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Artificial Kidney

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Abstract: **The main aim of this paper is to reduce the death that is caused by kidney failure and to make every people to get a cheaper treatment towards kidney failure and to find the criteria for this sort of problem, so as a result we have concluded with this idea, so far Hemodialysis was only the rectifier for kidney failure but it is only a temporary cure which is an cyclic process which is said to be done for 2 to 3 times a week as per the subjects condition and the time taken for this process is about $4\frac{1}{2}$ hours and the charge is about Rs.1800 and twice a week special injections for blood cell regeneration and blood test is necessary so as an result an person who suffers from kidney malfunction is said to be spending Rs.30,000 approx. it could be even more than that and it is obligatory that transplantation shoulds be done after a phase of instant, so my aphorism is to make an "Artificial kidney" which can be rooted to an victim at an cost less than that of actual kidney transplantation.**

Key words: **Kidney failure, cell regeneration, kidney Malfunction, subjects, artificial kidney.**

I. INTRODUCTION

The kidney is a main organ for the human body, which helps in removing the salt content and other toxic materials from blood it is connected to the urinary bladder, in India 5 lakh people are suffering from kidney failure and every year 1 lakh people are added to this list. The kidney is located on both side of the spinal cord above the hip and behind the stomach each kidney will be in the size of fist; kidney is 10-12 cm long, 5-6 cm wide and 3-4 cm thick and weighs approximately 150 gm[1]. Our kidneys purify around 1500 liter of blood and convert it into approximately 1.5-litre urine per day. 1200ml of blood flows through both the kidneys per minute and out of it 1 ml of urine is formed per minute. They convert vitamin-D from 25-Dihydroxy cholecalciferol to 1:25 Dihydroxy cholecalciferol, which absorbs calcium from intestine and makes bone strong. Kidneys also help in formation of the red blood cells (which are formed in bone marrow) by releasing erythropoietin hormone[1].

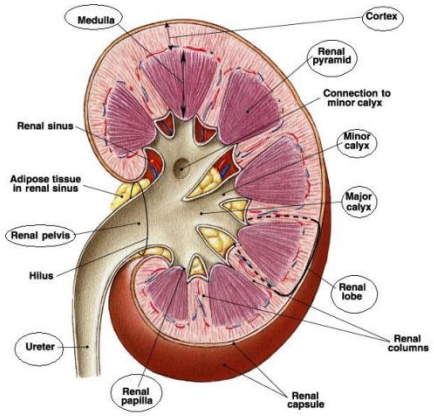

Fig 1 Actual kidney and its description

As per the doctor the kidney failure occurs to people who are suffering from high blood pressure, diabetes and johndiece, these factors gives rise to the increase in urea, creatinine, phosphate, Sulphate etc.., and eating of junk foods can cause this problem, kidney failure mainly occur to the people of all age, the only method to rectify this process is only by doing dialysis[2].

The machine consists of two needles connected to the vein and a glucose bottle and an operation is done to increase vein diameter for the quick absorption of blood by the filter to remove the toxic content from the blood, this process can be of twice or thrice a week and for four hour duration or else kidney transplantation can be done but it would cost around Rs.8 Lakh so we have planned to modify the process by creating an artificial kidney which

could cost around 2 lakh and it can do the same process as the kidney does and it is purely operated by electronic systems and this is an feasible because there is an huge demand for kidney transplantation. So we can make a huge profit out of it.

The design and structure is a greatest challenge because already this type of artificial kidney is found but it is externally fixed like a Hemo-dialyser which is portable[3]. So our plan is to reduce the size and increase the efficiency and to reduce the cost.

II. FUNCTION OF KIDNEY AND ITS MALFUNCTION

Our kidney constitutes lacs of filters and 140-mile long tubules in approximation. The main functional unit of kidney is nephrons. Each kidney comprises approximately 10 lac Nephron[4]. Filters filter the blood and the filtered blood is sent to the tubules. The tubules reabsorb useful substances such as sodium, potassium, calcium etc from the liquid and approximately 1.5 liter urine

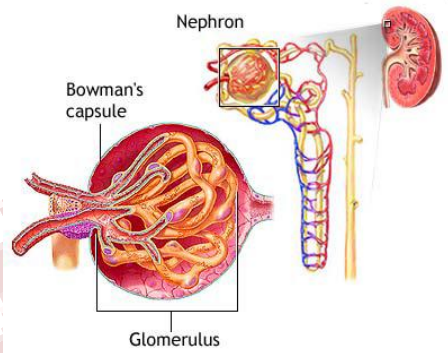

Fig 2 Filtration unit of the Kidney Nephron[1]

