Biodegradeable Magnesium Alloy Suitable For Clinical Vascular Stent Apllication: A Review

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Abstract- *Many studies have demonstrated that late thrombosis after drug-eluting stent (DES) implantation may cause incomplete neointimal coverage. We justified the results of neointimal coverage followed by SES and PES using optical coherence tomography. Thus, an angiography with OCT examination was performed in 29 patients with 32 lesions for more than 2 years and 101 patients with 104 lesions at 9 months after the index procedure. The status of neointimal coverage was evaluated. The number of stunts with completely covered struts was higher. The percentage of uncovered struts and malpositions struts were lower. In conclusion, the pattern of neointimal coverage between 9 months and 2 years appeared to be somewhat different between PES and SES.*

Keywords- thrombosis; neointimal coverage, SES, PES

I. INTRODUCTION

The interest in magnesium and its alloys as degradable material we have used the magnesium as base metal due to its biodegradeable properties.

The stunt is placed in the heart valve of the human to treat the restenosis disease in the heart valve due to blockage of cholesterol makes the heart valve narrowing.A stunt tube of hollow shape is placed in the narrowed valve of the heart .The stunt is nowdays made up of aluminium alloys the drawback in using the aluminium stunt is after a period of time the stunt become rusted and poisonous to the human health which initates infection in the valve. To overcome this drawback magnesium based alloys are used because of its biodegradeable property it dissolve in the blood after certain time period without leaving any poisonous to the human.The stunt made is in vitro testing of magnesium based composition in tested using hank solution of PH level 7.5 to same as PH level of human blood the corrosion rate of the magnesium based composition the microstructures of the magnesium alloy is tested using the scanning electron microscope to determine the mechanical property of the magnesium alloy.

In stunt angioplasty magnesium alloys based stunt is placed in the heart valve of the human the stunt area is 5.2 millimeter square is used to cover the valve affected by restenosis disease.

In vitro degration of pure m agnesium response to glucose the present pure magnesium exhibiting different corrosion response to saturated hanks solution with different glucose content and ensure that the magnesium and its alloy are suitable for the person health high level of blood glucose or diabetics

The corrosion rate of pure magnesium increase with glucose concentration in saline solution therefore the glucose is converted into the gulconic acid the PH value of the hank solution increases slightly. But the corrosion resistance get increases with glucose content in the hank solution. Ca^{2+} ion in the hank solution form the Ca-P compound on the pure magnesium surface. In the hank solution the calcium form a protective biological layer over the stunt to protect it from immune system of the body the KCL of molarity 0.005M is added to increase the solubility of the solution to make ready for other chemical such as NaCl to mix completely in the hank solution.

The $NaHCO_3$ is added to the hank solution to improve the PH level of the hank solution to the human blood PH level. The magnesium chlorides are added to improve the chemical reaction in the hank solution for achievement of better PH value.

II. TESTING

SAMPLE PREPARATION

Magnesium contain purity of 99 percentage and above are used for tests. The as-cast metals were cut by Electrical Discharge Machining [EDC] process and form a plates like structure with the dimension of 20mm*20mm*3mm .The required content of the plates will be shaped and collected with the specific measurements.

The working surface of the metal was polished with silicon carbide paper from the grit sheet of 400mm to

2000mm. And the plates were cleaned with acetone and ethyl alcohol and the plates will be dried with the warm air.

IMMERSION TEST

The Magnesium is immersed by using the two kinds of solution. One is the 0.9wt% of NACL solution with glucose and Another is the hank solution with glucose. The correction rate of magnesium is increases with the solution contain of NACL with glucose and The correction resistance of magnesium is increases with the hank solution with glucose.

In the hydrogen evolution test, the volume of the sample surface was 30ml/cm and it will be maintained at the ambient temperature of 37 degree Celsius.

