Design of Automatic Infusion Mechanism for Intravenous Infusion of Pneumoconiosis Patients in Mining Area

Li Yuxiao, Zhang Lijian*, Li Ying

Binzhou Polytechnic, Binzhou, Shandong, China

*email: 651131355@qq.com

Keywords: Automatic Infusion Mechanism, Intravenous Infusion, Pneumoconiosis Patients

Abstract. Pneumoconiosis is a disease characterized by pulmonary fibrosis caused by long-term inhalation of productive dust in occupational activities and retention in the lungs. The early stage of pneumoconiosis mainly manifested as macrophage alveolitis, and in the late stage, it showed diffuse fibrosis of progressive lung tissue, resulting in destruction of lung structure and decreased function. In this paper, the operation time of the multi-stent intravenous infusion plus drug automatic control device was significantly less than manual operation, and the number of bacterial contamination and the total number of colonies were significantly reduced. Conclusion The multi-stent intravenous drug-adding device is easy to operate. The multi-stent intravenous drug-adding device can improve work efficiency, reduce bacterial contamination, improve the quality of intravenous infusion and the safety of intravenous infusion therapy.

Introduction

Coal worker's pneumoconiosis is a systemic disease in which lung tissue fibrosis is caused by a large amount of inhalation of coal dust and dust in the production labor. Coal workers Pneumoconiosis is a life-long disease. There is no cure for it. Clinically, it can only treat complications. Therefore, the treatment of coal workers with pneumoconiosis is a long process. Intravenous administration is the primary treatment during treatment.

Infusion is an important measure for clinical treatment. It is widely used and is essential for the maintenance of life-sustaining substances and water by intravenous administration. It is also one of the important measures for the treatment of patients. Because of the variety of drugs and the large amount of use, the nurse's infusion operation is extremely heavy. So far, China has been using traditional manual methods, which not only wastes manpower and material resources, but also causes artificial pollution and infusion reactions. To this end, we have successfully developed a multi-stent intravenous infusion plus drug automatic control device, and through clinical trials and multiple monitoring and comparison, the application of multi-stent intravenous infusion plus drug automatic control device is significantly better than manual operation.

Clinical intravenous infusion configuration frequently asked questions

Due to the negligence or blindness of the doctor when prescribing or ordering the doctor, the concentration of the infusion is too high, and the patient has adverse reactions such as discomfort at the intravenous site, chills, fever, palpitation, chest tightness, nausea, vomiting, and impaired renal function. These drugs mainly include aminoglycoside antibiotics for injection: amikacin, netilmicin, etimicin; fluoroquinolone antibacterials for injection: levofloxacin, ciprofloxacin, gatifloxacin, fleroxacin, Pefloxacin, etc.; antibiotics such as macrolides for injection: erythromycin, azithromycin; fusidic acid injection; antiviral drugs for injection: acyclovir, ganciclovir; Oncology drugs: cyclophosphamide, ifosfamide, pirarubicin, mitomycin, cisplatin, etc.; traditional Chinese medicine injection. For example, in the outpatient injection room of our hospital, 3 patients were reported to have adverse reactions such as chest tightness, hernia and nausea after intravenous injection of stellar (gatifloxacin) injection. The clinical pharmacists found that during the analysis of adverse

  DOI: 10.25236/epcimms.2019.24

reactions, the 3 The infusion concentration of gatifloxacin in patients exceeded the maximum concentration of 2 mg·mL-1 specified in the drug manufacturer's instructions; one patient had sudden symptoms of renal colic when intravenous acyclovir injection, and its infusion the drug concentration also exceeded the maximum concentration of 7 mg·mL-1 specified in the drug manufacturer's instructions. In addition, the author often finds that turbidity and sedimentation occur due to excessive concentration of the infusion solution. For example, the concentration of Adding injection combined with glucose injection should be less than 0.25 mg·mL-1, otherwise it is prone to turbidity.

In clinical work, patients are often exposed to multiple groups of fluids per day. Some caregivers are accustomed to pre-matching all infusions, causing some infusions to be placed too long. Some drugs are relatively stable in the dry state, and accelerate in the case of moisture, especially the longer the time in the aqueous solution, the greater the change. For example, β-lactam antibiotics cause prolonged hydrolysis of drugs, which not only reduces the efficacy, but also increases the sensitizing substances, causing various infusion reactions; chemotherapy drugs are extremely easy to be in aqueous solution due to their specific chemical structure. Cracking, hydrolysis, oxidation, polymerization, isomerization and other reactions should be paid attention to the current distribution; in addition, many anti-tumor drugs such as cisplatin, cyclophosphamide, cytarabine and other anti-tumor drugs Quinolone antibiotics, sodium nitroprusside, nimodipine, vitamin B12, vitamin K1, compound chlorpromazine, hydrocortisone, etc., for a long time, chemical changes will also occur due to the influence of light, resulting in reduced efficacy and increased toxicity. At the same time, the long-term placement of the configured infusion also increases the chance of being contaminated by the surrounding environment.

