A Cost-Effective Solution for HIPEC Machines

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Keywords: Cancer, Cytoreductive surgery, HIPEC machine design

Abstract: A retrospective survey shows that approximately 8.6% of all cancers that occur in India was mainly abdominal and stomach cancer. The statistics show that a person who has undergone HIPEC (Hyperthermic Intraperitoneal Chemotherapy) treatment will be able to survive for nearly 3.5 years. Generally, the cost for designing a HIPEC Machine is too high (above 75lakhs) and the treatment is also not affordable. So, our aim is to design a HIPEC Machine at low cost, compact size and safely, which could reach all the people across the nation. Before the patients receive HIPEC treatment, the oncologists perform Cytoreductive surgery to remove the visible tumors in the abdomen. Once all the visible tumors are removed, the patient undergoes a HIPEC treatment. This machine could remove all the microscopic tumors that human eyes fail to identify. Also, certain modifications has been made to this present HIPEC Machine design to create a new cost effective automated chemotherapy machine.

INTRODUCTION:

Cytoreductive surgery combined with preoperative intraperitoneal chemotherapy is currently a valid treatment option for selected cases diagnosed with these diseases[1]. Peritoneal carcinomatosis from colorectal cancer is a stage 4 disease that requires massive chemotherapy and other major surgeries. This HIPEC machine help in curbing this deadly cancers to a good level. But this is not possible to be used in all the countries. Not all hospitals are well capitalized in treating patients using this machine.

There are many "home-made" techniques to create an alternate HIPEC machine. Hereby a method has been proposed to reduce the cost of the machine. The price of the HIPEC machines available in India ranges from 70,000–1,35,000 US dollars (USD). The cardiopulmonary bypass machine costs around 80,000 USD and is already present in a hospital that performs cardiac surgery and extra expenditure is that of the water bath costs 5000 USD. Consequently, several studies have investigated the cost-effectiveness of CRS and HIPEC, but the financial consequences of postoperative complications after CRS and HIPEC have never been extensively described in a European health care setting[2]. HIPEC is composed of several constants clubbed together- the drug choice and its quantity, the carrier solution and its volume, the duration of the procedure, the level of hyperthermia, the flow rate, and how the technique is performed–open or closed [3]. The open method confirms optimal distribution of heat and cytoxic solution throughout the abdomen. The main disadvantage for open method is the leakage of cytoxic drugs and heat loss. The closed method prevents the heat loss and drugs spillage, increases drug penetration, thereby overcoming the disadvantage of the open method, but the closed method does not guarentee the homo distribution of the drug. In the present years the treatment of peritoneal malignancies is changed, moving from a palliative one to an aggressive multimodal therapy, in which maximal surgical effort cytoreductive surgery can remove as much tumor is possible which is followed by the direct installation of heated intraperitoneal chemotherapy to eradicate the microscopic residual tumor cells.

Though there is no ideal level for fluid volume, the degree of heat used or the flow rate- the procedure is done using a liquid level of 1.5–3 L at a flow rate of 1.5–2L/min with an intra-abdominal temperature of 41–43°C. Some constants like the technique of HIPEC, the degree of hyperthermia, depend on the device used, that consists of a heating device and a roller pump[4]. In these HIPEC machines, a heating device and roller pump are all enclosed in one external covering. There are 2–4 temperature probes, inflow and outflow tubes, and a reservoir bag which are available separately, but connected to the machine for the procedure. This is mainly focused for abdominal cancers where the doctors primarily perform a cytoreductive surgery, later proceeds on with this HIPEC treatment to remove the micro-cancer cells which human eyes cannot perceive.

