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Electronic Device for Reducing the Acute Intussusception , Application in the Pediatric Surgery

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Abstract

The present work is a realization of an electronic device intended for the domain of the pediatric surgery, where the acute intussusception occupies an essential importance.The most frequent method of the resolution of this pathology is the surgery which is effective but presents a risk for the infant. There are other methods to resolve the intussusception as the manual pneumatic reduction. Our device is the seat of an improvement of this system of manual pneumatic reduction and which exists for a long time, in our work we automated this system and to make it working with a microcontroller of the Microchip family 16F877A and a piezoresistive pressure sensor Motorola Mpx 7050 .

Keywords— - Acute Intussusception, Digestive System, Piezoresistive Pressure Sensor,Microcontroller.

Introduction

Intussusception occurs , it can create a blockage in the bowel, with the walls of intestines pressing against one another. This , in turn leads to swelling, inflammation , and decreased blood flow to the part of the intestines involoved.

Intussusception:

- Occures most often in babies between 5 and 10 months of age (80% of cases occur before a child is 24 months old).
- Affects between 1 and 4 infants out of 1000.

(figure .1). [1]

Figure 1.Acute intussusception

II . Anatomopathologie of intussusception

The digestive system consists of numerous organs: oesophagus, stomach, small intestine. It is who assures the digestion of food .

The intussusception presents the following characteristics

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(1) : The head of the sausage of intussusception

(2) : The invaginal bowel

(3) : External cylinder or conductor

(4) : The snare of the intissusception

The reduction by insufflation of air

As we saw it previously the surgical treatment presents a risk for the infant . The principle of the pneumatic reduction is simple ,by injecting the air by reactionary way using a plastic tube insert in the probe of foley and is injected in the rectum of infant, the pressure shall not exceed 120 mmHg [2] .This method was used by pump (figure.2).

This system constitutes of a pump to create the pressure, a barometer for measured the pressure, a safety valve and the probe of Foley which enters in the rectum.

The system with manual pump deserves of the simplicity but delivers peaks of pressure can exceed 120 mmHg and in that case the perforing of the bowel.

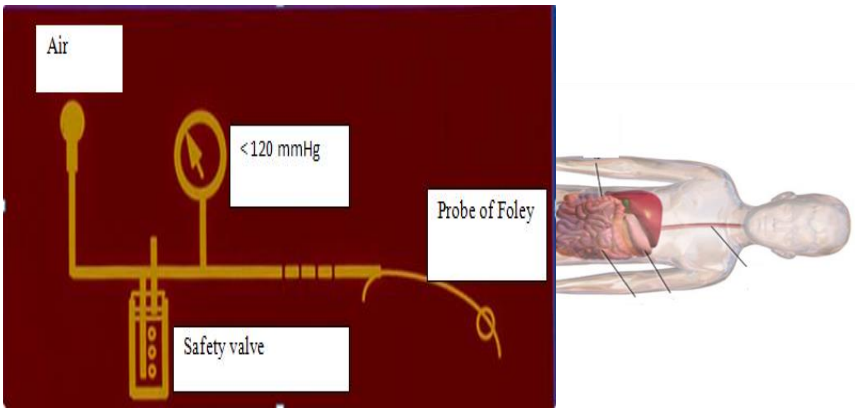

Figure . 2. The manual reduction system of the intissusception

Methods of pneumatic reduction of intussusception

In the figure .3. we present the equipment for pneumatic reduction of intussusception used at Korle Bu Teaching Hospital [2],

Figure .3. equipment for pneumatic reduction

In the figure .4. we present an interactive teaching device simulating intussusception reduction using a plastic tubing with the instructor's external release valve connects the aneroid gauge and bulb insufflators to the cylinder within the doll. Additional tubing extends from the doll to a pressure sensor and is transmitted via USB cable to a computer [3]

*figure .4***.** interactive teaching device simulating intussusception

Presentation of the electronic device of reducing the intussusception

We are show that the manual system contains essentially a pump air, with it we can injecting the air in the bowel , but this technic can productcs piks of pressure , so a risk of perforation of bowel because in there is'n a control of pressure. In our work we automated this manual system of which we made it automatic, our device contains the following elements:- A piezoresistif pressure sensor of the family MOTOROLA typifies MPX 7050 and their circuits of conditioners [4], the purpose of this circuit and to measure the pressure intra-stomach pain in the circuit and which is between 0 mmHg and 120 mmHg and even the intra-abdominal pressures connected to the contraction of the muscles of the abdominal wall or to the gesticulation of the child in case the act is made without general anesthesia and thus more security.

