

In this specification, where reference has been made to external sources of information, including patent specifications and other documents, this is generally for the purpose of providing a context for discussing the features of the present invention. Unless stated otherwise, reference to such sources of information is not to be construed, in any jurisdiction, as an admission that such sources of information are prior art or form part of the common general knowledge in the art.

For the purpose of this specification, where method steps are described in sequence, the sequence does not necessarily mean that the steps are to be chronologically ordered in that sequence, unless there is no other logical manner of interpreting the sequence.

Embodiments of the present invention provide a nutrient recycling device which overcomes or at least partially ameliorates some of the abovementioned disadvantages or which at least provides the public with a useful choice.

BRIEF DESCRIPTION OF THE INVENTION

According to a first aspect, there is provided a nutrient recycling device configured to collect digestive contents from a surgically created first gastrointestinal tract opening and pump the digestive contents to a second gastrointestinal tract opening, the device including:

- a flexible bag adapted to receive the digestive contents from the first surgically created opening, through a first bag opening,

- a pump located within the flexible bag or having a pump body incorporated with a wall of the flexible bag, the pump adapted to pump the collected digestive contents to the second gastrointestinal tract opening, the pump comprising:

- a pump inlet in fluid communication with an interior of the flexible bag,

- a pump outlet connected to an outlet conduit adapted to provide a flow pathway for the digestive content to flow from the pump to the second gastrointestinal tract opening, and

- a pump actuator separable from the pump and adapted to be operably coupled to the pump.

In an embodiment, the first bag opening is configured to be positioned over the first gastrointestinal tract opening.

In an embodiment, the first bag opening is configured to be positioned over the first and second gastrointestinal tract openings.

In an embodiment, the first bag opening is configured to be positioned over the first gastrointestinal tract opening, and a second bag opening is configured to be positioned over the second gastrointestinal tract opening.

In an embodiment, the pump operates approximately every 30 minutes to 6 hours.

In an embodiment, the pump operates for approximately 30 seconds to 20 minutes at a time.

In an embodiment, the pump is automated according to a programmable schedule tailored to each patient's needs.

According to a second aspect, there is provided a kit of parts for constructing a nutrient recycling device according to the first aspect, wherein the kit includes:

a flexible bag adapted to receive digestive contents from a first gastrointestinal tract opening, the flexible bag comprising at least a first bag opening,

a pump adapted to pump the digestive contents to a second gastrointestinal tract opening,

an outlet conduit adapted to provide a flow pathway for the digestive content to flow from the pump to the second gastrointestinal tract opening.

In an embodiment, the kit further comprises a pump actuator.

Other aspects of the invention may become apparent from the following description which is given by way of example only and with reference to the accompanying drawings.

As used herein the term "and/or" means "and" or "or", or both.

As used herein "(s)" following a noun means the plural and/or singular forms of the noun.

The term "comprising" as used in this specification and claims means "consisting at least in part of". When interpreting statements in this specification and claims which include that term, the features, prefaced by that term in each statement, all need to be present but other features can also be present. Related terms such as "comprise" and "comprised" are to be interpreted in the same manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example only and with reference to the drawings in which:

Figure 1 shows a schematic of a patient and the nutrient recycling device.

the digestive contents in the device and pumping the digestive contents towards the second opening 4.

In some configurations, the digestive contents 6 are recycled from a first opening 3 in the gastrointestinal tract to a downstream opening 4 in the patient. In other configurations, the digestive contents 6 are recycled from a first opening 3 in the gastrointestinal tract to an upstream location 4' in the patients gastrointestinal tract.

In some configurations, the first opening is the proximal opening 3 of the ileum 2 (distal small bowel). Preferably the second opening is a distal opening 4 of the ileum 2. In this configuration, the digestive contents 6 are recycled downstream from the first opening 3. The device 1 preferably limits fluid and nutrient loss from a stoma 5 as digestive contents 6 are recycled back into the digestive tract. In another configuration, the digestive contents 6 are recycled from the first opening 3 of the gastrointestinal tract to an upstream location 4'. In some configurations the upstream location 4' is at or near the jejunum (middle segment of the small intestine, upstream from the ileum) where absorption occurs. Preferably, the second opening is downstream from the stomach and duodenum.

Preferably once the digestive contents 6 exits the upstream gastrointestinal tract location, the digestive contents 6 flow naturally, such as by smooth muscle contracts, from the upstream location 4' downstream towards the first opening 3 of the gastrointestinal tract. Recycling digestive contents 6 upstream as described in this configuration means that a particular portion of the gastrointestinal tract can be reused as the digestive contents 6 passes along the same multi-circulation gastrointestinal flow path 7, more than once as shown in figures 10A and 10B (shaded -pattern of the gastrointestinal tract). Preferably, the digestive contents 6 pass through the same flow pathway between the output end 47 and the first opening of the gastrointestinal tract 3 a plurality of times to increase absorption.