LITERATURE REVIEW

The average cost of CRS and HIPEC per patient was $83,680.26, and the median overall survival period was 47 months. The calculated cost per life year who underwent a CRS and HIPEC was $21,375.19. In comparison, the average cost of palliative chemotherapy was S$44,488.87, with a median overall survival of 8 months[6]. From 2011 to 2017, HIPEC (Coliseum technique) was performed in 81 patients using HMM. The home-made machine was a cardiopulmonary bypass machine available in our institution, with an additional water bath.[5] A cardiopulmonary bypass machine (Terumo Sarns Modular Perfusion System 8000, Bloomfield, USA) in combination with a series of heating devices and a fluid reservoir was used.[4] Some centers use a homemade machine (HMM) that usually consists of a cardiopulmonary bypass machine used in conjunction with a water bath [3]. A model predicts that CRS and HIPEC have reduced the morbity of cancer each day, but the rate of people who could use such a treatment is very limited. Our research group has identified patients at risk of high hospital admission costs[5].

The present HIPEC method of treating abdominal cancers is a much innovative way except the cost being so huge.

EXISTING METHOD

What is Peritoneal Cancer? The organs that includes the abdominal cavity such as the stomach and the intestine and the abdominal wall are covered with a thin layer of cells. This layer is called the peritoneal lining or peritoneum. Sometimes, the peritoneum can be even invaded by the deadly cancer cells. This condition is commonly called "peritoneal cancer," but it has also been called peritoneal surface malignancy, peritoneal carcinomatosis, peritoneal metastases or pseudomyxoma peritonei. There are three different potential origins for the cancer cells originating in the peritoneal region. First of all, the cancer may arise from the so-called mesothelial cells that line the peritoneum, that causes a very rare type of cancer called "malignant mesothelioma". The second source of cancer cells is a mucus-producing tumor, which is mostly situated in the appendix. This tumor may rupture while growing, and this rupture can spread the mucus-producing cells throughout the abdomen. The most common peritoneal cancer arises from cancer cells that are shed by a primary tumor elsewhere in the body. The cells travel to the peritoneum and start to grow on the surface of surface. The cancer cells will go on multiplying and form small tumor nodules on the peritoneum.

Peritoneal cancer is regarded as a very serious and advanced form of cancer. The cancerous nodules further obstruct the bowels ausing the fluid to accumulate in the abdomen. HIPEC may be a life prolonging and can even be a life-saving treatment for some patients. Unfortunately, there are certain limitations as well. There is an average chance that all patients may experience positive results from a HIPEC procedure. This varies from every individual patient due to cetain factors. Some of these factors are outlined below.

Extent of the disease: The extent of peritoneal cancer throughout the peritoneal cavity can be identified with the help of the peritoneal cancer index (PCI). In general, PCI is interrelated with the prognosis after HIPEC. Higher PCI values are often considered as a worst prognosis. The maximum PCI in colorectal cancer patients varies due to many factors.

Formation of Peritoneal Cancer: New vital evidences and scientific support treatment with HIPEC in some selected patients with mesothelioma and with patients whose peritoneal cancer derived from a colorectal tumor. A tremendous effect from HIPEC is expected for majority of patients with peritoneal cancer of a gastric or ovarian origin. This form of treatment is still under investigation and treatment of these patients with HIPEC should ideally be performed in clinical studies. Currently very dangerous pancreatic cancer or high-grade sarcoma with HIPEC is not supported by sufficient scientific evidence.

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Clinical condition: A HIPEC procedure is considered to be a lengthy, invasive and complex one. Patients should be healthy and fit. They must be in good clinical condition to endure this treatment with good results, and a chance for full recovery. Some hospitals keep an upper age limit for this treatment which is about 65 or 70 years. Various hospitals have now proven that a HIPEC procedure can be performed safely in fit and otherwise healthy patients over 65-70 years old.

Cancer outside the abdomen: The HIPEC procedure for the abdominal cavity is considered as a regional treatment. Therefore, cancer that has spread to organs outside the abdominal cavity (e.g., to the lungs, brain, or bones) is usually not considered to be a suitable target for a HIPEC procedure. No metastatic cancer is encouraged to be solved using the HIPEC procedure. An exemption to this statement may be made for the presence of only a few (three or less) treatable liver metastases from colorectal cancer. Different studies have shown that treating such liver metastases with a combination of HIPEC and systemic chemotherapy for limited peritoneal cancer is safe and feasible. Additionally, this approach has resulted in prolonged survival compared with treatment with chemotherapy alone.