- A circuit of calculation and processing with microcontroller of the family Microchip typifies 16F877A [5], connected essentially to both interfaces, a keyboard 16 keys allows to enter the necessary data and a display LCD 16X2 allows to visualize all the operations of command and control.

- A circuit of command which receives the order through the circuit of calculation and processing, to give the order to the pneumatic system which is on the base of a small compressor of 300 mmHg for transporting the insufflations of air towards the bowel of the newborn through the rectum, As the insufflation progresses, the air accumulates more and more and repulses the sausage .

- Plastic pipes of the various diameters, the joins in the form of letter T, an anti lid return, a safety valve and a reservoir

- A safety valve allows to reduce the pressure to create by the newborn and by the doctor.

- An anti lid return to transport the air in a single sense to avoid the return of the materials and the gases at the level of the pressure sensor and of the insufflator.

- A reservoir to collect the abdominal waste at the time of the reducing the intissusception

- At the level of the patient, the breathed air circulates through a special probe sterilized, it carries the name: probe of Foley

C.1 Piezoresistif pressure sensor and conditioner circuit

The measurement system of pressure is realized with a piezoresistif pressure sensor of the family MOTOROLA typify MPX 7050 it detect the pressure of the air breathed in the bowel and it presents the minimized value of the offset voltage[6][7]

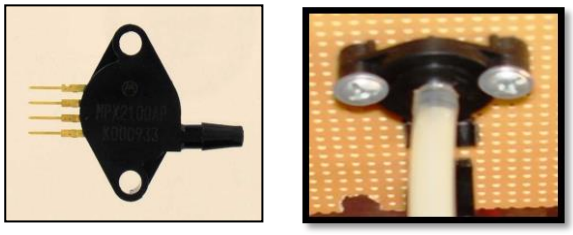

Figure 5. Piezoresistif pressure sensor , Motorola MPX 7050

This sensor is supplied by power supply at 12V. It output voltage has a proportional variation in function the absolute pressure, from 0 to 40 mV for a pressure going of 0 to 50Kpa. The piezoresistif pressure sensor carries the following characteristics: Compensated in temperature more than 0 ° C to 85 ° C and also calibrated

· Linearity ± 0,25 %

C.2 Conditioner Circuit

In absence of pressure we have see that our sensor delivers a zero voltage in its output voltage and 40 mV for 50 kpa where the maximal pressure authorized for the reducing intissusception does not exceed 16kpa (120 mmHg) what imposes us to hold it in account. For a pressure of air equal to 16 kpa, we found 13 mV of output voltage **.** The figure.6 represents the electronic circuit with two operational amplifiers constituting the conditioner of the pressure sensor . The two signals e^+ and e^- represent respectively the output voltage (+) and the output voltage (-) of the sensor.

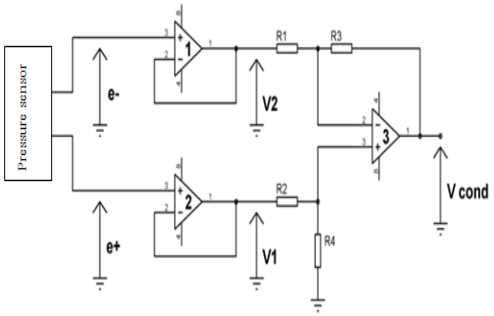

Figure 6. Electric schematic of the conditioner

The amplifier 1 and 2 represent a voltage follower , the lines of signal (e^+) and (e^-) are directly inject in the entrances of amplifiers for giving very high impedance of entrance and an effective insulation. The gain in voltage of assembly followers is equal to the unity G = 1. It What means that the amplitude of the signal is the same at the output and the input. The amplifier 3 represents the differential amplifier, the use of this type of amplifier allows to make the amplification of the difference of two voltages V_1 and V_2 giving from the output of our two amplifiers .

The gain of the circuit of amplification thus cost

$$G = \frac{V_{conditioner}}{(V_1 - V_2)} = \frac{R_s}{R_1} \qquad (1)$$

The expression of the gain of the assembly differential amplifier indicates that this one depends only on values of the resistances R_1 and R_2 of the conditioner circuit. The choice of the value of the gain of amplification is conditioned by the sensor and the microcontroller. For a pressure of air equal 16kPa (120 mmHg),our output voltage equal 12,792 mV thus we can calculate the gain of amplification**:**

$$G = \frac{5}{12.792 \times 10^{-3}} = 390 \qquad (2)$$

So we chose the values of the resistances as follows:

$R_1 = R_2 = 3.9\ M\Omega$ and $R_3 = R_4 = 10\ K\Omega$

We obtain a gain:

$$G = \frac{V_{conditioner}}{(V_1 - V_2)} = \frac{R_3}{R_1} = \frac{3.9 \times 10^6}{10 \times 10^3} = 390$$

C.3 Command Circuit

The circuit below represents the command circuit.The diode D_1 is placed in parallel with relay to protect the transistor , and this one works as a switch which opens and closes the power supply of the relay (Figure.7).

