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# Stem Cell Possible Cure for Diabetes Mellitus and Arthritis

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# Abstract

The Stem Cell technologies and the therapeutic areas in which stem cells find many applications on Challenges in Clinical complication and therapy. The Research provides a market insight into the ever progressing and debatable market of Stem Cell Research segmented by type, technology and therapeutic area. Stem Cells by Type are further classified into Adult Stem Cells, Embryonic Stem Cells, and Cord Blood Stem Cells. Stem Cell Research by Technology is segmented into Stem Cell Transplantation, Cell Based Genomics, Xenotransplantation, Cord Blood Banking, and Other. The Therapeutic applications of Stem Cell Research are analyzed by area into Neurology, Bone and Cartilage, Cancer, Hematology, Cardiology, Diabetes, Dermatology and Other. Projections and estimates are graphically illustrated by geographic regions encompassing North America, Europe, Asia-Pacific and Rest of World. Keywords: Arthritis; Stem Cell; Cord Blood

# **Cellular Therapies**

Many newer applications are still undergoing development. In some cases, like spinal cord injury and heart attacks, the cells are directly injected into the damaged tissues (Figure 1).



Figure 1

Some of the benefits experienced appear to be due to new blood vessel formation, which restores blood flow to damaged tissue. As these treatments develop, we expect to see umbilical cord blood stem cells used in different ways. In some cases, the stem cells will be treated in the laboratory to make new cell types before use. In other cases, they will be delivered directly into damaged tissue.

# Future of Stem cells

The list of stem cell treatable diseases continues to grow at a rapid pace. With the potential to become different cell types, scientists are exploring the possibility of using cord blood stem cells to treat some of the most common life-threatening diseases such as heard diseases and stroke. Thus, by saving your baby's cord blood you can give your child access to his/her own stem cells for such cellular therapy in the future.

Now the technologies like regeneration of the organ by means of a strategy to addresss the problems like Shortage of organ supply in terms of Tissue matching, GVHR, Short supply of Donors, and other ethical issues. The recent technology application of 3D printing integrated technology for creating an organ using autologous stem cells will be future of Stem cell technologies [1-4].

#### **Diabetes**

o A multisystem disease related to

- o Abnormal insulin production or
- o Impaired insulin utilization or
- Both of the above 0
- o Leading cause of heart disease, stroke, adult blindness, and non-traumatic lower limb amputations

## **Normal Insulin Metabolism**

# Insulin

- o Produced by the  $\beta$  cells in the islets of Langherans of the pancreas
- o Facilitates normal glucose range of 3.9 6.7 mmol/L



# **Diabetes Mellitus confirmatory Diagnosis**

- o Fasting plasma glucose level > 7 mmol/L
- Random plasma glucose level > 11.1 mmol/L plus symp toms
- Impaired Glucose Tolerance Test Diabetes if BG > 11.1
  mmol /L 2 hr post challenge
- o Hemoglobin A1C test (glycosylated Hgb)
- o Reflects amount of glucose attached to Hgb over life of RBC

# HbA1c

By measuring glycated haemoglobin (HbA1c), clinicians are able to get an overall picture of what our average blood sugar levels have been over a period of weeks/months.

For people with diabetes this is important as the higher the HbA1c, the greater the risk of developing diabetes-related complications.



Figure 3

# **Type 1 Diabetes Mellitus**

## **Acute Complications**

- o Diabetic ketoacidosis
- o Hyperglycemia hyperosmolar state
- o Hypoglycemia

# **Chronic complications**

## Chronic complications-----> Vascular Disease

Chronic elevation of blood glucose level leads to damage of blood vessels (angiopathy) cause the basement membrane to grow thicker and weaker. In diabetes, the resulting problems are grouped under micro vascular disease (due to damage to small blood vessels) and Macro vascular disease (due to damage to the arteries).

The damage to small blood vessels leads to a microangiopathy, which can cause one or more of the following: Diabetic neuropathy, Diabetic nephropathy, Diabetic retinopathy, Diabetic cardiomyopathy.



# **Diabetic Neuropathy**

 Abnormal and decreased sensation, usually in a 'glove and stocking' distribution starting with the feet but potentially in other nerves, later often fingers and hands.

- o When combined with damaged blood vessels this can lead to diabetic foot.
- o Other forms of diabetic neuropathy may present as mono neuritis or autonomic neuropathy.
- o Diabetic amyotrophic is muscle weakness due to neuropathy.