In addition to the above factors mentioned, there are many other factors that may need to be considered for an individual patient, and these may influence the advice concerning the best possible medical treatment. Furthermore, indications to continue with a HIPEC procedure may vary between countries, and even hospitals within a country, depending on local expertise. To be in a safer side, a patient with peritoneal cancer should be counseled by a multidisciplinary team of experts with specific knowledge on peritoneal cancer to define the optimal treatment strategy. The strategy may include HIPEC in selected patients. Some cancer types are very difficult to treat. Cancer that has unfolded to the liner surfaces of the serosa (abdominal) cavity from primary large intestine cancer, female internal reproductive organ cancer, viscus cancer are such cancers. Despite various recent advances in therapy, the likelihood of therapy being curative continues to be low, and the side effects are difficult for the patient to endure. When these cancers are concentrated mostly to the peritoneal cavity, Hyperthermic Intraperitoneal Chemotherapy (HIPEC) becomes an option for those patients. The surgeon will circulate a heated sterile solution up to 420C that contains a chemotherapeutic agent. This will be spread throughout the peritoneal cavity, for a maximum of two hours. The HIPEC procedure is meant to try to kill any remaining cancer cells. A HIPEC procedure consists of four phases combined into one operation: exploration, resection, HIPEC and reconstruction.

Exploration: The operation starts with a complete investigation of the abdominal cavity by the surgical team, during which the surgical team can precisely determine the extent of the peritoneal cancer . Several scores are used to determine the extend of the cancer. The most commonly used score is the Peritoneal Cancer Index or "PCI". The PCI is correlated with the prognosis after HIPEC. Higher PCI values are associated with a worse prognosis. Most hospitals have a defined maximum threshold value of PCI for this treatment. If the PCI exceeds this threshold value, then the Cytoreductive surgical operation is terminated and the HIPEC procedure cancelled because the benefit of the procedure in terms of survival does not outweigh the risks. The maximum PCI may be different for various disease types and different among institutes worldwide. Taking into account, the PCI for the patient, the surgical team judges whether all visible tumor nodules can be radically removed. The procedure continues only when the surgical team is much confident that the complete removal of the tumor nodules is possible.

Surgical Resection: The operative part of the procedure is called "cytoreductive surgery" and is a crucial part of the overall procedure. Cytoreductive surgery mainly involves surgical removal of all peritoneal surfaces and organs that have been attacked by cancer cells. For example, the spleen, a part of the small bowel, the gallbladder or other abdominal organs. In general, the surgeons try to spare as many organs as possible. Only the affected areas are given more importance. The number of resections that has to be performed varies widely among patients. Even after removing all visible cancer nodules, the microscopic cancer cells are left behind. If these cells are left unnoticed, these cancer cells will start dividing again soon after the operation and lead to the formation of the peritoneal cancer.

HIPEC: To terminate these invisible tumor cells, the abdomen is filled with a high dose of chemotherapy during the operation. The types of chemotherapy that may be used includes oxaliplatin, mitomycin-C, and cisplatin. This chemotherapy is heated to 41-42 degrees Celsius. If the temperature is increased above this value, the heat will increase the effectiveness of the chemotherapy. This heating is achieved by a device capable of heating and circulating the chemotherapy into the abdomen of the patient. Depending on the rules followed by various institutes around the world, this step in the procedure lasts for 30 to 90 min. This portion of the procedure is called "Hyperthermic Intraperitoneal Chemotherapy" or in short: HIPEC. Although this step is just part of the entire procedure, the term HIPEC is now commonly used to describe the entire surgical procedure.

