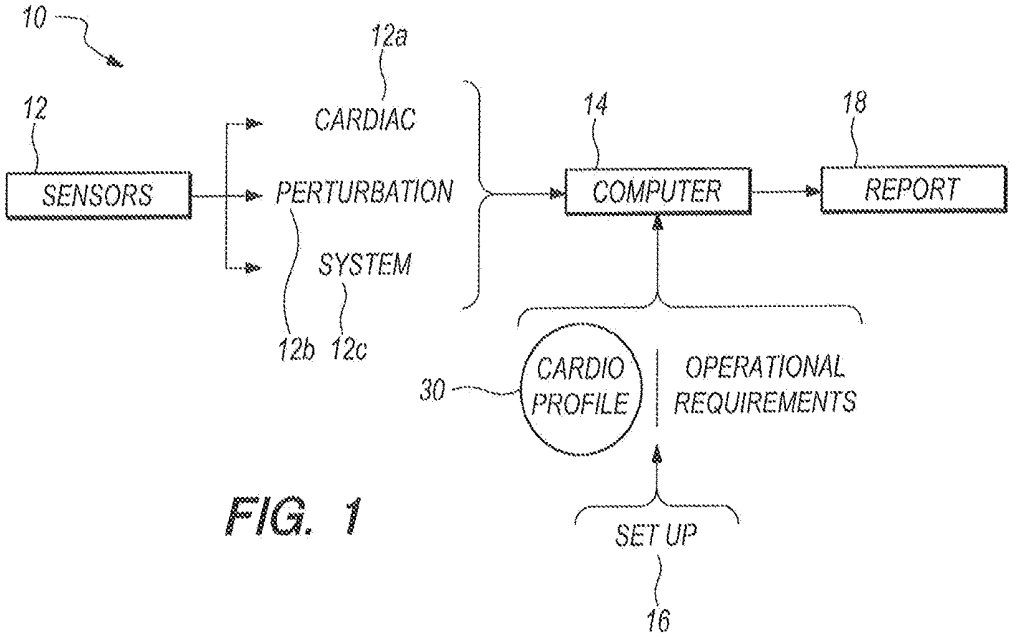

10
12a
12
CARDIAC
14
18
SENSORS
PERTURBATION
COMPUTER
REPORT
SYSTEM
12b 12c
30
CARDIO PROFILE
OPERATIONAL REQUIREMENTS
SET UP
16