Certain drugs, due to their special properties, react chemically with certain infusion sets. Platinum anti-tumor drugs such as cisplatin and carboplatin will produce black precipitates and gases when in contact with aluminum, so they should not be in contact with aluminum-containing infusion devices; metronidazole should not be in contact with aluminum-containing needles and cannula; paclitaxel should be used. Non-PVC materials for infusion devices, and use a microporous membrane filter with a pore size of less than 0.22 μm; amperidine should use a glass syringe; diazepam, nimodipine, nitroglycerin, amiodarone, insulin and other drugs are easily adsorbed in the poly For the infusion equipment of vinyl chloride plastic material, the equipment of this kind should be avoided as much as possible to avoid the effect of reducing the effect; the non-polyvinyl chloride soft bag has the adsorption effect on the sodium chloride and sodium chloride injection, and the glass bottle infusion should also be used.

Intravenous infusion automatic control ideas

Control of the total amount of infusion the total amount of infusion is pre-set by the medical staff. The system saves the total amount and monitors whether it has been lost or not. Drop speed control the control unit is “drip/min”, and its value is also pre-set by medical staff, such as 80 drops/min. Temperature control the control content is optional. The medical staff determines whether to open the control according to the external environment and experience and the needs of the patient. Instillation process monitoring the control information such as bed number, current liquid amount, drip speed, temperature (if this control is selected) is transmitted to the monitoring center in the nurse's duty room by serial communication, and the medical staff can at any time. Understand the infusion situation, and when the patient is abnormal, press the help button. The nurse's duty room will display an alarm message and display the bed number.

The equipment used in hospitals is related to the health of patients and even the safety of their lives. The work must be safe and reliable, and no mistakes can be made. Therefore, when selecting the device, we must consider its stability. Try to use high-integration chips to reduce each Interference between components.

Selection of single chip microcomputer PIC16F877 produced by M ICROCHIP company is selected. The internal hardware resources of this kind of single-chip microcomputer are quite abundant, and it is almost unnecessary to expand other devices. It integrates an A/D module, a timer

counter module, a capture comparison and pulse width modulation (CCP) module, a serial communication module, and a built-in EEPROM to meet the needs of the device.

Selection of peripheral integrated chips in order to ensure the stability of the system and reduce the design difficulty, peripheral devices use M ICOCHIP products as much as possible. The temperature sensor uses TC1046, its high-precision temperature-voltage conversion can operate from -40 to 125 °C with a sensitivity of 6.25 mV/ °C, operating current as low as 60 μA, and output current of 100 μA. The amplifier uses the standard single op amp M CP6041 produced by M ICROCHIP, which features micro power consumption, ultra low operating voltage, high BW/ IQ ratio, and ultra low THD +N (total harmonic distortion + noise). For driving A/D conversion, it is impeccable for use on medical devices. In order to ensure safety and reliability, the serial bus diagram 2 PTC characteristic curve communication is carried out using the CAN bus protocol. Use M ICORCHIP's CAN bus controller M CP25025.

Selection of other devices the heating element uses PTC thermal components, mainly considering the characteristics of the resistance of PTC components increasing with temperature to ensure patient safety. The characteristic curve of the PTC component. It adopts optocoupler type isolator, DC motor, BN5279A digital tube and keyboard interface chip, standard 4×4 matrix keyboard, 6-digit LED display.

Implementation method and hardware circuit design

Only a pair of photocoupler diodes are placed on both sides of the protruding portion of the Tomas tube. When there is no droplet, the light signal from the D1 LED turns on the photocell T1. When a droplet passes through, it blocks the light and turns off T1. This generates a pulse and sends it to the microcontroller counter pin T0CK0. Each 16 drops is about 1 mL (usually a certain margin is left after the infusion is completed, so The amount of the drop can be estimated by the method of counting the drops. At the same time, the remaining amount displayed by the display is reduced by 1. If the remaining amount is reduced to 0, the alarm is triggered and the infusion is automatically turned off. At the same time, the pulse is also sent to the pin CCP1 of the capture function module of the microcontroller. When the microcontroller captures the rising edge of each pulse, an interrupt is generated, and the value of TM R1 is automatically recorded, so that it can be written appropriately. The program detects the time interval of the two pulses, thereby obtaining the dripping speed of the liquid medicine, and the single chip microcomputer determines the forward and reverse rotation of the DC motor by comparing the dripping speed with the preset dripping speed, and realizes the medicine droplet speed by the actuator. control.