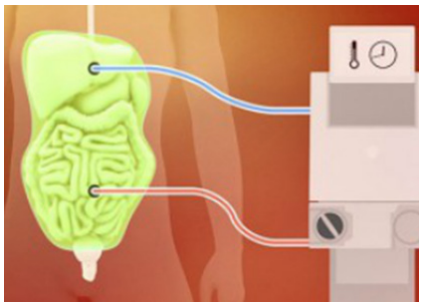

Fig. 1.2. Heating and perfusion by a dedicated perfusion device

Reconstruction: Soon after the HIPEC procedure is over, the operation proceeds by restoring continuity of the bowels whenever possible. However, a temporary or even permanent colostomy is sometimes required. In most patients, various catheters are inserted, such as catheters in the stomach, urinary bladder or abdominal cavity. These catheters will be removed based on the clinical condition of the patient in the days after the operation. As the HIPEC procedure is often a lengthy and radical one, most patients are admitted to an intensive care unit(ICU) after surgery for close monitoring of their vital and clinical functions.

Post-operative course: HIPEC is a complex and invasive procedure, postoperative complications can occur frequently. Frequent complications include a wound problems, an infection of the lungs or urinary bladder, and the inability to eat or drink during several days or even weeks. A less frequently seen but a more serious complication observed is the leakage of bowel contents into the abdomen resulting in abdominal infections. A second procedure may be needed in these patients to control the leakage. Some of the patients experience side effects from the chemotherapy that is used during HIPEC.

PROPOSED SYSTEM:

After a prior clinical research we have identified, the cost of heat exchanger used in the treatment process is too high. An average steel heat exchanger may cost about US $1500-150000 which may shoot up the price of a HIPEC machine, so we came out with the new design model, where the heat exchanger is replaced by a automatic heater bath. This heater bath has two compartments, the upper portion consists of the saline water, and the lower portion consists of the chemotherapy drug.

The water bath is subjected to heating by giving appropriate power supply to the lower chamber. It consists of a coil wounding, which heats up the bath, such that the chemo drug will boil to a temperature of 42-43oC. Here the lower portion and the upper portion are separated by a phenolic foam insulating material, so that heated chemotherapy solution doesn't make contact with saline water. Two tubes are inserted at the top of the water bath through which the liquids are taken out. The two tubes which are inserted to both the portions of a heater bath, are used as inlet and outlet. The inlet tube helps in the inputting the chemo drug into the abdomen, and the outlet tube helps in getting the chemo drug from the abdomen. There are two valves present at the outlet side of the water baths. These valves open and close accordingly, allowing or blocking the passage of both solutions.

Initially the saline water is sent to the patient's abdomen from the upper partition with the flow rate of 1L/min. Then once the power supply is switched on, the chemotherapy drug starts heating, and once the temperature reach 430C (fixed temperature in which the solution is heated), the thermocouple

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placed at the lower chamber sends the signal to the PID controller, which then automatically opens the valve of the tube and the solution starts moving to the abdomen. Here the PID controller switch off the power supply to the heater bath, once the temperature reaches 430C, by taking the input from the thermocouple.This reduces the continuous wastage of supply.

Then we have modified the temperature probe which is placed inside the abdomen with minimal size to which a closed compact medically certified temperature sensor (biomedical sensor) is attached, which continuously monitor the temperature inside the abdomen.

Usually the temperature of the chemotherapy solution inside the abdomen is to be maintained at 41.50C. Hence by taking the input of the temperature sensor, the temperature probe starts heating.

We have developed a keypad input, where the doctor, before starting the treatment, determines the desired time the chemotherapy solution has to be inside the abdomen. So once the time period is covered, the solution inside the abdomen automatically starts draining out. We have replaced the costly and heavy compressors by Single phase AC Motors which is more cost effective

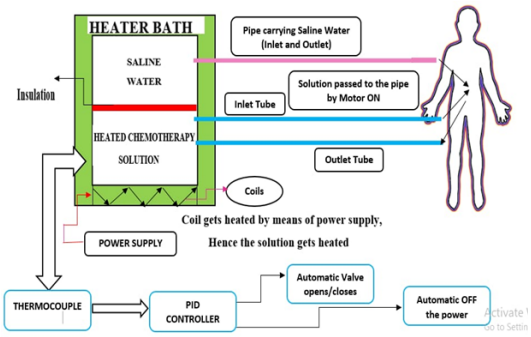

Fig.1. represents a basic architectural design of the HIPEC machine.

