

System and method for administering medicaments on the basis of urine values

The invention concerns a system and a method for administering medicaments to a patient.

Patients, in particular in intensive care units, are conventionally treated with medicaments and where applicable synthetic nutrition by means of one or more supply devices, for example intravenously. Supply devices can be infusion pumps which keep the vital blood values of the patient at a predeterminable level in reaction to a blood picture/blood gas analysis previously performed in the blood circulation of the patient.

All supply devices of this type, also when integrated into a system for administering medicaments and/or nutrients, have previously required the input of values by a doctor or further clinical personnel to form the basis for the supply by means of the supply device. For example here quantity values, time intervals at which the supply should be made, intermittent supply etc. are entered as the basis for subsequent supply of medicaments.

This supply is preceded by a usually manual taking of a blood specimen from the patient, which requires the intervention of clinical personnel. Also further clinical personnel is required with the necessary professional knowledge of the input functions of the supply device, such as the infusion pump, in order to subsequently perform this supply.

Usually such infusion therapies, in particular when involving urine values, are not determined to targeted values today. Rather the usual procedure is to set an infusion rate on the basis of a urine value status and/or a blood value status based on the experience of the clinical personnel and/or prespecified standards, protocols, instructions, specifications or similar.

Consequently the object of the invention is to provide a system and method for administration of medicaments to a patient which, also taking into account urine

values, allows a supply of medicaments with the correct medicament parameters in an automated manner.

This object is achieved by the system with the features of claim 1 and by the method with the features of claim 10.

The core concept of the invention is that a system for administering medicaments to a patient contains the following devices:

- at least one first measurement device to measure the urine values of the patient's urine;
- at least one first analysis device to analyse the urine values measured;
- at least one first calculation device to calculate first medicament parameters of the medicaments to be administered on the basis of the urine values analysed and measured; and
- at least one supply device to supply the respective medicaments with the common calculated medicament parameters.

Such a system advantageously allows measured urine values to be taken into account in calculating the medicament parameters of the medicaments to be administered by the supply device. For example by means of the analysis and calculation device, the active substance furosemide can be administered to the patient automatically by means of the supply device as a function of the previously measured urine and blood values. This allows an additional control of the values measured for optimised administration of the active substance and for optimised setting of the infusion rate, wherein instead of the active substance furosemide, other medicaments can also be supplied.

It is also possible that competing values, for example urea, creatinine, lysc etc. from the urine value measurement and blood analysis evaluation are detected and can be corrected automatically by the calculation device. The calculation device can also take into account differences occurring in the relation between individual measured values and between these values, in calculating the optimised infusion value and hence does not rely on measurement of absolute values. Also the calculation device in calculating the infusion values, for example an infusion rate, can take into account

the chronology and sequence of the previously measured values of this patient and their relative importance.

The urine values measured by the first measurement device can, as well as the said values, be further urine values for example the pH value, the protein content, the glucose content of the urine, the nitrite content of the urine, the bilirubin content of the urine, the ketone content of the urine, the bacteria content of the urine and/or the urine sediment results.

Advantageously a second measurement device measures the quantity of urine eliminated by the patient and a connected second analysis device can be used to analyse the urine quantity measured. Also the second measurement device can also measure the quantity of secretion from the patient's wounds and the second analysis device can analyse this accordingly.

This serves to ensure that by means of a second calculation device, a fluid balance of the patient's body can be calculated from the quantity of fluids eliminated and fluids supplied. The fluids eliminated can for example be the measured urine quantity previously analysed and the measured secretion quantity analysed, and the fluids supplied can be liquid medicaments supplied. Second medicament parameters are calculated from this.

A third measurement device serves to measure vital values of the patient such as ECG, EEG and similar data and a connected analysis device serves to analyse the vital values measured. By means of a third calculation device, third medicament parameters are calculated on the basis of the measured vital values analysed.

Advantageously in an automated manner by means of a common calculation device, the common medicament parameters can be calculated from the first, second and third medicament parameters. This has the consequence that all medicament parameters resulting from the calculated urine values, calculated blood values, fluid balance values and vital values can be taken into account to calculate optimised common medicament parameters in order to initiate the infusion with the optimised infusion rate.

Advantageously with the first measurement device, the patient's blood values can also be measured which can be analysed by the first analysis device and used by the first calculation device to calculate the first medicament parameters.

Thus taking into account a large number of measured values, in particular taking into account the urine values, an automated function of the complete system and an associated method for administering medicaments should be provided, wherein the transfer of the respective values, medicament parameters and other data can take place automatically. It is also conceivable that the medicament parameters and nutrient parameters determined for the proposed infusion for treatment of the patient can be displayed as proposed parameters or respectively data to support the clinical personnel on a corresponding display on the bed of the patient to be treated, so that the clinical personnel can set up the infusion pump by means of these displayed and entered data to the patient.

To ensure an automated secure transfer from the individual measurement devices, analysis devices and calculation devices to each other and to the infusion system, which can for example be one or more infusion pumps, these data are transferred by means of a data protocol which contains the patient ID, the time the measurement was taken, the time the specimens were taken, the identification of the measurement device concerned, the quality class of the measurement device as well as further quality features.