Comes out from the body as per a normal victim. There are many reasons for kidney failure but the prominent ones are the following:

1. Diabetes Mellitus.

2. High Blood Pressure.

3. Some medicines such as taken for relieving pain (pain killers) and other unnecessary medicines.

4. Dehydration that is less amount of blood and water in the body due to vomiting, cholera and diarrhea etc.

5. Inflammation of filters of the kidney due to which proteins are lost in urine and this process is called Glomerulonephritis. Healthy kidney does not allow proteins go in urine .Formation of stones in kidney and urinary system

7. Obstruction in the flow of urine.

III. TYPES OF KIDNEY FAILURE THAT OCCUR INSTANTLY

There are three main types of kidney failure

1. Acute Renal Failure –

This can be treated and cured as the kidney is in diseased state for a short time, which results in reversible damage. Its causes include reduction in level of water in body (dehydration) due to cholera, excessive diarrhea and vomiting, low blood pressure, side effects of medicine and infection etc.

2. Chronic renal failure –

This can be treated but cannot be cured as the kidney is in diseased state for a long period, which results in irreversible damage. Its causes are diseases like long duration of uncontrolled diabetes, high blood pressure, swelling of membrane etc. It requires life-long dialysis or kidney transplantation.

3. Nephrotic Syndrome –

Proteins are lost from the kidney in urine, which leads to swelling up of body and eventually results in kidney failure[5].

IV. SYMPTOMS OF KIDNEY FAILURE

Even if one kidney is removed from a person, the person can still lead his life with the other healthy kidney. Symptoms of kidney failure develop when both the kidneys are damaged[6].

The following can be some of the symptoms:

1. Swelling of the body.
2. Decrease in appetite.
3. Recurring vomiting or nausea.
4. Reduction in blood hemoglobin level
5. Weakening of bones (osteoporosis).
6. Fatigue/ weakness.
7. High blood pressure.
8. Reduction in urine formation.
9. Breathlessness.

As per all the analysis made there are many causalities are reported to transplant kidney daily by means of illegal form of work and due to the economic condition of a family or an person so by means of this.

V. EXISTING SYSTEM:

The existing method as a cure for kidney failure is hemo dialysis, here the blood of an subject is meant to be dissolved with salts and other by products, so as a result the subject's Kidney malfunctions and at the end it fails to work. This can be rectified by doing dialysis, in which a machine is meant to do the work of the kidney and here the subject's blood is driven via an hemo filter and dialysate is also passed[6].The contaminated blood is meant to be purified, the toxin and major salt content are being removed and it is an periodic process and which a subject is meant to in rest position for 5hrs and by this process we are only capable to replace about 13% of actual kidney process and still lack behind by 83% and this highest ratio can cause adheres effect towards subject by means of swelling of legs, lack of immunity etc..,

Hemo filter is the main component that is being used in a dialysis machine.

Hemofilter contributes to the stabilization of hemodynamics in patients with systemic inflammatory response syndrome (SIRS) due to a mechanism other than the removal of cytokines[7].Seven critically ill patients who met criteria for SIRS with unstable hemodynamics requiring vasopressors after emergency surgery.

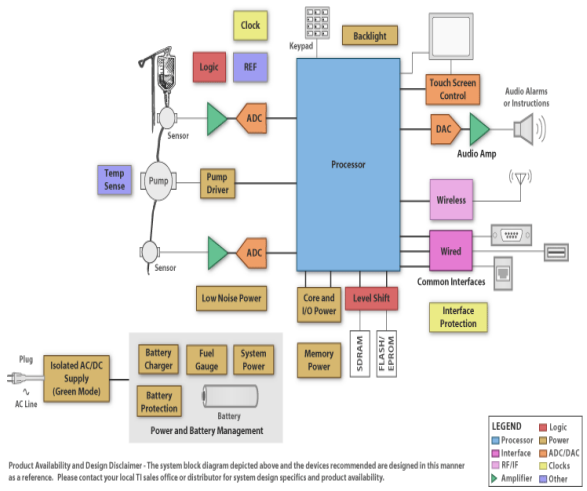

Fig 3 Block diagram of Hemo-Dialysis Machine used to purify the salt content of blood.