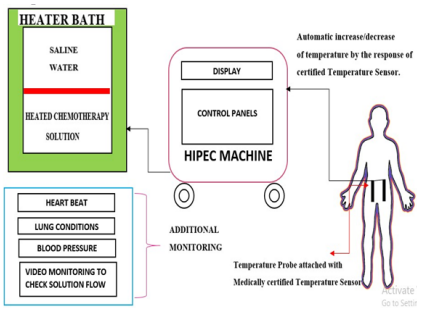

Fig. 2.1. Architecture of the HIPEC model

After the surgery is over, the HIPEC treatment is started. Initially the water bath is heated up gradually to the required temperature. A temperature sensor is placed near the bath, which sends the information to the PID controller. As soon as the required temperature is reached, the PID controller cut off the power supply to the bath. The saline solution is first sent in to the abdomen and it is then taken out through the outlet tube. The boiled drug is now sent into the abdomen. After the prescribed time elapses, the drug is taken out. Two temperature probes are kept inside the abdomen to maintain the heat. Few minutes before the elapse time, the PID controller switches on the supply to the water bath giving it time to warm up before the drug arrives. This process works the same as the normal HIPEC machine, but only difference is, our proposed model reduces the cost to a much wide level. In addition to the present HIPEC machine we have improved the design in such a way that addditional monitoring is executed. This is mainly concentrated on the patient's heart and lung conditions. There may be some factors, considering the patient's age and clinical conditions that this high temperature and acid drugs may affect the functioning of the heart. Special monitoring is given to all other organs such that no other organ will be damaged due to this procedure. An alarm or a flash message will be present.

COMPONENTS USED

Heater Bath: Before designing the HIPEC machine, we had researched the difficulties found in the present day machine setup. After a prior clinical research, we had identified that the cost of the heat exchanger which is being used to pre-heat the chemotherapy drug is quite costly and not affordable. So we planned to replace the heat exchanger with a modified automatic heater bath. The basic design model of this heater bath consists of two compartments, upper part is used to carry the required amount of saline water. Here, before the patient undergoes HIPEC, the abdomen should be cleaned with the saline water. So the upper partition of our heater bath is completely dedicated for the saline water. The upper partition consists of one tube/pipe (Acts as the inlet and outlet) for discharging the saline water from the heater bath to the patient's abdomen. Then the lower partition is completely dedicated for the chemotherapy drug. The lower layer in the partition is completely wounded by a closed copper coil without any air gap, in which the required amount of power supply is given from the external source.

So once the power supply is switched ON for a certain amount of time, the coil receives the enormous amount of heat energy and such a heat energy gets transferred to the lower layer of the heater bath, which is made of a special material which accepts heat energy and at the same time the material doesn't react with the chemotherapy drug during the heating process. The lower partition also has carries two tubes, one for sending the drug into the abdomen and one for receiving the treated drug from the abdomen to the heater bath in a loop process. This process continuously happens until the prescribed time by the oncologists is attained. (Note: Before starting the process, the oncologists need to determine the amount of time in which the drug to be inside the abdomen and the timing could be given in the special control panels). Here the lower partition and the upper partition are separated by means of a phenolic foam Insulating material, so that heated chemotherapy solution doesn't made contact with saline water. Also the lower partition consists of a compact miniature thermocouple for sensing the temperature of the chemotherapy drug.