FIG. 1

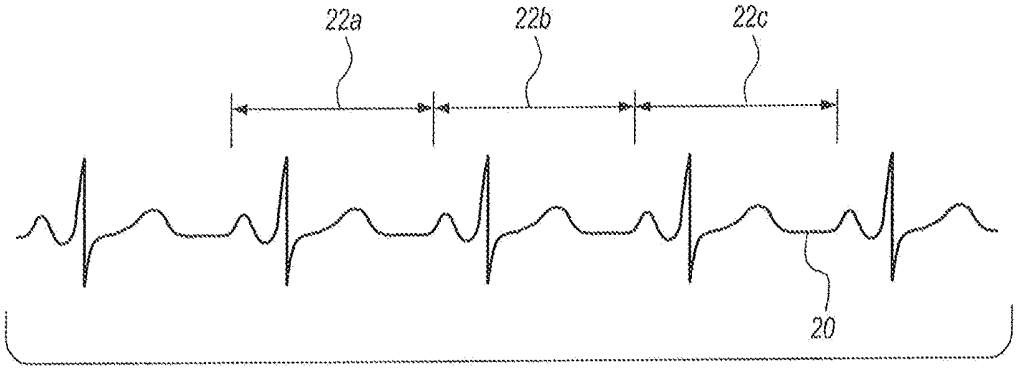

22a
22b
22c
20

FIG. 2

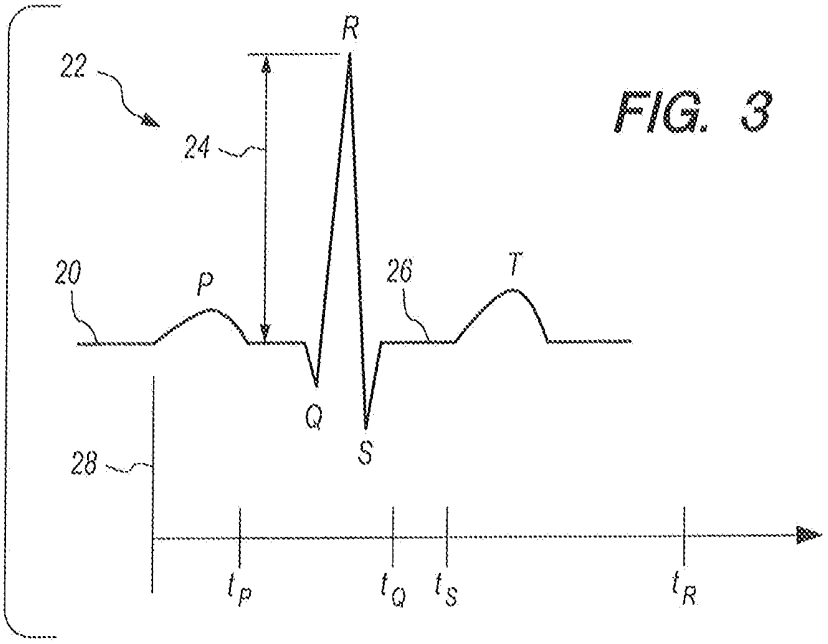

R
22
24
20
P
26
T
Q
S
28
t_P
t_Q
t_S
t_R

FIG. 3

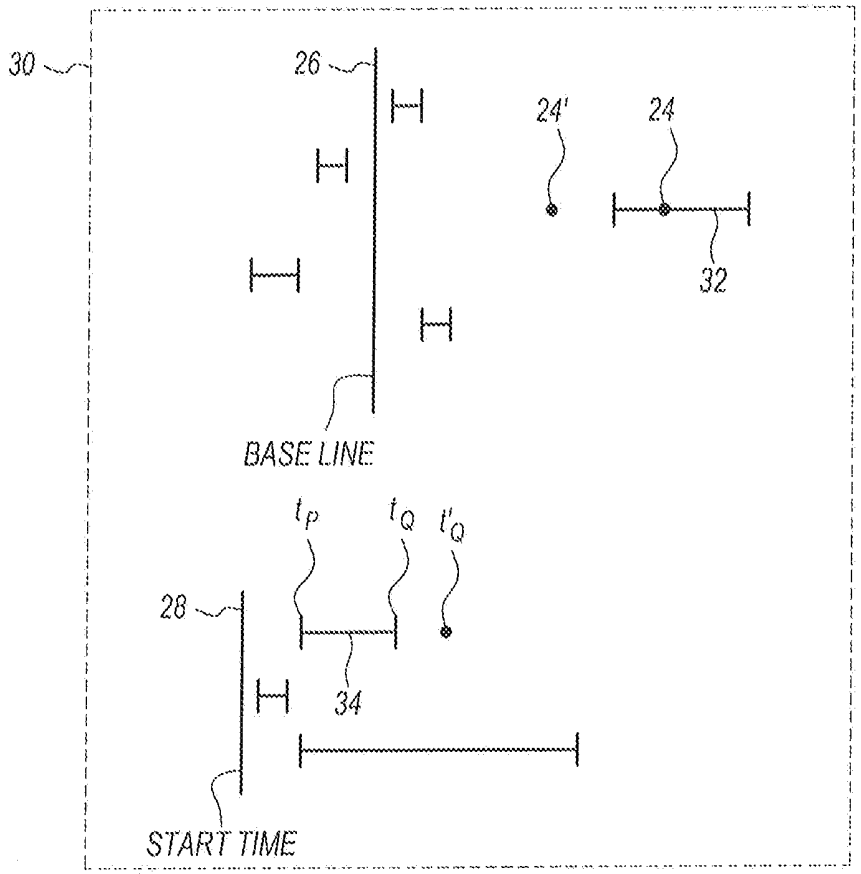

30
26
24'
24
32
BASE LINE
t_P
t_Q
t'_Q
28
34
START TIME

FIG. 4

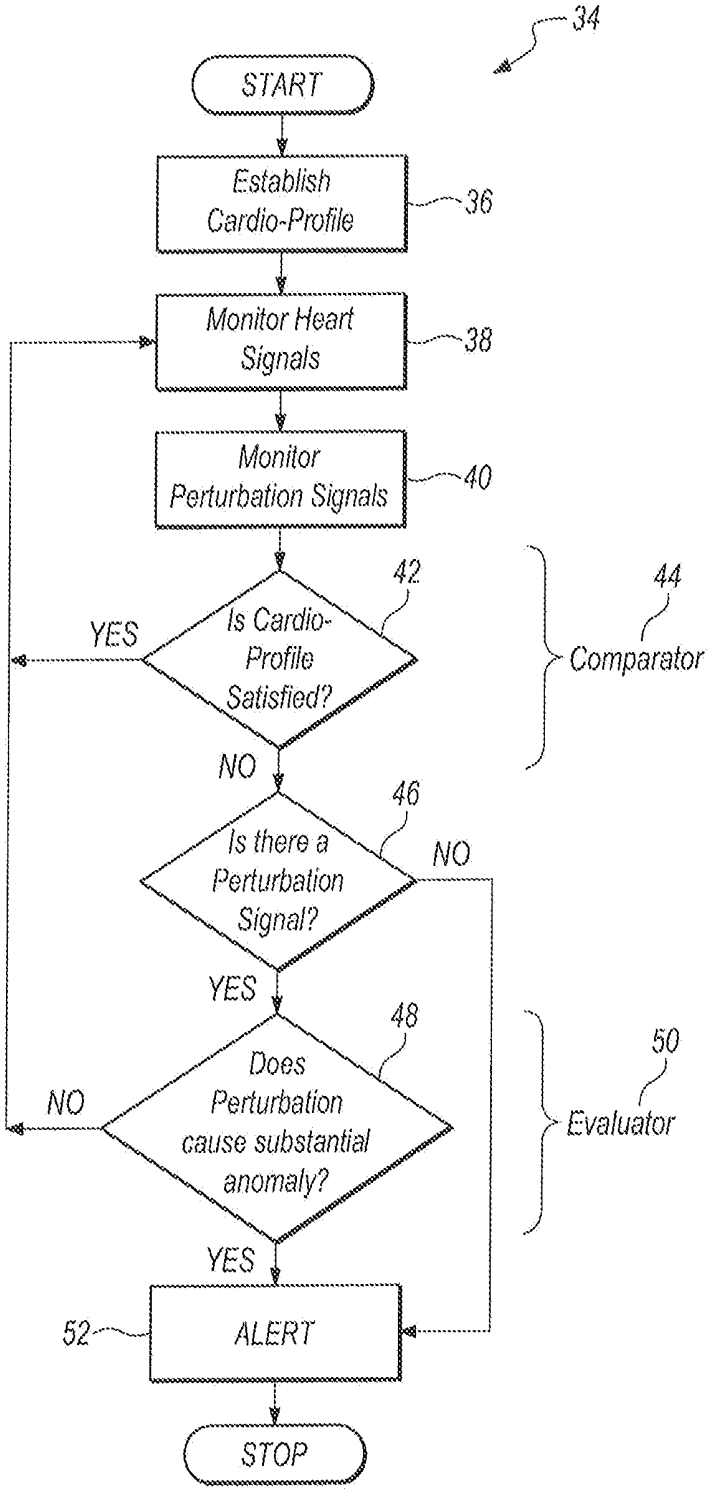

34
START
Establish Cardio-Profile
36
Monitor Heart Signals
38
Monitor Perturbation Signals
40
42
Is Cardio-Profile Satisfied?
YES
NO
44
Comparator
46
Is there a Perturbation Signal?
NO
YES
48
Does Perturbation cause substantial anomaly?
NO
YES
50
Evaluator
52
ALERT
STOP

FIG. 5

METHOD FOR MONITORING AND EVALUATING CARDIAC ANOMALIES

FIELD OF THE INVENTION

[0001] The present invention pertains generally to methods for monitoring and evaluating a patient's heart muscle function. More particularly, the present invention pertains to methods for evaluating anomalies in the cardiac signals of a patient that are caused by an external influence (i.e. an environmental or a physical perturbation). The present invention is particularly, but not exclusively, useful as a method for determining when a cardiac signal anomaly is not compliant with a predetermined cardio-profile and requires an appropriate action.

BACKGROUND OF THE INVENTION

[0002] It is well known that the heart muscle function of a patient (user) can be affected by either external (i.e. extracorporeal) influences or internal (i.e. systemic) influences. Whereas internal influences are typically chronic in nature, external influences are typically acute. Also, external influences are typically the result of either physical or environmental stimuli which are experienced by a person within a relatively brief period of time. For both cases however, whenever it is determined that a patient's heart muscle function may be at risk, an ability to monitor and evaluate the situation can be of considerable importance for the patient. In particular, it will be important to not only detect when there is an anomaly in the heart muscle function, but to also determine what is the cause of the anomaly, its severity, and the affect it can have on a patient's health and wellbeing.