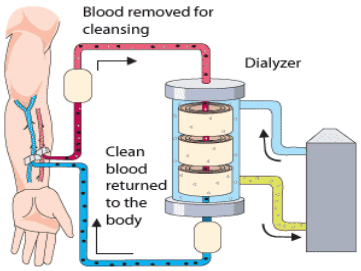

Fig 4 Process of dialysis that takes place in the hemo filter of a dialysis machine

The above fig (3) & (4) shows how the exact process of dialysis happens here the blood is taken from the arteries and purified blood is again sent into the body by means of the veins for this sort if removal of blood from body an surgery is done near the wrist and it is called as fistula for the process of dialysis fistula is mandatory[8].

Vital signs were monitored continuously and hemo-dynamics were evaluated intermittently. The blood level of endotoxin and the plasma levels of cytokines were measured at 0 and 6 h. Changes in plasma levels of cytokines passing through the hemo-filter were evaluated at 3 h. A significant decrease of body temperature ($P < 0.05$ at 3 and 6 h vs 0 h), a significant elevation of mean arterial pressure ($P < 0.05$ at 0.5 h, $P < 0.01$ at 3 and 6 h vs 0 h), and a significant increase of urinary flow rate ($P < 0.05$ at 0 to 3 h vs -3 to 0 h) were observed with ECC. Neither the blood level of endotoxin nor the plasma levels of cytokines decreased. A significant increase of plasma IL-6 as it passed through the hemo-filter was noted[9].

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VI. PROPOSED SYSTEM

The proposed system is that an idea of implanting the artificially made kidney into an subject so that it is meant to be effective about 100% of the natural kidney process the below given is the block diagram of the module.

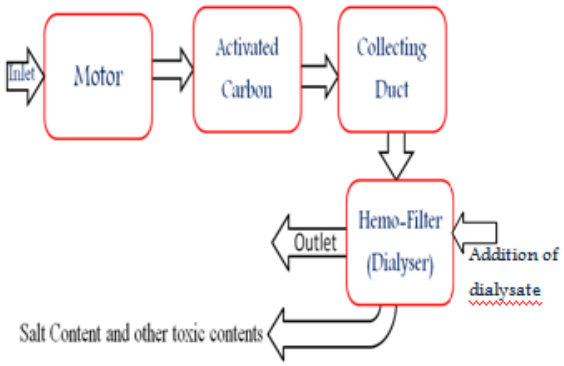


Fig 5 Block diagram of the proposed system

Here it is proven that by this method of replacing the affected kidney we can get absolute and accurate result in this method over dialysis.

VII. CONSTRUCTION OF THE MODULE

The module consists of majorly two parts they are Activated Carbon and Hemo Filter and for the model purpose the motor is being used as we can be able to show model similar to the actual blood flow along the veins of the kidney and we can able to describe it by means of the actual system the implantable model will be of this format given below.

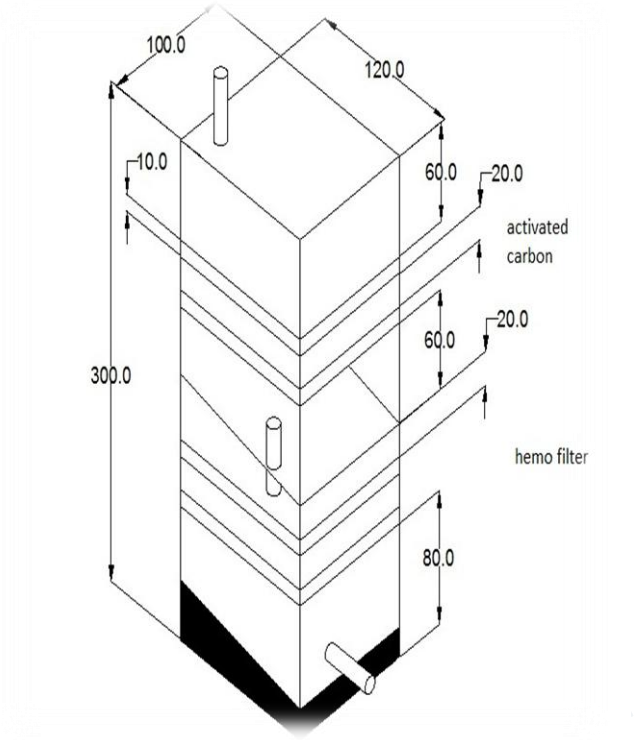


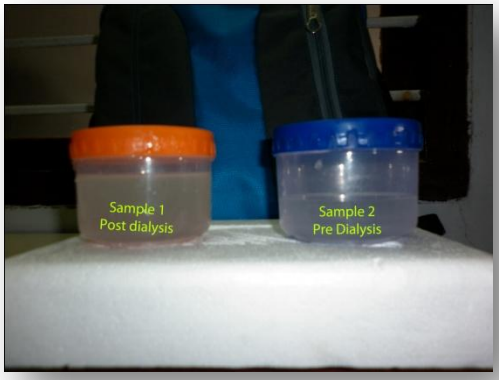
Fig 6 Proposed model that can be implanted and the size is to be reduced by 15 times so that it can be implanted into the subject