The samples were socked into beaker with different solution and the hydrogen gas was carefully collected from the specimen surface using a funnel placed over a specimen

The hydrogen evolution rate vH=v/st(where v is the hydrogen evolution volume(ml),s is the sample area exposed to solution(cm2)and t is the immersion time(h)).The PH value of saline type of solution is recorded at different intervals and the PH value of hank solution id recorded at the same interval of time and the value are noted.On comparing the corrosion resistance of magnesium alloy in both hank solution and saline solution. In saline solution the corrosion rate of the magnesium is slighty higher than the corrosion rate measured in the hanks solution.

In hank solution the corrosion rate is low due to the basic nature of the solution.

ELECTROCHEMICAL TESTING

In electrochemical testing three electrodes (PARSTAT2273) system are used two of the electrode are kept as references electrode inbetween the both references electrode counter electrode is placed to maintain balanced electro chemical reaction.

The electrolyte are of two types hank solution and saline solution both are used to compare metal ion dissolution rate in the electrolyte. Saturated calomel electrode (SCE) are used as cathode for metal deposition the metal dissolution rate is measured using the open circuit potential(OCP) plot the result using the graph.

The corroded surface are completely immersed on the electrolyte solution to find the corrosion rate.The tafe curve varies the corrosion rate using the both electrolyte hank solution and saline solution.The tafe curve scanning rate at 2mVs-1.The curve describes the corrosion rate of the magnesium alloy.

SEM TEST

The corroded surface of the magnesium alloys were discerned using emission electron microscopy(FE-SEMI NOVA NANO SEM-450). It produces the magnified image for analysis it is more effective in failure analysis of solid inorganic material. It perform high magnification and generate high resolution image. The chemical composition were clearly explained by this image.The SEM also capable of performing analysis of selected point locations on the samples and determine the chemical composition and crystal orientation.

X-RAY SPECTROMETER

The chemical composition of the corroded surface were probed using an attached energy-dispersive x-ray spectrometer(EDS,JXA-8230). Every sample was sprayed with carbon prior to each test. Comparision of the specimen specturum with the spectare of samples of known composition produces quantitative result.

X-RAY DIFFRACTROMETER TEST

The phases of corrosion products were identified using x-ray diffraction diffractometer. The chemical composition of the sample immersed in saline solution with glucose and hank solution with glucose were probed using x-ray diffraction diffractometer and x-ray spectrometer test.

In XRD the x-ray beam is short at the sample at a specified point.On various ways depending on the crystal structure the x-ray deflects or diffract. It provide more in depth information about crystalline compound which includes the qnantification of morphology of crystalline faces

CYTOTOXICITY TEST

In vitro to absorb the morphologyical effects and chemical structure of magnesium alloy were identified and clarified by this test.It is the important indicator for toxicity evolution of medical device and it is high sensitive and can save living organism from toxicity. Three typtes of toxicity test are stated. The present review provides a brief insight into the in vitro toxicity test . It is one of the important methods for biological evolution it includes the detection of cell damage and structure of magnesium alloy which resulting in the identification of the toxic content in magnesium alloy.By the analysis of the cytotoxicity test the magnesium alloy composition is non-toxic to human.

III. CONCLUSION

The results taken from the machining and extensive characterization of the machined surface integrity shown in this paper result that the machining-induced surface can reduce the rate of corrosion in the AZ31 magnesium alloy, by rapidly increasing its application in blood sorbable implants. Similarly by using the cryogenic machining at reduced feed may be effective in this regaeds. Thus, the characterization result says that the primary driver are being used to improve the corrosion resistances in the surfaces which includes micro-texture that may affect the wettability to body fluids and high residual stress and also the surface nano structure. The galvanic potential and current of the machined surface is reduced, corrosion rate in pitting, and bio-fluid media with dissolution.

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 1 the number of cross section analyzed was 797, and in group 1 the number of patients analyzed was 29 with 32 lesions.