[0003] In accordance with accepted clinical practices, the heart muscle function of any patient can be recorded as a waveform, using sensors such as an electrocardiograph (EKG). Moreover, because they are individually unique, the EKG waveform for each patient will exhibit measurable parameters that can be identified and evaluated by a trained clinician. In particular, such parameters can be identified to establish an acceptable operating envelope (i.e. cardio-profile) for the heart muscle function of the particular patient (user).

[0004] Using the cardio-profile as a start point or benchmark, perturbations to the EKG waveform that cause a measurable parameter to become non-compliant with the cardio-profile can be identified for further consideration. For this purpose, the nature, extent, and severity of a perturbation may be of particular importance. Specifically, the effect a perturbation has in creating an anomaly of the heart muscle function will be useful for determining whether immediate medical attention is required, routine medical attention will suffice, or no action needs to be taken.

[0005] In light of the above, an object of the present invention is to provide a methodology for monitoring and evaluating cardiac anomalies, whereby a cardio-profile is established to identify cardiac anomalies resulting from internally or externally caused perturbations that can be evaluated for requisite medical attention. Another object of the present invention is to provide a methodology for monitoring and evaluating cardiac anomalies that is easy to use, is effective for its intended purpose and is comparatively cost effective to implement.

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, a methodology for monitoring heart muscle activity of a patient (user) involves detecting a cardiac anomaly relative to the patient's normal cardiac waveform or a desired target waveform indicated by a physician. The cardiac anomaly is then evaluated for its response to a concurrent perturbation of the cardiac waveform. For the present invention, this requires employing three different types of sensors. These are: a cardiac sensor for recording the actual, real time, cardiac waveform of the patient; at least one perturbation sensor for simultaneously detecting external and/or internal factors influencing the cardiac waveform in real time; and system sensors that determine whether the cardiac and perturbation sensor(s) is(are) operational.

[0007] As a first step in the methodology of the present invention, a cardio-profile is established. For the present invention, this cardio-profile may be either patient-specific, or it may be predetermined. In detail, the creation of a cardio-profile requires selecting pre-identified measurable parameters from the patient's cardiac waveform that can be subsequently monitored on a continuing, or predetermined periodic basis. Further, the cardio-profile establishes acceptable ranges for variations of each parameter in the cardiac waveform that is being monitored.

[0008] For a typical operation of the present invention, the parameters selected for monitoring will generally be either temporal or dimensional measurements. For example, the parameters for dimensional measurements will typically include waveform shape characteristics and amplitudes within the waveform. On the other hand, temporal measurements will typically include the repetition rate of heart function cycles within the waveform, variability of the waveform shape, discontinuities in the waveform, and variability in beat to beat timing. Collectively, such parameters and the acceptable ranges for variations of these parameters constitute the cardio-profile. Once the cardio-profile has been established it can be input to a computer.

[0009] The cardiac sensor for the present invention will typically be of a type that is well-known in the pertinent art, and is capable of recording the cardiac waveform of the patient's heart muscle function, such as an electrocardiograph (EKG). Preferably, recordation of the waveform is accomplished in real time on a continuing basis. As envisioned for the present invention the cardiac sensor will be conveniently located on the body of the patient (user) and, if needed, it can be implanted. In any event, the cardiac signal that is detected by the cardiac sensor will be provided as a direct, real time input to the computer.

[0010] As noted above, the perturbation sensors are used for the present invention to detect perturbations of the heart muscle waveform that are caused by either external or internal influences. These perturbations can be further categorized according to the nature of the influence into either environmental perturbations or physical perturbations. For example, the environmental perturbations will be typically caused by local weather conditions and other factors such as electromagnetic radiations, radioactivity, time of day, climatic considerations, and altitude. On the other hand, physical perturbations will result from factors such as stress, trauma, disease, extrinsic exercise/activity level, sleep patterns, and body contacts. Recall, that the cardiac sensor and the perturbation sensors detect contemporaneous signals simultaneously. Moreover, like the cardiac signal from the

cardiac sensor, the perturbation signals from the perturbation sensor are directly input to the computer.

[0011] For an operation of the present invention, the cardiac sensor is used to detect cardiac signals that are generated by the heart muscle of the patient (user). Typically, the cardiac signals will be waveforms that are recorded by an EKG, and they will include a continuous sequence of heart muscle function cycles. At the same time that the cardiac signal is being monitored and recorded, an array of perturbation sensors also monitor the environment and physical status of the patient (user).