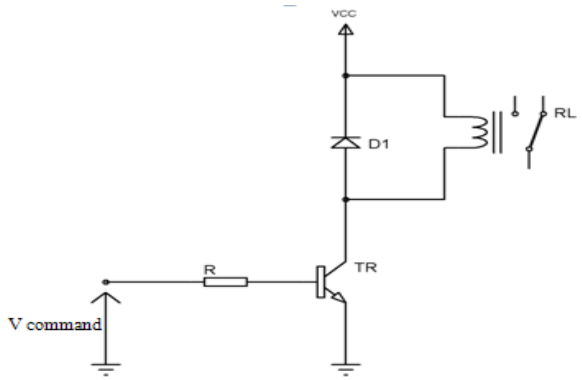

Figure 7. Electric schematic of Command circuit

C.4 Pneumatic System

The pneumatic system transport the air breathed towards the patient, the first part of our system is an insufflator of air , possesses the following characteristics: power supply 5V DC and the pressure which can achieve is 300 mmHg .

Presentation of the electronice device

The realized model is given by the electronic circuit presenting in figure 8 also we present our device with photos , the device of which we used to solve a problem of the intussusception for newborn, we noticed the progress of the air in the bowel and when we obtained the preferred pressure the progress stops and the abdominal distension becomes homogeneous, this operation was made a success and the obtained results were very satisfactory.

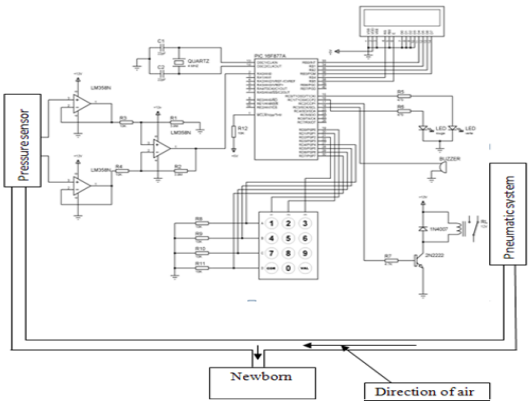

Figure 8. Electric circuit of the the electronic device

Figure 9. Use of the device

Figure .10. Progress of the air in the bowel

Figure .11. Stop of the progress

Figure .12. The abdominal distension becomes homogenous

Conclusion

The intussusception for infant is an medical urgency requires a surgical treatment , also the system with manual pump deserves of the simplicity but delivers peaks of pressure can exceed 120 mmhg and in that case the perforing of the bowel. In our work we proposed an electronic device for reducing this problem , we confirm that this device realized gives many advantages, using the principle of injection of air, controlled and commanded by a piezoresistif pressure sensor , by programming the micocontroleur we can varied the pressure from 20mmHg to 120 mmHg and after a a few minutes we will obtain a reducing for acute intussusception.

References

Talwalker, V,C "Intussusception in the newborn", From the Hospital for Sick Children, Great Ormond Street, London, 1961, pp 203-208.

Mensah, Y. B., Glover-Addy, H., Etwire, V., Twum, M. B., Asiamah, S., Appeadu-Mensah, W., & Hesse, A. A. (2011). Pneumatic reduction of intussusception in children at Korle Bu Teaching Hospital: an initial experience. *African Journal of Paediatric Surgery*, *8*(2), 176

Stein-Wexler, R., Sanchez, T., Roper, G. E., Wexler, A. S., Arieli, R. P., Ho, C., ... & Soosman, S. K. (2010). An interactive teaching device simulating intussusception reduction. *Pediatric radiology*, *40*(11), 1810-1815

www.datasheetcatalog.org/datasheet/motorola/MPX7050GSX.pdf

www.microchip.com/downloads/en/DeviceDoc/39582b.pdf

Campabadal, F., Carreras, J. L., & Cabruja, E. (2006). Flip-chip packaging of piezoresistive pressure sensors. *Sensors and Actuators A: Physical*, *132*(1), 415-419

Stankevič, V., & Šimkevičius, Č. (1998). Application of aluminum films as temperature sensors for the compensation of output thermal shift of silicon piezoresistive pressure sensors. *Sensors and Actuators A: Physical*, *71*(3), 161-166.