PID Controller: Since the entire objective of the process gets dealt with the real human lives, the operation performed is to be cent percent safe. The entire automatic operation which is going to perform by our HIPEC Machine is purely depends based on the appropriate commands provided by the controller. So the controller acts as the brain in our entire setup. Because of all higher priority and importance, we had chosen the controller as PID (Proportional-Integral-Derivative) for achieving our target. It is a closed feedback controller widely used in modulated control applications. It continuously calculates the error value with respect to the provided set points and automatically takes the appropriate actions to rectify it. The main advantage of this controller is accurate and its responsiveness. Because of the above mentioned features this controller suits with our applications. The control actions taken by the controller in our operation is as follows: The main challenge part in HIPEC operation is maintaining and regulating the temperature range inside the abdomen and also inside the heater bath, which carries the chemotherapy drug. Once the power supply is switched ON, the coil gets heated which enhances the temperature rise of the chemotherapy drug in the lower partition.

Once the temperature reaches 430C (Fixed temperature in which the drug is heated), automatically the PID Controller cuts off the power supply and switch ON the motor and then opens the valve through which the drug is passed into the abdomen from the heater bath. Also after a certain time it again switch ON the motor and this time the drug from the abdomen is drained and passed to the heater bath again. This operations happens continuously as a loop performance. Also after sometimes, the temperature of the drug may get reduced. So once the temperature of the drug inside the heater bath stats decreasing, the controller automatically switch ON the power supply to heat the coil. Also the temperature regulation inside the abdomen is also being regulated by this controller. After the Cytoreductive surgery, the abdomen of the particular patient gets closed temporarily. Before the closing of abdomen, the temperature probe is placed inside the abdomen and stitches it permanently. Invisible cancer cells inside the abdomen gets destroyed at the temperature range of 41.50C and also if the temperature reaches above the prescribed range, the patient may lead to death or in sudden coma condition.

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For maintaining this particular temperature range the PID controller helps a lot.

Thermocouple: Thermocouple sensor is a kind of temperature sensor which consists of two wires of different metals, which when joined together it forms a junction. That particular junction is placed on the surface or external environment and that's being measured. So whenever the temperature changes are noted, the two dissimilar metal wire is tends to deform, causing a change in resistance value as a output. Also this sensor provides the accurate value, available at low cost and reliable. We are using this sensor for sensing the temperature of the chemotherapy drug which is poured inside the lower partition of the heater bath. This sensor provides the necessary signal pulses to the PID Controller, once the temperature reaches 430C. Also this sensor is closely packed and placed inside the lower partition of the heater bath, such a fashion that the chemotherapy drug doesn't affects it.

Biomedical Temperature Sensor And Temperature Probe: Since there is a high priority need to maintain the temperature range inside the abdomen, an external temperature probe is placed inside the abdomen. This temperature probe is designed in such a fashion that it very compact in size and made up of an ideal conducting material for accepting the heat as an input. This probe is wounded with a suitable copper coil and completely packed. So whenever the controller take its appropriate control actions to ON the power supply, the probe gets heated. Here the temperature range is to be maintained constantly inside the stomach. For sensing a temperature variations of the probe, there is a need for the placement of a sensor attached with the probe. Since the abdomen is completely filled with the chemotherapy drug and it gets closed temporarily, we can't place a normal temperature sensor for measurement. For providing an accurate results and for the reliability, we planned to use a Bio-medical temperature sensor, which is being attached with the temperature probe. This biomedical sensor is a RF-powered small miniature embedded sensor with the specified electronic configuration which is being used inside the abdomen for sensing the temperature range. For providing a high resolution output and for ensuring the safety of the patients, we are using this kind of specialized sensor and superior temperature probe construction.

Valves: The valves used in the operations are Solenoid Actuated Valves. The valves are used in the HIPEC process, to control the flow of saline water and chemotherapy drug. This valve plays a vital, because it has to open/close at the right time. Whenever the temperature of the chemotherapy drug reaches 430C, the controller takes the necessary action to cut offs the power supply and send the necessary signal pulses to this solenoid actuated valves. When the triggering pulses strikes the solenoid coil wounding part, automatically the valve gets opens and it provides the closing actions, when the required conditions met. This kind solenoid valve is simple in construction, readily available in market with the appropriate coil wounding, easy to install and maintain and also available at low cost.