[0012] In the course of events, whenever an external/internal influence that is detected by a perturbation sensor causes an anomaly to simultaneously occur in the cardiac signal, both the cause/source of the perturbation and the nature/extent of the anomaly on the cardiac signal are comparatively evaluated. More specifically, as noted above, when an anomaly is created in the cardiac signal that does not comply with the predetermined cardio-profile, such an evaluation is initiated in the computer. The result of this comparative evaluation is a determination (i.e. a report) as to whether a responsive medical action is required.

[0013] An additional feature of the present invention is the optional incorporation of a system sensor with the perturbation sensor. When incorporated, the system sensor will function to monitor the respective operational status of the cardiac sensor and the perturbation sensor. A purpose here is to detect perturbations in the system that may be caused by the patient (user). Also, the system sensor can be used to monitor the system operation for regulatory compliance, and to identify and address maintenance considerations, such as battery charge and operational readiness requirements.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The novel features of this invention, as well as the invention itself, both as to its structure and its operation, will be best understood from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts, and in which:

[0015] FIG. **1** is a functional schematic of operational tasks required for the methodology of the present invention;

[0016] FIG. **2** is an exemplary cardiac waveform of a patient (user) as would be recorded by an Electrocardiograph;

[0017] FIG. **3** is a representative heart function cycle taken from the cardiac waveform shown in FIG. **2**;

[0018] FIG. **4** is a presentation of amplitude and time based parameters selected from the heart function cycle shown in FIG. **3** for inclusion in a cardio-profile in accordance with the present invention; and

[0019] FIG. **5** is a logic flow chart of the sequential tasks and functions required for an operation of the methodology of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Referring initially to FIG. **1**, the various operational tasks that are required for implementing the methodology of the present invention are collectively designated **10**. In FIG. **1** they are shown schematically in their interactive relationship with each other. In overview, the methodology **10** requires the use of several different types of sensors **12** which are each directly or indirectly connected with a patient/user (not shown). Data that is collected by the sensors **12** are electronically transmitted to a computer **14** for evaluation. For an operation of the methodology **10**, the task **16** shown in FIG. **1** indicates that it is first necessary to set up (i.e. pre-program) the computer **14**.

[0021] As envisioned for the present invention, the sensors **12** are essentially of three different types. In general these sensors are: a cardiac sensor **12***a* for recording the actual, real time, cardiac activity of the patient; at least one perturbation sensor **12***b* for simultaneously detecting external and/or internal factors that can influence the cardiac activity in real time; and system sensors **12***c* that determine whether the computer **14** and the other sensors **12** are operational. The condition of all sensors **12**, and an evaluation by the computer **14** of data collected from the sensors **12** is then compiled by the computer **14** and presented as a report **18**.

[0022] The primary purpose for the methodology **10** of the present invention is to monitor the waveform **20** of a patient's heart muscle function. With this in mind, the waveform **20** shown in FIG. **2** is typical. More specifically, however, the methodology **10** is provided to monitor the waveform **20** for variations that may be indicative of an adverse effect on the patient's health and wellbeing. To do this, the methodology **10** is primarily concerned with sequentially monitoring individual heart function cycles **22** in the waveform **20**. In FIG. **2**, the heart function cycles **22***a*, **22***b* and **22***c* of waveform **20** are only exemplary. Importantly, for a normal heart function, all cycles **22** are essentially similar.

[0023] As shown in FIG. **3** a single heart function cycle **22** includes universally recognized points (P, Q, R, S, and T) in the waveform **20**, which are characteristic of the particular heart function cycle **22**. For purposes of this disclosure, the characteristics of a heart function cycle **22** are recognized as having various measurable parameters that collectively exemplify the efficacy of the heart muscle function.

[0024] In FIG. **3** it will be appreciated that both dimensional and temporal parameters of a heart function cycle **22** can be measured by the cardiac sensor **12***a*. For example, the amplitude **24** of R is a dimensional parameter that can be measured relative to a base line **26**. Likewise, the amplitudes of P, Q, S and T have respective amplitudes that are similarly measurable from the same base line **26**. Further, the occurrence of P, Q, R, S and T can also be measured relative to a start time **28** as a temporal parameter. With all of this in mind, it will be appreciated that heart function cycles **22** are patient-specific. Moreover, for each patient, P, Q, R, S and T will have a respective range of acceptable amplitudes, and each will have an acceptable range for the time during which they occur in the heart function cycle **22**. Other parameters, such as the temporal spacing between subsequent QRS cycles, or the variability of that spacing, may also apply. For purposes of the present invention, these amplitude ranges (dimensional) and occurrence ranges (temporal) within a heart function cycle **22** are collectively referred to here as a cardio-profile **30**.