# **Diabetic Nephropathy**

- o Damage to the kidney which can lead to chronic renal failure, eventually requiring dialysis.
- o Diabetes mellitus is the most common cause of adult kidney failure



## **Diabetic retinopathy**

- Growth of friable and poor-quality new blood vessels in the retina as well as macular edema (swelling of the macula), which can lead to severe vision loss or blindness.
- Retinal damage (from microangiopathy) makes it the most common cause of blindness among non-elderly adults.





## Macrovascular disease

- o Coronary artery disease, leading to angina or myocardial infarction.
- o Ischemic stroke
- Peripheral vascular disease accompanied with neuropathy causes diabetic foot leading to amputation.
- o Diabetic myonecrosis
- Carotid artery stenosis does not occur more often in diabetes, and there appears to be a lower prevalence of abdominal aortic aneurysm. However, diabetes does cause higher morbidity, mortality and operative risks with these conditions.
- Diabetic encephalopathy is the increased cognitive decline and risk of dementia observed in diabetic patients.

# **Diabetic cardiomyopathy**

Damage to the heart, leading to diastolic dysfunction and eventually heart failure.

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Figure 8

## **Diabetic Angiopathy**

Diabetic gangrene referred to as diabetic foot comes under peripheral vascular diseases categorized under macro vascular diseases.



- o Pancreas or a kidney-pancreas transplant.
- Stem cell research has also been suggested as a potential avenue for a cure since it may permit regrowth of Islet cells which are genetically part of the treated individual, perhaps eliminating the need for immuno-suppressants.
- o Also, immune suppressive drug therapy can be used since it is an auto immune disease.

#### **Cure for Diabetes Type 2**

Type 2 has had no definitive cure, although recently it has been shown that a type of gastric bypass surgery can normalize blood glucose levels in 80-100% of severely obese patients with diabetes.

## Stem cells and Regenerative medicine

- A form of cell based therapy with an objective of the damaged organ or tissue to heal or regenerate the activity by replacing with totipotent or pluripotent cells and to treat disease, injury or ailment.
- Cell therapy is the only way to enable the body to renew itself and regenerate into a healthier state due to the renewed tissues or organs.
- o Cell therapy is being carried out around the world every day.
- This includes blood transfusion and transplantation of organs

## Stem cell research on type I Diabetes



Indications Being Addressed using MSCs in Clinical Trials Data for 352 registered clinical trials

# **Cure for Diabetes Type 1**

 Type 1 diabetes is due to the failure of one of the cell types of a single organ with a relatively simple function i.e. the failure of the beta cells in the Islets of Langerhans it can be cured by

Citation: Pravin Patel. "Stem Cell Possible Cure for Diabetes Mellitus and Arthritis". Acta Scientific Microbiology 2.1 (2019): 45-52.



## **Our Treatment methods**

- o We do combination of treatment to create synergistic effect to recover the patients from the problems
- o We analyze the route cause and do treatment and for the cause and effect
- We prefer the methods of alternative medicines which does no side effects to our body.

## **Role of Ozone in diabetes Treatment**

- o The Positive effective of Ozone treatment
- 92% of the insulin dependent and 88% of the insulin- in dependent patients resulted decrease of the hyperglycemia diminish of thirst Dis appearance of poly urea, Skin itch, weakness.
- o Average level of hyperglycemia decreased by 26%.
- The dose of insulin was reduced by 50% and diminished 2/3 of Treated patients.
- o The dose of oral sugar reducing remedies was reduced to 36%.
- o The intravenous infusions of Ozone found to be effective elimination tissue hypoxia.
- The application of Ozone treatment also helped the pati ents to recover from foot with purulent necrotic and other inflammatory lesions and also reduces the en dogenous intoxication.
- Antimicrobial (bactericidal, viricidal and fungicidal), anti-inflammatory, immunostimulating, antihypoxic and detoxicating, biosynthetic, (activation of the metabolism of carbohydrates, proteins, lipids) bioenergetics, hemostatic etc.

**Diabetes Treatment milestone Achievement** 

# Ozone therapy effect in Patients with Insulin –dependent Diabetes

Г	Severity of	Number of Patients	Results of Treatment				
	Disease		Good	Satisfactory	Unsatisfactory		
	Mild	-	-	-	-		
	Moderate	17	15	2	-		
Г	Severe	10	10	-	-		
	%		92 %	8 %	-		
_							

Figure 12

# Ozone therapy effect in Patients with Insulin –independent Diabetes

Severity of	Number of	Results of Treatment				
Disease	Patients	Good	Satisfactory	Unsatisfactory		
Mild	14	14	-	-		
Moderate	47	40	-	7		
Severe	6	5		1		
%		88 %	-	12 %		