Controls And Displays: In any Biomedical Instruments, the controls and displays plays a very important role for visualizing and controlling different parameters. Through the control panel we can give the input requirements depend on the patient's condition. The display panel acts as the communication interface between the real world and the instruments. In our HIPEC Machine setup, through the help of control panel, the oncologists initially set the appropriate time in which the chemotherapy drug is to be inside, and at what time the drug needs to drains out. Also oncologists can set at what temperature the drug to heat. We had incorporated this control panel in a more user interface manner with a simple keypad format. Just by typing in the keypad the set points are edited and provided the appropriate actions by the PID Controller. Then the display is used only for visualizing different parameters like desired temperature, actual temperature, amount of chemotherapy drug present inside the heater bath, timings left to drain the solution out, patient's heartbeat rate, lung conditions, blood flow rate etc. Also we planned to use Infrared camera for visualizing the solution flow inside the abdomen. That solution flow can be showcased in a dedicated computer display system.

MAIN FEATURES:

Our HIPEC Machine also has an emergency button, and suppose in case of any complexity, by pressing the button it completely cut off the power supply, which is to ensure the safety. Any disconnection of tubes or breakdown of the circuit during any of the procedures gives an alert to the doctor. There will be no failures to obtain the target temperature and flow rate. Constant monitoring of the temperature will be done. A steady temperature of 420C will be maintained throughout. If there's any leakage of the liquid, whether saline water or the chemo drug it will be notified. The PID controller will be maintained to check whether it on and off the power supply correctly. An external temperature checker is present which shuts down the full system if the temperature of the system increases the threshold value.

Many changes has been incorporated to the present HIPEC Machine design only to reduce the cost in an efficient manner. Our HIPEC Machine also has the additional feature to monitor the heartbeat, lung conditions, and blood pressure. The solution flow inside the abdomen is continuously visualized in a monitor by using the infrared camera which is being placed outside, since at the treatment, the abdomen gets closed temporarily.

COST

Existing method:

The cost of the HIPEC machine ranges from US $35,000 dollars/Set. The hospitalization and surgery charges may add another $20,000-$30,000 separate. The cost of a heat exchanger is about $3000 US dollars. The roller pump accounts to about $810 US dollars. The disadvantage of roller pump is that is draws tremendous amount of current and since the device has to the fully on throughout, the wastage of current is more. The medical reservoir is about $300 US dollars. The catheters(inflow and outflow) are almost the same as used in cardiopulmonary bypass which accounts to about $70-$80 US dollars. The temperature probes has to measure a temperature of nearly 400C-450C, such a probe cost nearly $80US dollars.

Present method:

The hospitalization and surgery cost remain the same but the cost of HIPEC machine, as per our calculation drops down to a much low level. The heat exchanger is replaced by a water bath which substantially reduces from $3000 dollars to nearly $100 dollars. Since the water bath has two separations for the saline water and chemo drug, there is no need of an extra reservoir. The costly and heavy compressors of $1800 dollars is replaced by Single phase AC Motors. The extra cost is for PLC controller which is about $1000 dollars but the main advantage is a large amount of current can be saved. The PLC controls the flow of current, and since every component takes up only a reasonable amount of voltage, the wastage of current can be reduced. Overall, thousands of dollars can be spared.

CONCLUSION:

Hence our solution is fully automated with low cost and helps the oncologist to do the operation in an effectively manner. Our solution reduces the cost of the machine tremendously. Our solution provides a cost effective, compact size and safe HIPEC Machine, which can be used by the all the Government, public and private hospitals and provide a low cost treatment, so that every person across the nation gets benefited and creates a big rivalry in the Cancer Treatment process and promotes the growth of our society.

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