It is also advantageous that the fluid balance takes place automatically and the determination of eliminated fluids is not carried out by means of complicated weighing techniques. Rather more, the quantity of all eliminated measurable fluids is determined preferably automatically and the remaining fluids lost by the human body are simulated by calculation. These eliminated fluids are compared with the fluids supplied in the form of liquid medicaments or nutrients which can easily be determined.

In the method according to the invention for administration of medicaments to a patient, the following steps are performed:

- measurement of urine values of a patient's urine by at least one first measurement device;
- analysis of the measured urine values by at least one first analysis device;
- calculation of first medicament parameters of the medicaments to be administered to the respective patient on the basis of the measured urine values analysed, by means of at least one first calculation device; and
- supply of the respective medicament with calculated common medicament parameters by means of at least one supply device.

According to a preferred embodiment, in the method according to the invention a fluid balance of the patient's body is calculated and/or determined and carried out by measurement and calculation of the eliminated fluids and measurement and calculation of the supplied fluids.

Further advantageous embodiments arise from the subclaims.

Advantages and features arise from the description below in conjunction with the drawing.

The only figure is a diagrammatic depiction of the system for administration of medicaments according to one embodiment of the invention.

The system shown in this figure for the automated administration of medicaments (for example active substances or drugs such as furosemide, insulin etc.) is an automatic infusion system 1 with a multiplicity of infusion pumps for the treatment of individual incorrectly set values within the body of the patient 2.

A patient 2 in intensive care thus according to reference numeral 3 receives from the automated infusion system 1 medicaments with the associated infusion rates, where applicable taking into account a change in medicament quantity, administration period and further parameters.

The patient 2 in intensive care can be analysed in various aspects, as priority in his urine values, by means of one or more measurement devices 4, 7, 8, or 9.

For example by means of the measurement devices 8 the urine values and/or blood values can be measured automatically at the intensive care unit by the taking of urine and blood specimens from the patient 2. Individually, according to reference numeral 6a, the urine values are the pH value of the urine, the protein content of the urine, the glucose content of the urine, the nitrite content of the urine, the bilirubin content of the urine, the ketone content of the urine, the bacteria content of the urine and the urine sediment results. The blood values are individually the glucose value, the lactate value, the electrolyte value (Na^+ , CL^+ , K^+), the pO_2 value, the pCO_2 value, the medicament level values, the calcium antagonist values (blood pressure) and the propofol values (sedation).

The blood values are shown according to reference numeral 6b.

In addition, the urine and secretion quantity values can be measured, preferably automatically, by means of a second measurement device 9. From these, the urine quantity and secretion quantity values are determined by means of analysis device 10.

By means of a third measurement device 4, preferably by means of sensors, automatically vital parameters such as ECG and EEG values and similar values are determined which are analysed in a third analysis device 5.

The analysed values from all analysis devices 5, 6 and 10 are transmitted preferably automatically to a respective associated first, second and third calculation device 11, 12 and 13. The transfer takes place according to reference numerals 14, 21 and 22 by means of a data protocol which additionally comprises data such as the patient identification numbers, the time the measurement was performed, the time the specimen was taken, the identification of the respective measurement device, the quality class of the measurement device and an allocated quality feature.

In the calculation device 11, a calculation is performed of the relevant medicament parameters and nutrient parameters for the administration of medicaments and/or nutrition with the infusion system 1. Here, for a fluid balance to be performed, a

balance is produced of all eliminated fluids i.e. for example the measured secretion quantity and urine quantity, and the fluids supplied such as for example the liquid medicaments and liquid nutrition according to the supply device 1.

The following comments apply to such a fluid balance of infused fluids versus eliminated fluids:

Human beings are known to eliminate fluids in various ways. Firstly, urine quantities and wound secretion quantities are eliminated which can be measured automatically and directly for patients in intensive care. In addition to the directly measurable fluids, there are further fluids which can be established indirectly such as water vapour eliminated by respiration, transpiration through the skin of the body and fluid elimination by faeces and similar. These fluid quantities are determined by means of physiological models taking into account the body surface area, body temperature and similar.

With the calculation device 12, the second medicament parameters can be calculated for the medicament to be administered by means of the infusion system 1 and where applicable associated nutrients.

By means of calculation device 13, on the basis of the urine and/or blood values measured, the medicament parameters and nutrient parameters can be calculated for the medicaments and nutrients to be administered by means of the infusion system 1.

The calculated medicament parameters and nutrient parameters are transmitted according to reference numerals 15, 16 and 17 to the infusion system 1, hard-wired or wirelessly, preferably encrypted.

On a change of infusion rates of the infusions or respectively medicaments and/or nutrients to be administered, a feedback takes place to the calculation device 11, 12 and 13 according to reference numerals 18, 19 and 20 so that these changes can be taken into account in the recalculation of medicament parameters and/or nutrient parameters.

All calculation devices 11, 12 and 13 are combined within a common calculation device.