Figure 13

## **Rheumatoid Arthritis**

- o **Symptoms:** Pain, stiffness, swelling in joints of hands, wrists, elbows, feet, ankles, knees, and neck
- Diagnosis: joint examination, medical history, several tests
- o **Risk Factors:** Age, Gender (female), genetic susceptibi lity, smoking



Figure 14

Age group	Pre treatment	HbA1c scale	Treatment Dose	Intervention	Post treatment	HbA1c scale
25 - 30	7.8 ± 1	7.8 ± 1	1 million/Kg BW	Ozone/Herbal preparation	Insulin reduced to 50%	5.1 <b>±</b> 1
30 - 45	8.1 ± 2	8.1 ± 2	1 million/Kg BW	Ozone/Herbal preparation	Insulin reduced to 30%	5.5 <b>±</b> 0.75
45 - 65	9.1 ± 2	9.1 ± 2	1 million/Kg BW	Ozone/Herbal ppn Chelation	Insulin reduced 1/3 dose	6.1 ± .25
> 65	9.6 ± 2	9.6 ± 2	1 million/Kg BW	Ozone/Herbal ppn Chelation	Insulin reduced 1/3 dose	7.6 ± 0.2

Table 1: Total No of Patients Treated for Diabetes: 45

Type I: 08, Type ii: 37, Success percentage: 85%, Failure percentage: 13%,

Reason for failure: Poor cooperation by the patients and other associated problems.

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Figure 15

# Arthritis

- o Age-associated breakdown and eventual loss of cartilage "cushion" of one or more joints, leading to pain and limi tation of joint mobility.
- Over the last years, surgeons and scientists have elabo rated a series of cartilage repair procedures that help to postpone the need for joint replacement.
- Own stem cells could drastically speed up the healing process
- The stem cells injected intravenously to assist in genera lized healing and inject the cells locally and painlessly into joints as depicted.



Figure 16

# **Rheumatoid Arthritis**

# Treatment

- o Physical Therapy: exercise, heat/cold, massage
- o Occupational Therapy

- o Biofeedback (to control pain)
- o Counselling
- o Accupuncture
- o Supplements
- o Blood Filtering (severe cases).



Figure 17

## Osteoarthritis

## Treatment

- o **Medications:** NSAIDS, Acetomeniphen, corticosteroids, hyaluron injections
- o **Surgery:** arthroscopy, osteomoty, joint replacement, hip replacement, arthrodesis (fusing).

# Repair

- Cartilage has limited repair capabilities, once damaged.
  Because chondrocytes are bound in lacunae, they cannot migrate to damaged areas.
- Also, hyaline cartilage does not have a blood supply, the deposition of new matrix is slow. Damaged hyaline carti lage is usually replaced by fibrocartilage scar tissue.
- In a 1994 trial, Swedish doctors repaired damaged knee joints by implanting cells cultured from the patient's own cartilage.
- In 1999 US chemists created an artificial liquid cartila ge for use in repairing torn tissue. The cartilage is injected into a wound or damaged joint and will harden with exposure to ultraviolet light

## **Arthritis Impact Measurement Scale**

## Mobility

- 4 Are you in bed or chair for most or all of the day because of your health?
- 3 Are you able to use public transportation?
- 2 When you travel around your community, does someone have to assist you because of your health?
- Do you have to stay indoors most or all of the day because of your health?

#### Physical Activity

- 5 Are you unable to walk unless you are assisted by another person or by a cane, crutches, artificial limbs, or braces?
- 4 Do you have any trouble either walking one block or climbing one flight of stairs because of your health?
- 3 Do you have any trouble either walking several blocks or climbing a few flights of stairs because of your health?
- 2 Do you have trouble bending, lifting, or stooping because of your health?
- Does your health limit the kind of vigorous activities you can do such as running, lifting heavy objects, or participating in strenuous sports?

# Activities of

#### Daily Living

- 4 How much help do you need to use the toilet?
- 3 How well are you able to move around?
- 2 How much help do you need in getting dressed?
- When you bathe, either a sponge bath, tub or shower, how much help do you need?

#### Pain

- 4 During the past month, how often have you had severe pain from your arthritis?
- 3 During the past month, how would you describe the arthritis pain you usually have?
- 2 During the past month, how long has your morning stiffness usually lasted from the time you wake up?
- During the past month, how often have you had pain in two or more joints at the same time?

## Figure 18

## Arthritis Impact Measurement Scale (AIMS) questionnaire

## Dexterity

- 5 Can you easily write with a pen or pencil?
- 4 Can you easily turn a key in a lock?
- 3 Can you easily button articles of clothing?
- 2 Can you easily tie a pair of shoes?
- 1 Can you easily open a jar of food?