These readings were taken for the period of two years.The values found to be in group 1 the number of struts were 6728, mean lumen area is approximately 5.7 millimeter-square and the mean stunt area is approximately 6.8. Mean NIH area is approximately 1.1 and the mean neointimal thickness is approximately 13.1 micron and the uncovered and malapposition were approximately 5.4 and 0.5 respectively. Thus the presence of Thrombi was 1 and the complete coverage were 8.

Effect of sirolimus-eluting-stents

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 1 the number of cross section analyzed was 487, These readings were taken for the period of two years. The values found to be in group 1 the number of struts were 3794, mean lumen area is approximately 6 millimeter-square and the mean stunt area is approximately 6.8. mean NIH area is approximately 0.8 and the mean neointimal thickness is approximately 10.7 micron and the uncovered and malapposition were approximately 6.5 and 0.6 respectively. Thus the presence of Thrombi was 1 and the complete coverage were 6.

Effect of Paclitaxel-eluting-stents

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 1 the number of cross section analyzed was 310, These readings were taken for the period of two years. The values found to be in group 1 the number of struts were 2934, mean lumen area is approximately 5.3 millimeter-square and the mean stunt area is approximately 6.9. mean NIH area is approximately 1.6 and the mean neointimal thickness is approximately 17.1 micron and the uncovered and malapposition were approximately 3.7 and 0.3 respectively. Thus the presence of Thrombi was 0 and the complete coverage were 2.

Effect of total lesions

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 2 the number of patients analyzed was 101 with 104 lesions.These readings were taken for the period of two years.The values found to be in group 2 the number of cross coverage were 14.

Effect of sirolimus-eluting-stents

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 2 the number of cross section analyzed was 1711, These readings were taken for the period of two years. The values found to be in group 2 the number of struts were 15127, mean lumen area is approximately 6.1 millimeter-square and the mean stunt area is approximately 6.8. mean NIH area is approximately 0.7 and the mean neointimal thickness is approximately 8.7 micron and the uncovered and malapposition were approximately 10.9 and 1.7 respectively. Thus the presence of Thrombi was 24 and the complete coverage were 9.

Effect of Paclitaxel-eluting-stents

Tae-Hoon-Kim (2011) et al. has experimented and found that in group 2 the number of cross section analyzed was 963, These readings were taken for the period of two years. The values found to be in group 2 the number of struts were 8305, mean lumen area is approximately 6.1 millimeter-square and the mean stunt area is approximately 7.6. mean NIH area is approximately 1.5 and the mean neointimal thickness is approximately 17.1 micron and the uncovered and malapposition were approximately 4.0 and 1.0 respectively. Thus the presence of Thrombi was 5 and the complete coverage were 5.

The experiment also carried out using the cooling system for various water depths. If the experiment was done with 2cm as depth, the productivity decreases by 14% than in the lower depth. If it is 3 cm, the productivity decreases by 16% than in the lower depth. If it is done with 4 cm depth, the productivity decreases by 18% than in the lower depth. The results it is clear that the temperature difference between the glass cover and water temperature plays the vital role in productivity so the attention must be higher for the cooling system of the solar still.

Effect of phase change material

Naga sarada somanchi et al. (2015) has experimented, the basin is made up of a material stainless steel of thickness 0.8mm and the top cover is glass which is inclined at an angle of 32 degrees. To improve the utilization of the solar energy in evaporating the water the basin is coated with the black paint. In this setup phase, change material is used because it has higher energy absorbing capacity as well as energy releasing capacity. The phase change materials used here are potassium dichromate, sodium acetate, and potassium permanganate. From the experimental result, it is clear that the phase change material potassium permanganate is more effective compared to other materials used in this experiment. It is because of the melting point of the potassium permanganate which is 240°C, which comparatively lower than the materials used in this experiment. The experiment results are Basin temperature is approximately around 43°C, 27°C, 25°C, and 23°C while using potassium permanganate, sodium acetate, potassium dichromate and without using any Phase-changing material. From the result, it is concluded that the use of phase changing material helps to increase the productivity of the solar still.

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