Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2026.64.010112

Clinical Efficacy Analysis of CBMC in the Treatment of Type 2 Diabetes Mellitus

Dong Qiqiang[1], Zhang Qin[2], Hou Jianxi[1], Gao Xiong[3], Chen Huaiyuan[3], Song Dexin[3] and Liu Baochi[1,2,3]*

[1]*Zhengzhou Renji Hospital, China*

[2]*Hangzhou Zhonghongruikang Executive Health Management Center, China*

[3]*Zigong Hospital Affiliated to Southwest Medical University, China*

***Corresponding author:** Liu Baochi, Zigong Hospital Affiliated to Southwest Medical University, China

ARTICLE INFO

Received: February 16, 2026

Published: February 25, 2026

Citation: Dong Qiqiang, Zhang Qin, Hou Jianxi, Gao Xiong, Chen Huaiyuan, Song Dexin and Liu Baochi. Clinical Efficacy Analysis of CBMC in the Treatment of Type 2 Diabetes Mellitus. Biomed J Sci & Tech Res 64(5)-2026. BJSTR. MS.ID.010112.

ABSTRACT

Objective: To study the clinical efficacy and mechanism of concentrated bone marrow cell (CBMC) infusion into the pancreas for the treatment of type 2 diabetes mellitus (T2DM).

Methods: Bone marrow blood was collected via bone marrow aspiration at the anterior superior iliac spine, and concentrated bone marrow cells were isolated. Under the guidance of B - ultrasound, precise infusion of these cells into the pancreas was performed. Changes in fasting blood glucose (FBG), glycated hemoglobin (HbA1c), C - peptide level, and insulin dosage were observed before treatment, as well as 1 month, 3 months, 6 months, and 12 months after treatment. A comparative analysis was conducted with a conventional treatment group.

Results: There were 39 cases in the concentrated bone marrow cell treatment group and 29 cases in the conventional treatment group. At 1, 3, 6, and 12 months after treatment, the fasting blood glucose, glycated hemoglobin, and insulin dosage in the concentrated bone marrow cell treatment group were significantly lower than those in the conventional treatment group, while there was no significant change in the C - peptide level. Complications such as lower limb numbness and renal insufficiency were alleviated.

Conclusion: Precise puncture and infusion of concentrated bone marrow cells into the pancreas under B - ultrasound guidance can improve islet function, reduce blood glucose levels and insulin dosage, and alleviate and delay the occurrence of complications.

Keywords: Type 2 Diabetes Mellitus; Concentrated Bone Marrow Cells; B - Ultrasound; Pancreas; Complications

Research Background

Type 2 diabetes is a chronic disease that severely endangers human health. It is a metabolic disorder caused by insulin resistance and β-cell damage resulting from overnutrition and insufficient physical activity. Conventional treatments include hypoglycemic drugs and insulin, but they still fail to prevent the progression of diabetic complications. Stem cells are a type of cell with multipotent differentiation capabilities. In different organ microenvironments, they can differentiate into various cell types or secrete certain factors to repair damaged cells and improve organ function. Bone marrow contains stem cells, immune cells, platelets, and various growth factors. Infusing concentrated bone marrow cells into the pancreatic tissue of diabetic patients can improve islet function. We retrospectively analyzed diabetic patients with complete clinical data who underwent concentrated bone marrow cell pancreatic infusion therapy and were followed up for more than one year to evaluate the treatment outcomes.

Clinical Data and Methods

We conducted a retrospective analysis of medical records from diabetic patients treated with concentrated bone marrow cells at Zhengzhou Renji Hospital, Zigong Hospital Affiliated with Southwest Medical University, and Hangzhou Zhonghongruikang Executive Health Management Center from January 2023 to December 2024.

Inclusion Criteria

Both male and female patients aged 20–70 years, with fasting blood glucose ≥7 mmol/L and 2-hour postprandial blood glucose ≥11 mmol/L, requiring hypoglycemic drugs or insulin to control blood glucose levels close to normal or remaining significantly elevated, and no significant coagulation disorders. Patients receiving conventional insulin and hypoglycemic drug therapy were selected as controls.

Treatment Method

Under local anesthesia, bone marrow aspiration was performed at the anterior superior iliac spine using a specialized 20 mL syringe prefilled with 4 mL of heparinized saline. Four 20 mL syringes were filled with bone marrow blood. The specialized syringes used for bone marrow collection were sealed with screw caps at the tip. The syringe plungers were threaded and connected to rubber stoppers. After removing the plungers, the syringes were placed tip-up in a centrifuge for density gradient centrifugation. After centrifugation, red blood cells settled at the bottom, plasma at the top, and immune cells, stem cells, and platelets from the bone marrow were located just above the red blood cell layer. The screw caps were removed and replaced with three-way valves. A new syringe was connected to the valve to aspirate the plasma from the upper part of the specialized syringe.