[0025] Referring now to FIG. **4**, a cardio-profile **30** is shown as a collection of the acceptable ranges that are clinically established for respective dimensional and temporal parameters of a heart function cycle **22**. As implied above, when all measurable parameters remain within their respective acceptable ranges, the heart muscle function is considered normal. However, when any measurable param-

eter falls outside its acceptable range an anomaly occurs which requires further evaluation. In FIG. **4** the amplitude **24** of R and the time interval between P and Q in the cardio-profile **30** are used as examples for purposes of disclosure.

[0026] In FIG. **4** a range **32** for the amplitude **24** of R is dimensionally established relative to the base line **26**. In this example, the range **32** is considered acceptable for variations of the amplitude **24**. Accordingly, an amplitude **24'** which is outside the range **32** when detected by the cardiac sensor **12***a* would be considered to be an anomaly. Similarly, from a temporal perspective, the range **34** is considered to be an acceptable time interval between the occurrence of P, at time t_P, and the occurrence of Q, at time t_Q. In this example, an occurrence of Q at the time t_Q' when it is detected by the cardiac sensor **12***a* outside the range **32**, would be considered an anomaly. Likewise, the amplitudes for P, Q, S and T, as well as the times t_P, t_R, t_S, and t_T in the heart function cycle **22** are also similarly evaluated in comparison with the cardio-profile **30** to identify respective anomalies. In the event, an analysis and evaluation of a heart muscle function cycle **22** as disclosed above can be used to identify anomalies in waveform shape characteristics, amplitudes within the waveform, the repetition rate of heart function cycles in the waveform, variability of the waveform shape, and discontinuities in the waveform.

[0027] For the present invention, the detection of anomalies in a heart muscle function cycle **22** does not end the inquiry. Instead, in accordance with the methodology **10** of the present invention, the extent, severity, and cause of an anomaly are evaluated relative to a simultaneously occurring perturbation. To do this, perturbation sensors **12***b* are appropriately positioned relative to the patient (user). For purposes of the present invention perturbation signals detected by the perturbation sensors **12***b* will typically include both environmental perturbations and physical perturbations. In particular, the environmental perturbations will typically involve local weather conditions, electromagnetic radiations, radioactivity, time of day, climatic considerations, and altitude. On the other hand, physical perturbations will typically involve stress, trauma, disease, extrinsic exercise/activity level, sleep patterns, and body contacts.

[0028] As an additional feature of the present invention a system sensor **12***c* can be incorporated with the perturbation sensor **12***b* for monitoring a respective operational status of the cardiac sensor **12***a* and the perturbation sensor **12***b*. Specifically, the system sensor **12***c* will be incorporated to detect system perturbations that may be caused by the patient (user). In particular these perturbations will relate to compliance and system maintenance considerations, and will include considerations for such matters as battery charge and operational readiness requirements.

[0029] An operation for the methodology **10** of the present invention is presented by the logic flow chart which is generally designated **34** in FIG. **5**. As indicated by the block **36** of chart **34** in FIG. **5**, it is important that a cardio-profile **30** be initially established, or selected, for the particular patient (user). In FIG. **1**, this requirement is shown as part of task **16** for setting up the computer **14**. Also, during this initial setup, the operational requirements to be monitored by the systems sensor **12***c* are also input to the computer **14**. Then, once the cardio-profile **30** is established, and the sensors **12** have all been properly positioned and located, block **38** indicates that the cardiac sensor **12***a* is activated to monitor the cardiac waveform **20**. Simultaneously, block **40** indicates that the perturbation sensor(s) **12***b* are also activated to monitor for environmental and physical perturbations. Importantly, as noted above, perturbations sensors **12***b* operate concurrently with the cardiac sensor **12***a* and, thus, they provide for a comparison of the data that is received simultaneously by the sensors **12***a* and **12***b*.

[0030] Inquiry block **42** of chart **34** indicates that the cardiac signals detected by cardiac sensor **12***a* are compared directly with the cardio-profile **30**. Preferably, this comparison is made by a comparator **44** that is incorporated into the computer **14**. If this comparison determines that the cardiac signal is compliant with the cardio-profile **30**, chart **34** shows that the methodology **10** requires continued monitoring by the cardiac sensor **12***a* and the perturbation sensors **12***b*. On the other hand, if the comparator **44** determines the cardiac signal that is detected by the cardiac sensor **12***a* is not compliant with the cardio-profile **30**, the methodology **10** determines that an anomaly has occurred and the methodology **10** continues to the inquiry block **46**.