By the way, also the urine values and blood values can be determined by means of a measurement device 7 within a laboratory.

Insofar as competing values are measured by the different measurement devices, the calculation devices 11, 12 and 13 can take these into account and apply a corresponding correction, taking into account the weighting of the individual measurement devices and the values measured therewith.

It is also conceivable that the calculation devices take into account the chronology of measurements, the sequence of measurements and the quality of measurements in determining the medicament parameters and/or nutrient parameters. Also relations and differences of individually determined values in relation to each other and to other values from other measurement devices are taken into account in determining the medicament parameters and/or the nutrient parameters.

All features disclosed in the application documents are claimed as essential to the invention where novel individually or in combination in relation to the prior art.

List of reference numerals

- 1 Infusion system
- 2 Patient
- 3 Medicaments
- 4 Third measurement device
- 5 Third analysis device
- 6 First analysis device
- 6a Urine values
- 6b Blood values
- 7 First measurement device in laboratory
- 8 First measurement device at intensive care unit
- 9 Second measurement device
- 10 Second analysis device
- 11 First calculation device
- 12 Second calculation device
- 13 Third calculation device
- 14 Transfer of values by means of data protocol
- 15 Transfer of medicament and nutrient parameters to the infusion system
- 16 Transfer of medicament and nutrient parameters to the infusion system
- 17 Transfer of medicament and nutrient parameters to the infusion system
- 18 Feedback to calculation device
- 19 Feedback to calculation device
- 20 Feedback to calculation device
- 21 Transfer of values by means of data protocol
- 21 Transfer of values by means of data protocol

Claims

1. System for administration of medicaments for a patient (2) comprising:
 - at least one supply device (1) to supply liquid medicaments and/or nutrients to the patient (2)
 - at least one first measurement device (7, 8) to measure urine values of the urine of a patient (2);
 - at least one first analysis device (6) to analyse the measured urine values (6a); and
 - at least one first calculation device (13) to calculate first medicament parameters of the medicaments to be administered to the respective patient (2) on the basis of the measured urine values analysed (6a); characterized by comprising:
 - a second measurement device (9) to measure the quantity of urine eliminated by the patient (2);
 - a second analysis device (10) to analyse the urine quantity measured; and
 - a second calculation device (11) to calculate a fluid balance of the body of the patient (2) from the quantity of urine eliminated and from the quantity of the liquid medicaments and/or nutrients supplied by the at least one supply device (1) and to calculate second medicament parameters; wherein
 - the at least one supply device (1) supplies the respective medicaments with common medicament parameters calculated on the basis of the first medicament parameters and the second medicament parameters.
2. System according to claim 1, characterised in that as urine values (6a), the pH value, the protein content, the glucose content of the urine, the nitrate content of the urine, the bilirubin content of the urine, the ketone content of the urine, the

bacteria content of the urine and/or the urine sediment results can be measured with the first measurement device (7, 8).

3. System according to claim 1, characterised in that also the quantity of secretion eliminated from the wounds of the patient (2) can be measured with the second measurement device (9) and analysed by the second analysis device (10).
4. System according to claim 3, characterised by the second calculation device (11) further being to calculate a fluid balance of the body of the patient (2) from the measured urine quantity analysed and the measured secretion quantity analysed, and from the quantity of the supplied liquid medicaments and/or nutrients, and to calculate the second medicament parameters.
5. System according to any of the preceding claims, characterised by a third measurement device (4) to measure vital values of the patient (2) such as ECG, EEG and similar data, and a third analysis device (5) connected thereto to analyse the vital values measured.
6. System according to claim 5, characterised by a third calculation device (12) to calculate third medicament parameters on the basis of the measured vital values analysed.
7. System according to claim 6, characterised by a common calculation device which calculates the common medicament parameters from the first, second and third medicament parameters.
8. System according to any of the preceding claims, characterised in that also blood values (6b) of the patient (2) can be measured with the first measurement device (7, 8) and analysed by the first analysis device (6) and used by the first calculation device (13) to calculate the first medicament parameters.

9. Method for calculation of medicament parameters of medicaments to be administered to a patient (2) with the following steps:
- measurement of urine values of the urine the patient (2);
 - analysis of the measured urine values (6a);
 - calculation of first medicament parameters of the medicaments to be administered to the respective patient (2) on the basis of the measured urine values analysed (6a),;
characterized by comprising
 - measurement of a quantity of urine eliminated by the patient (2);
 - analysis of the urine quantity measured; and
 - calculation of a fluid balance of the body of the patient (2) from the quantity of urine eliminated and from a quantity of liquid medicaments and/or nutrients supplied to the patient (2) and calculation of second medicament parameters;
 - calculation of common medicament parameters on the basis of the first medicament parameters and the second medicament parameters.
10. Method according to claim9, characterised by further comprising the steps:
- measurement of a quantity of secretion eliminated from wounds of the patient (1);
- calculation of the fluid balance of the body of the patient (2) from the quantity of urine and secretion eliminated and from the quantity of liquid medicaments and/or nutrients supplied to the patient (2) and calculation of second medicament parameters.