When nearing the red blood cell layer, another new syringe was used to continue aspirating the plasma above the red blood cell layer and approximately 1.5 mL of the uppermost red blood cells. This process collected platelets, white blood cells, stem cells, some plasma, and a small amount of red blood cells into the syringes. A total of 6 mL of concentrated bone marrow cells, including a small amount of bone marrow plasma, was extracted from the four specialized syringes. Under ultrasound guidance, the concentrated bone marrow cells were infused into the pancreatic parenchyma via fine-needle puncture. The remaining bone marrow plasma and red blood cells after separation were mixed and reinfused intravenously. After the concentrated bone marrow cell therapy, patients could resume normal activities. The second and third treatments were administered at one-month and two-month intervals after the first treatment, respectively. After each treatment, patients initially continued their original insulin and hypoglycemic drug regimens. When fasting blood glucose dropped below 6 mmol/L, the insulin and hypoglycemic drug dosages were gradually reduced.

Statistical Methods

SPSS 19.0 statistical software was used for analysis. Measurement data are expressed as mean ± standard deviation (±s), and count data were analyzed using the chi-square test. A P-value <0.05 was considered statistically significant.

Results

A total of 68 diabetic patients were followed up for more than one year, including 39 in the concentrated bone marrow cell treatment group and 29 in the conventional treatment group. In the concentrated bone marrow cell treatment group (n=39), there were 21 males and 18 females, with an average age of 44 years. In the conventional treatment group (n=29), there were 16 males and 13 females, with an average age of 45 years. Comparisons of changes in fasting blood glucose before and after treatment between the two groups are shown in Table 1, changes in glycated hemoglobin in Table 2, changes in C-peptide in Table 3, and changes in insulin dosage in Table 4. In the concentrated bone marrow cell treatment group, 9 patients had lower limb numbness, and 4 had serum creatinine levels above 160 μmol/L. After concentrated bone marrow cell treatment, lower limb numbness significantly improved or disappeared in 7 patients. One patient with a non-healing skin ulcer on the right big toe for one year showed basic healing after one month of treatment and complete healing after two months. Among the 4 patients with elevated serum creatinine, 3 showed no significant change, while 1 returned to normal levels. In the conventional treatment group, 7 patients had lower limb numbness, and 3 had serum creatinine levels above 160 μmol/L. After one year of observation, lower limb numbness did not improve, and 2 patients experienced significant worsening. Serum creatinine levels slightly increased in 3 patients, and 2 additional patients developed elevated serum creatinine levels above normal.

Table 1: Comparison of Changes in Fasting Blood Glucose (mmol/L) Between the CBMC Treatment Group and the Conventional Treatment Group.

Group	Number of Cases	Before	1 Month After	3 Month After	6Month After	12Month After
CBMC group	39	8.29±1.36	7.63±1.21	6.93±0.89	6.60±0.75	6.28±0.87
Routine Treatment Group	29	8.28±1.67	8.05±1.52	7.83±1.63	7.38±1.29	7.41±1.36
t		0.03	-1.32	-2.98	-3.12	-4.12
P		0.976	0.192	0.004*	0.003*	<0.001*

Note: Compared with before treatment, *P<0.05.

Table 2: Comparison of Changes in Glycated Hemoglobin (%) Between the CBMC Treatment Group and the Conventional Treatment Group.

Group	Number of Cases	Before	1 Month After	3 Month After	6 Month After	12 Month After
CBMC group	39	8.24±1.62	7.91±1.48	7.23±1.21	6.78±0.94	6.41±0.92
Routine treatment group	29	8.31±1.75	8.23±1.61	8.12±1.82	7.68±1.53	7.52±1.48
t		-0.18	-0.87	-2.42	-3.01	-3.78
P		0.86	0.388	0.018*	0.004*	<0.001*

Note: Compared with before treatment *P<0.05.

Table 3: Comparison of Changes in C-Peptide (ng/ml) Between the CBMC Treatment Group and the Conventional Treatment Group.

Group	Number of Cases	Before	1 Month After	3 Month After	6 Month After	12 Month After
CBMC group	39	1.82±0.76	2.01±0.62	2.24±0.54	2.38±0.48	2.41±0.52
Routine treatment group	29	1.78±0.68	1.92±0.71	2.18±0.82	2.32±0.79	2.36±0.75
t		0.24	0.57	0.36	0.38	0.33
P		0.813	0.572	0.721	0.705	0.742

Note: Compared with before treatment, □P<0.05.