[0031] At the inquiry block **46** the methodology **10** questions whether a perturbation signal has been received from a perturbation sensor **12***b*. If there is such a perturbation signal, the methodology **10** proceeds to inquiry block **48** and makes further inquiry into whether the anomaly is substantial. In particular, the determination of substantiality is made by an evaluator **50** that is incorporated into the computer **14** and it is based on an overall evaluation of the effect a particular perturbation has had on the cardiac waveform **20**. In the event the determination of substantiality is that the perturbation was minimal, and likely had no long term adverse effect on the patient (user), the methodology returns to block **38**. The cardiac sensor **12***a* and the perturbation sensor **12***b* then continue their respective monitoring activity.

[0032] It is to be noted that in accordance with the methodology **10** presented in chart **34**, an alert signal **52** is generated under the following three scenarios. First, when there is no cardiac signal from the cardiac sensor **12***a* that can be compared with the cardio-profile the alert signal **52** is activated (see inquiry block **42**). Second, when according to inquiry block **48**, the evaluator **50** in computer **14** determines a substantial anomaly has occurred. And third, the alert signal **52** is activated when the inquiry block **46** determines that no perturbation signal is being received from the perturbation sensor **12***b* (see inquiry block **46**). In each of these situations, the methodology **10** requires that some form of assessment is to be made.

[0033] While the particular Method for Monitoring and Evaluating Cardiac Anomalies as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as described in the appended claims.

What is claimed is:

1. A method for monitoring and evaluating cardiac anomalies which comprises the steps of:

establishing a cardio-profile for a patient, wherein the cardio-profile identifies certain measurable parameters of cardiac signals generated by the heart muscle of the

patient, and wherein the cardio-profile establishes acceptable ranges for variations in individual parameters of a cardiac signal;

detecting the cardiac signals generated by the heart muscle of the patient;

detecting perturbation signals experienced by the patient, wherein the cardiac signals and the perturbation signals are correspondingly detected simultaneously;

comparing the cardiac signals with the cardio-profile to identify when a perturbation signal causes an anomaly; and

evaluating the perturbation signal causing the anomaly to determine whether the resultant anomaly requires an appropriate action.

2. The method recited in claim **1** wherein the measurable parameters of cardiac signals from the heart muscle are selected from the group consisting of waveform shape characteristics, amplitudes within the waveform, the repetition rate of heart function cycles in the waveform, variability of the waveform shape, discontinuities in the waveform, and variability of the repetition rate.

3. The method recited in claim **1** wherein an anomaly is identified when a perturbation extends the cardiac signal beyond an acceptable range in the cardio-profile.

4. The method recited in claim **1** wherein the perturbation signals include environmental perturbations and physical perturbations, wherein the environmental perturbations are respectively caused by local weather conditions, electromagnetic radiations, radioactivity, time of day, climatic considerations, and altitude, and wherein the physical perturbations are respectively caused by stress, trauma, disease, extrinsic exercise/activity level, sleep patterns, and body contacts.

5. The method recited in claim **1** further comprising the steps of:

transmitting an alert to a remote facility whenever an anomaly requires an active medical response; and

receiving information from a remote facility to update the cardio-profile when needed.

6. The method recited in claim **1** wherein the cardiac sensor and the perturbation sensor are mounted on a same substrate.

7. The method recited in claim **1** wherein the cardiac sensor is implanted in the torso of the patient.

8. The method recited in claim **1** wherein the cardiac sensor is an electrocardiograph, and wherein the perturbation sensor is an array of sensors, wherein each sensor in the array detects a respectively different perturbation.

9. A method for using sensors to evaluate the heart muscle function of a patient which comprises the steps of:

establishing a cardio-profile for the patient, wherein the cardio-profile identifies certain measurable parameters of cardiac signals generated by the heart muscle of the patient, and wherein the cardio-profile establishes acceptable ranges for variations in individual parameters of a cardiac signal;

locating a cardiac sensor on the patient to monitor and record cardiac signals generated by the heart muscle of the patient;

positioning a perturbation sensor on the patient to detect a perturbation signal, wherein the perturbation signal is caused by an external influence experienced by the patient affecting at least one parameter of the cardiac signals detected by the cardiac sensor;

incorporating a system sensor with the perturbation sensor for monitoring a respective operational status of the cardiac sensor and the perturbation sensor, to detect system perturbations caused by patient compliance and system maintenance considerations, to include battery charge and operational readiness requirements;

comparing each cardiac signal with the cardio-profile to identify when a corresponding perturbation signal causes an anomaly;

evaluating the perturbation signal causing the anomaly to determine whether the resultant anomaly requires an appropriate action; and

providing a report in response to indications from the incorporating step and from the evaluating step signifying when appropriate action is required.