Preferably, the multi-circulation gastrointestinal flow path 7 is defined as part of the gastro-intestinal tract between the upstream gastrointestinal tract location to the first gastrointestinal tract opening 3.

It may be advantageous to reuse the same portion of gastrointestinal tract 7 to increase absorption. This desired segment of the gastrointestinal tract is configured to provide a multi-circulation gastrointestinal flow pathway 7 where the digestive contents 6 flow through the flow pathway more than once. Multi-circulation through the same flow pathway 7 in a desired segment of the gastrointestinal tract may increase the time that nutrients are in contact with the gastrointestinal tract wall, and therefore increase the likelihood of nutrients being absorbed by the patient.

Circulating digestive contents 6 over the same multi-circulation gastrointestinal flow pathway 7 effectively increases the length of gastrointestinal tract which the

content 6 to flow from the pump 100 through to the upstream location 4' in the patient's gastrointestinal tract.

As illustrated in figures 10A and 10B, in some configurations, the nutrient recycling device 1 comprises a delivery catheter 45 which extends to the upstream location 4'. The nutrient recycling device 1 as shown in figures 10A and 10B is shown to be off on a side of the patient for illustrative purposes only so that the internal organs are not covered. When the nutrient recycling device 1 is in use, the bag 10 can be positioned as required for functioning and/or for comfort.

In some configurations, the conduit 30 acts as the delivery catheter 45 and extends from the stoma bag 10 and directly enters the upstream location 4'. In other configurations, the delivery catheter 45 provides an extension from the conduit 30 to extend into the upstream location 4' at the desired location. The desired location in the most preferred configurations is in the small intestine where nutrient absorption in the gastrointestinal system occurs.

In some configurations, the delivery catheter 45 which extends into the upstream location 4' is an enteral feeding tube such as a gastro-jejunal tube. Preferably the delivery catheter 45 is flexible or semi-flexible so it can be directed into the patient and situated in the desired location.

In some configurations, the second opening 4 is located downstream from the first opening 3 in the gastrointestinal tract in a direction towards the anus. In one configuration, the first opening 3 is a proximal stoma, and the second opening 4 is a distal stoma. Preferably, the delivery catheter 45 includes an output end 47 of the delivery catheter 45 which is positioned downstream in the gastrointestinal tract from the first opening 3 configured to reintroduce the digestive contents back into a patient.

In other configurations, the upstream location 4' is located upstream in the gastrointestinal tract from the first opening 3 towards the stomach. The digestive contents 6 contained within the bag 10 of the nutrient recycling device 1 is driven to the upstream location 4' within the gastrointestinal system. As illustrated in figures 10A and 10B, it is anticipated that the delivery catheter 45 can be inserted and navigated to different locations in a patient, so that an output end 47 of the delivery catheter 45 is located in the desired location to reintroduce the digestive contents back into a patient. Figure 10A shows that the delivery catheter 45', 45'' can be provided through the nasal cavity or through the abdomen.

Figure 10B shows the delivery catheter 45''' can be inserted back through the first opening 3. Preferably, the output end 47 of the delivery catheter 45 is positioned upstream from the first opening 3.

CLAIMS

1. A **nutrient recycling device** configured to collect digestive contents from a surgically created first gastrointestinal tract opening and pump the digestive contents to a second gastrointestinal tract opening, the device comprising:
 - a flexible bag adapted to receive the digestive contents from the first surgically created opening, through a first bag opening,
 - a pump located within the flexible bag or having a pump body incorporated with a wall of the flexible bag, the pump adapted to pump the collected digestive contents to the second gastrointestinal tract opening, the pump comprising:
 - a pump inlet in fluid communication with an interior of the flexible bag,
 - a pump outlet connected to an outlet conduit adapted to provide a flow pathway for the digestive content to flow from the pump to the second gastrointestinal tract opening, and
 - a pump actuator separable from the pump and adapted to be operably coupled to the pump.
2. The nutrient recycling device as claimed in claim 1, wherein the first bag opening is configured to be positioned:
 - a. over the surgically created first gastrointestinal tract opening,
 - b. over the first and second gastrointestinal tract openings,
 - c. over the surgically created first gastrointestinal tract opening, and a second bag opening is configured to be positioned over the second gastrointestinal tract opening.
3. The nutrient recycling device as claimed in claim 1 or 2, wherein the flexible bag comprises an attachment portion configured to attach the flexible bag to a patient, and wherein the attachment portion is an adhesive backing.
4. The nutrient recycling device as claimed in any one of the previous claims, wherein the pump is incorporated with the flexible bag by attachment to:
 - a. an inside wall of the flexible bag,
 - b. an outside wall of the flexible bag, or
 - c. form at least part of the wall of the flexible bag.