## Social Role

- 7 If you had to take medicine, could you take all your own medicine?
- 6 If you had a telephone, would you be able to use it?
- 5 Do you handle your own money?
- 4 If you had a kitchen, could you prepare your own meals?
- 3 If you had laundry facilities (washer, dryer, etc.) could you do your own laundry?
- 2 If you had the necessary transportation, could you go shopping for groceries or clothes?
- 1 If you had household tools and appliances (vacuum, mops, etc.), could you do your own housework?

#### Social Activity

- 5 About how often were you on the telephone with close friends or relatives during the past month?
- 4 Has there been a change in the frequency or quality of your sexual relationships during the past month?
- 3 During the past month, about how often have you had friends or relatives to your home?
- 2 During the past month, about how often did you get together socially with friends or relatives?
- 1 During the past month, how often have you visited with friends or relatives at their homes?

# Depression

- 6 During the past month, how often did you feel that others would be better off if you were dead?
- 5 How often during the past month have you felt so down in the dumps that nothing could cheer you up?
- 4 How much of the time during the past month have you felt downhearted and blue?
- 3 How often during the past month did you feel that nothing turned out for you the way you wanted it to?
- 2 During the past month, how much of the time have you been in low or very low spirits?
- During the past month, how much of the time have you enjoyed the things you do?

#### Anxiety

- 6 During the past month, how much of the time have you felt tense or "high strung"?
- 5 How much have you been bothered by nervousness, or your "nerves" during the past month?
- 4 How often during the past month did you find yourself having difficulty trying to calm down?
- 3 How much of the time during the past month were you able to relax without difficulty?
- 2 How much of the time during the past month have you felt calm and peaceful?
- How much of the time during the past month did you feel relaxed and free of tension?

Figure 19

# **Rheumatoid Arthritis-Post cell Treatment evaluation**

<b>0 - 1</b> No pain	0	VAS	Nun	nerio M	c Pa odera pain	te	Dis	tres	s Sc Unbea pa	arable
0	1	2	3	4	5	6	7	8	9	10
Figure 20										

- Visual Analog Pain Scale [ Time Frame: Baseline, 6 weeks, 3 months, 1 year]
- o Change in subjective pain, function, functional activity measurement and a clinical physical exam
- Preparing the chart based on the patient's Statement
  Examination with the help of Physiotherapist about
  their severity of the pain Intensity Location Onset
   Duration Variation and Quality of Improvement.

## **Rheumatoid Arthritis-Post cell Treatment evaluation**

Physician Global Assessment

- o [Time Frame: Baseline, 6 weeks, 3 months, 1 year]
- o Change in physician rated disease activity measurement.

# Secondary Outcome Measures

- o Radiologic [Time Frame: Baseline, 1 year]
- o Radiographic changes of the knee.

# Cellular regeneration/growth

Growth occurs by two mechanisms

- Interstitial growth– Chondroblasts within the existing cartilage divide and form small groups of cells, isogenous groups, which produce matrix to become separated from each other by a thin partition of matrix. Interstitial growth occurs mainly in immature cartilage.
- Appositional growth Mesenchymal cells surrounding the cartilage in the deep part of the perichondrium (or the chondrogenic layer) differentiate into chondroblasts. Appositional growth occurs also in mature cartilage. Chondrocytes fill out the lacunae in the living cartilage

## **Role of Ozone in Arthritis Treatment**

- o Inhibit prostaglandins and cytokines and reduce oxidative stress
- o Degenerative, Inflammatory and Autoimmune Conditions
  - o Rheumatic and Rhenmatoid arthritis
  - o Arthrosis
  - o Psoriasis, MS
- o Anti-inflammatory, stimulation of antioxident capacity, immuno-modulation, release of TGF- $\beta$ .

## Cellular regeneration/growth



Figure 21

### Arthritis Treatment milestone Achievement

Age group	No of patients treated	Pain scale	Treat ment Dose	Intervention	Pain scale on treated grps
45 - 55	12	3 and above	1million cells per kg	Physiotherapy ozone	2
55 - 65	23	5	1million cells per kg	Physiotherapy ozone	2
> 65	24	5	1million cells per kg	Physiotherapy Ozone	1

# Table 2:

Total No of Patients Treated for Arthritis: 59 Success percentage: 85% Failure percentage: 12%

Reason for failure: Poor cooperation by the patients and further damage poor exercise, weak muscle Poor Physiotherapy and other associated problems.

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