The module is meant to contain two layers of activated carbon and two layers of hemo filter each layer is separated by an distance so that there can be an constant flow of blood along the device and there will not be any variation with the level of blood pressure and its viscosity and the equation for blood viscosity is given below

VIII. WORKING PROCESS OF THE SYSTEM

Here first the blood enters AC-1 Chamber there the micro dust particles are removed and 6% of the toxin and salt by products are being removed so as an result we have achieved almost 50% working of an dialysis machine so as per then, it passes to the AC-2 Chamber there the remaining salt contents are being removed. Now almost 28% of the purification process is been done, so as then the blood flow is intended to mix with the dialysate so that it does not clots internally and

it traces are found in the inner stratum of the device, Now it passes through the tiny absorbent membranes of the hemo-filter there hemo filter filters the undue salt and other residual salt contents. Mainly Creatine, Potassium, Phosphate, Sulphate are being removed so as they are meant to have a flow of prudent manner then the salt content are collected in a separate duct and the excessive toxins are also collected and the pure blood alone is meant to flow along the blood stream. The sample that is tested by means of the device is given below



We can see the color change in the Solution as sample 1 is obtained from an subject and it is being tested through the equipment and sample 2 clear solution is obtained at the end of the process.

IX. CONCLUSION

We have proposed this method for human welfare and as the existing treatment for kidney failure is costlier, which is not affordable by many and they are left to die so we made this idea and by introducing this project we can help all 5lac people of India and the rest of the world suffering from kidney failure. The main aim is only to reduce the death rate that is being caused by Chronic Kidney Failure(CKT). The regional and the premature results show great change in the rate of pH reduction, Clearance level of Creatine, Urea , Phosphate, Potassium and Sulphate. So this is feasible to the society and this has an greatest advantage that every person can use it there is no condition of perfect blood match which is required by actual kidney transplantation .

Result	S 1		S 2		S 3		Unit
Effective Urea Clearance	39.8	24.1	40.6	28.3	37.2	18.3	[mL/min]
Effective Creatine Clearance	40.9	25.1	43.1	28.3	28.9	22.5	[mL/min]
Total Urea Removal	15.3	12.4	19.7	14	11.1	10.2	[g]
Total Phosphate Removal	1.7	0.8	1.7	0.9	1.5	0.72	[g]
Total Potassium Removal	150.5	80	167.5	100	162	76.3	[g]
Total Creatine Removal	1.7	0.9	2.5	1.3	2.1	0.76	[mmol]
Extrapolated std Kt/V	7.7	6.9	8.2	8.8	7.2	5.7	-
pH Value	12.4	11.9	13.3	12.26	13.1	9.68	On Scale

Table 1 the preliminary results of the system

This table is done for the various samples collected from a subject named **Mohideen peer Kasaali S** and the test results of the sample is meant to effective throughout the process of the system here the primary results of the systems are compromisible for further development of the system and this can be implemented for the human use once it is being approved by the Indian medical council(IMC),we are near to the final stage of output.

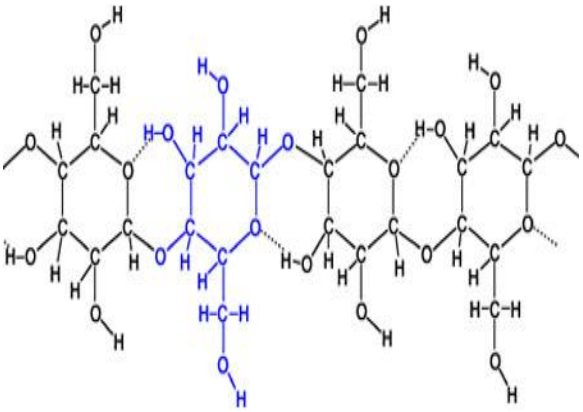


Fig 8 activated Structure of the activated carbon that is being used

Here the structure of the activated carbon is similar to the exact structure that is available but here the chain linkage is broken so the each link exhibits differential method of activation and its regulation are greater.

Fig 9 Activated carbon of IV value 1000 that is being used and MBS value about 350

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