Wrap the PTC thermal element around the neck of the vial and attach the temperature sensor TC1046 to the PTC. The output of the sensor is connected directly to the A/D input pin AN0 of the 16F877 via the amplifier MCP6041, through the calculation and analysis to obtain the temperature of the PTC component at a certain moment, the function relationship between the temperature of the PTC component and the temperature of the liquid chemical input to the human body needs to be obtained through experimental analysis. With this function relationship, the PTC component can be turned on and off. Electricity to control the temperature of the liquid. The above control information will be sent to the display buffer at any time, and sent to the CAN bus controller MCP25025 through the RD port, and the information will be fed back to the PC of the monitoring center via the CAN bus (simplex mode). Each controller has its own logo, which is the bed number entered by the medical staff in advance. With this sign, the monitoring center in the duty room can identify various information feedback from one controller, that is, a certain bed. The infusion situation is so that the medical staff can handle it. If the infusion is completed, or if the patient presses the help button, the duty room will also receive an alarm signal with the bed number information. If there is an unexpected situation in which the needle is clogged, the controller can detect that the drip rate is rapidly decreasing, and an alarm signal is also sent to the control center.

Software preparation

The software part is mainly composed of the following modules: 1) Main program module Complete initialization and start each sub-module. The main block diagram is shown in Figure 4. 2) BN5279A interface program module This module cooperates with the interface chip BN5279A to complete the input of preset information and the display of infusion conditions. 3) A/D interrupt subroutine module Enter the module every time the A/D conversion is completed, and the obtained digital quantity is processed by a certain algorithm, and compared with the preset temperature, it is decided whether to start PTC heating. 4) TIM ER0 overflow processing module sets TIMER0 to overflow every 16 times, the total register is decremented by one, and it is judged whether it is zero. If it is zero, the command will drive the motor to rotate until the infusion is turned off. If it is not zero, the display buffer is refreshed and the TIMER0 count is reset. 5) The CCP1 interrupt subroutine module will generate a CCP1 interrupt for each drop of liquid. The task of this module is to get the interval between two interrupts (you can read the value of TM R1) to calculate the drug at a certain time. The drip rate of the liquid is compared with the preset drip rate to determine the forward and reverse rotation of the motor. If a sudden drop in the drip rate is found, an abnormal alarm is issued.

Conclusion

The intravenous infusion control system has the following characteristics: It controls the whole process of intravenous infusion and reduces the labor of medical personnel. A highly integrated, high-stability chip is selected to reduce circuit interference. Communication is carried out using the CAN bus protocol, which improves reliability. Easy to operate and easy to use.

Acknowledgements

This research was financially supported by Colleges and universities in shandong province department of education scientific research and development projects. Project name: intravenous infusion of the control system of automatic dispensing apparatus development with item number: J14LB57.

References

[1] Wang Tiyan. Glucocorticoid treatment of acute lung injury [J]. Chinese Medicine Guide, 2016, 2(16): 68-71.

[2] Duan Zheping, Yu Xinjiang, Lu Yanling, et al. Prevention and treatment of compound Kushen injection on radiation-induced lung injury and myelosuppression in patients with non-small cell lung cancer [J]. Shandong Medicine, 2016, 14 (32): 91-93.

[3] Qi Zhihai, Wang Chen, Ma Jinhui, et al. Intake of pulmonary vascular endothelial cells and alveolar type II epithelial cells from iPSC exosomes [J]. Chinese Journal of Cardiovascular Surgery, 2016, 14(1): 46-48.

[4] Wang Junyao, Fang Yuzhi, Zhai Zourong. Study on the stability of meropenem after compatibility with four injections [J]. Chinese Pharmaceutical Journal, 2003, 38(9): 714.

[5] WU X, ZHANG C, WANG L, et al. Four-axis Linkage 3D Printing Structure Design of Blood Vessel Stent[J]. Journal of Applied Science and Engineering Innovation, 2018, 5(4): 125-128.