10. The method recited in claim **9** wherein the measurable parameters of signals from the heart muscle are selected from the group consisting of waveform shape characteristics, amplitudes within the waveform, the repetition rate of heart function cycles in the waveform, variability of the waveform shape, discontinuities in the waveform, and variability of the repetition rate.

11. The method recited in claim **9** wherein an anomaly is identified when a perturbation signal extends the cardiac signal beyond an acceptable range in the cardio-profile.

12. The method recited in claim **9** wherein the perturbation signals include environmental perturbations and physical perturbations, wherein the perturbation signals include environmentally caused perturbations and physically caused perturbations, wherein the environmental perturbations are respectively caused by local weather conditions, electromagnetic radiations, radioactivity, time of day, climatic considerations, and altitude, and wherein the physical perturbations are respectively caused by stress, trauma, disease, extrinsic exercise/activity level, sleep patterns, and body contacts.

13. The method recited in claim **9** further comprising the steps of:

transmitting an alert to a remote facility whenever an anomaly requires an active medical response; and

receiving information from a remote facility to update the cardio-profile when needed.

14. The method recited in claim **9** wherein the cardiac sensor and the perturbation sensor are mounted on a same substrate.

15. The method recited in claim **9** wherein the cardiac sensor is implanted in the torso of the patient.

16. The method recited in claim **9** wherein the cardiac sensor is an electrocardiograph, and wherein the perturbation sensor is an array of sensors, wherein each sensor in the array detects a respectively different perturbation.

17. A non-transitory, computer-readable medium having executable instructions stored thereon that direct a computer system to perform a process for monitoring and evaluating cardiac anomalies, the medium comprising instructions for:

establishing a cardio-profile for a patient, wherein the cardio-profile identifies certain measurable parameters of cardiac signals generated by the heart muscle of the patient, and wherein the cardio-profile establishes acceptable ranges for variations in individual parameters of the cardiac signal;

recording cardiac signals generated by the heart muscle of the patient;

detecting a perturbation signal, wherein the perturbation signal is caused by an external influence experienced by the patient affecting at least one parameter of the cardiac signals detected by the cardiac sensor;

monitoring an operational status of the cardiac sensor and of the perturbation sensor, to detect system perturbations respectively caused by patient compliance and system maintenance considerations;

comparing recorded cardiac signals with the cardio-profile to identify when a perturbation signal causes an anomaly; and

evaluating the perturbation signal to determine whether the resultant anomaly requires an appropriate action.

18. The medium recited in claim **17** wherein the measurable parameters of signals from the heart muscle are selected from the group consisting of waveform shape characteristics, amplitudes within the waveform, the repetition rate of heart function cycles in the waveform, variability of the waveform shape, discontinuities in the waveform, and variability of the repetition rate.

19. The medium recited in claim **18** further comprising an instruction for identifying an anomaly when a perturbation extends the cardiac signal beyond an acceptable range in the cardio-profile.

20. The medium recited in claim **18** further comprising instructions for:

preparing a periodic report pertaining to battery charge and operational readiness of the computer system; and

transmitting an alert to a predetermined facility whenever an anomaly requires an active medical response.

* * * * *

专利名称(译)	监测和评估心脏异常的方法		
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[标]发明人	DIPERNA PAUL M ROSE JR FREEMAN H		
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IPC分类号	A61B5/04 A61B5/0452 A61B5/00		
CPC分类号	A61B5/04012 A61B5/0452 A61B2560/0214 A61B2560/0247 A61B5/746		
外部链接	Espacenet USPTO		

摘要(译)

本发明涉及用于监测和评估患者心肌功能的方法。对于本发明，这需要同时检测由影响患者的环境和物理因素引起的心脏信号（即EKG）和扰动信号。特别地，当心脏信号不符合预定的心脏轮廓时，会导致异常。然后评估所得到的异常和引起异常的扰动以确定是否需要适当的动作。