5. The nutrient recycling device as claimed in any one of the previous claims, wherein the pump is located within the flexible bag.
6. The nutrient recycling device as claimed in claim 5, wherein the pump freely floats within the flexible bag supported by the outlet conduit.
7. The nutrient recycling device as claimed in claim 6, wherein the stoma bag further comprises at least one external conduit opening adapted to allow at least one external conduit to communicate between the inside and outside of the bag.
8. The nutrient recycling device as claimed in any one of claims 1-4, wherein the pump is attached to the bag, and the attachment is by:
 - a. clips,
 - b. clasps,
 - c. buckles,
 - d. Velcro,
 - e. zip,
 - f. slide fastener,
 - g. snap fasteners,
 - h. magnets, or
 - i. the bag having a pouch adapted to locate the pump, and the pouch is incorporated into a side wall of the bag.
9. The nutrient recycling device as claimed in any one of the previous claims, wherein the outlet conduit comprises a first portion and a second portion, wherein
 - a first portion of the outlet conduit is located within the bag, and
 - a second portion of the outlet conduit is located external to the bag,the second portion of the conduit adapted to be inserted into the gastrointestinal tract through the second opening of the gastrointestinal tract.
10. The nutrient recycling device as claimed in any one of the previous claims, wherein the outlet conduit comprises a one way valve to preclude backflow of digestive content.
11. The nutrient recycling device as claimed in claim 9 or 10, wherein the second portion of the outlet conduit comprises one or more apertures on a sidewall configured to allow fluid communication of the digestive contents with the gastrointestinal tract.

12. The nutrient recycling device as claimed in any one of the previous claims, wherein a delivery catheter extends from the bag into the second gastrointestinal tract opening.
13. The nutrient recycling device as claimed in claim 12, wherein the outlet conduit is a delivery catheter and includes an output end positioned downstream in the gastrointestinal tract from the first opening and is configured to reintroduce the digestive contents back into a patient.
14. The nutrient recycling device as claimed in claim 9, wherein the outlet conduit includes an output end positioned upstream from the first opening and is configured to reintroduce the digestive contents back into a patient.
15. The nutrient recycling device as claimed in any one of the previous claims, wherein the pump comprises a body and an impeller driven by a pump actuator.
16. The nutrient recycling device as claimed in claim 15, wherein the impeller is driven by a magnetic coupling between said pump actuator and said impeller.
17. The nutrient recycling device as claimed in claim 15, wherein the impeller is driven by a mechanical coupling between said pump actuator and said impeller.
18. The nutrient recycling device as claimed in claim 16 or claim 17, wherein the pump is located inside the bag and the pump actuator is located external to the bag.
19. The nutrient recycling device as claimed in claim 15, wherein the pump actuator is integrated with the pump.
20. The nutrient recycling device as claimed in any one of claims 1-19, wherein the pump comprises a syringe configured to push the digestive contents towards the second opening of the gastrointestinal tract.
21. The nutrient recycling device as claimed in claim 20, wherein the syringe comprises a plunger external to the bag.
22. The nutrient recycling device as claimed in any one of the previous claims, wherein the pump comprises one or more one-way valves.
23. The nutrient recycling device as claimed in any one of claims 1-19, wherein the pump comprises a controller and:

- a. the controller operates to increase or decrease a flow rate of the digestive contents,
- b. the controller is adapted to be operated manually by a patient,
- c. the controller operates automatically,
- d. the controller operates the pump at set intervals,
- e. the controller operates the pump approximately every 30 minutes to 6 hours,
- f. the controller operates the pump for approximately 30 seconds to 20 minutes at a time,
- g. the controller operates when a predetermined fluid level, bag weight, or bacteria level as detected by a sensor is reached,
- h. the controller operates the pump in a reverse direction to clear blockages,
- i. the controller operates the pump in a reverse direction from time to time to clear blockages,
- j. the controller operates the pump in a reverse direction when a sensor detects a predetermined condition to clear blockages, or
- k. the controller operates the pump alternately between a forward direction and a reverse direction to clear blockages.

24. A **kit of parts** for constructing a nutrient recycling device as claimed in any one of claims 1-23, wherein the kit comprises:

a flexible bag adapted to receive digestive contents from a surgically created first gastrointestinal tract opening, the flexible bag comprising at least a first bag opening,

a pump adapted to pump the digestive contents to a second gastrointestinal tract opening,

an outlet conduit adapted to provide a flow pathway for the digestive content to flow from the pump to the second gastrointestinal tract opening.

25. The **kit of parts** as claimed in claim 24, wherein the kit further comprises a pump actuator as claimed in any one of claims 15-18.