Table 4: Comparison of Changes in Insulin Dosage (u) Between the CBMC Treatment Group and the Conventional Treatment Group.

Group	Number of Cases	Before	1 Month After	3 Month After	6 Month After	12 Month After
CBMC group	39	25.64±20.12	20.51±15.23	14.87±12.34	11.28±10.56	8.97±9.23
Routine treatment group	29	32.31±18.45	31.03±17.89	30.17±16.78	29.48±16.21	29.31±16.05
t		-1.45	-2.65	-4.32	-5.62	-6.41
P		0.152	0.010*	<0.001*	<0.001*	<0.001*

Note: Compared with before treatment, □P<0.05.

Discussion

Diabetes is a major disease threatening human health [1-5]. Current common treatment methods include insulin and hypoglycemic drugs. However, due to the difficulty in achieving precise blood glucose regulation, various complications arise, severely affecting patients' quality of life. Conventional treatments cannot fundamentally address insulin resistance and islet β-cell dysfunction. Current research has shifted its focus to stem cell therapy for diabetes [6-10]. Allogeneic islet transplantation is a viable method for treating diabetes, aiming to replace the function of damaged islet cells. This approach requires the use of immunosuppressants. However, over time, immune rejection can still cause the transplanted islets to lose function. Animal studies have shown that umbilical cord mesenchymal stem cells can activate the expression of β-cell growth factors and secrete insulin-like growth factor-1 (IGF1), thereby enhancing islet viability and insulin secretion. However, allogeneic umbilical cord mesenchymal stem cells may also be rejected and lose their efficacy [11-13]. Induced pluripotent stem cells (iPSCs) can be differentiated into islet cells, providing an unlimited source of pancreatic cells. Nevertheless, this method is complex and currently cannot yield a sufficient number of glucose-responsive β-cells for clinical transplantation [14-15]. In the pancreatic microenvironment with islet cell damage, autologous bone marrow stem cells may differentiate into islet β-cells or secrete certain cytokines to promote the repair and regeneration of damaged islets, thereby improving blood glucose regulation [16-18]. If autologous bone marrow cells are infused intravenously, most stem cells may become trapped in the lungs after passing through the pulmonary circulation, with only a small number reaching the pancreas via the systemic circulation. Due to the limited number of stem cells, improvements in islet function may not be significant. Some reports have described using drugs like granulocyte colony-stimulating factors to mobilize bone marrow stem cells into peripheral blood, collecting these stem cells from peripheral blood, and then infusing them into the pancreaticoduodenal artery via femoral artery catheterization under radiological interventional therapy. This approach has shown promising results in improving islet function and treating type 2 diabetes.

This method also validates that transplanting bone marrow stem cells into the pancreatic microenvironment can differentiate them into islet β-cells and improve islet function. In our study, bone marrow aspiration from the anterior superior iliac spine under local anesthesia provided a more convenient method compared to mobilizing bone marrow stem cells into peripheral blood using granulocyte colony-stimulating factors and then collecting them. After harvesting autologous bone marrow, concentrated bone marrow cells were isolated. Under ultrasound guidance, a No. 7 puncture needle

was inserted through the upper abdomen, passing through the stomach into the pancreas, to inject concentrated bone marrow cells into the pancreatic tissue. Since the density of concentrated bone marrow cells differs from that of pancreatic tissue, ultrasound waves reflect at the interface of different densities. The ultrasound probe emits waves and receives the reflected waves, which are processed by a computer and displayed as bright spots on the screen. Therefore, ultrasound can visualize the infusion of concentrated bone marrow cells into the pancreatic tissue, showing increased brightness in the pancreas. Due to the fine needle used, patients could resume normal activities immediately after the procedure, making it more convenient than radiological interventional therapy.

Bone marrow stem cells may differentiate into islet cells in the pancreatic microenvironment or secrete certain growth factors to promote the repair of damaged islet cells [19-21]. Clinical observations have shown that patients treated with concentrated bone marrow cells experienced gradual reductions in blood glucose and glycated hemoglobin levels. In our analysis of 39 patients with type 2 diabetes who underwent concentrated bone marrow cell pancreatic transplantation, compared to 29 patients receiving conventional treatment, the concentrated bone marrow cell treatment group showed significant reductions in fasting blood glucose, glycated hemoglobin, and insulin dosage. There was no significant change in C-peptide levels between the two groups. Among the concentrated bone marrow cell treatment group, patients with initially higher C-peptide levels experienced gradual reductions in blood glucose after pancreatic infusion of concentrated bone marrow cells, with follow-up C-peptide levels also decreasing. Patients with initially lower C-peptide levels showed gradual reductions in blood glucose and increased C-peptide levels after treatment. Analysis of these clinical data suggests that type 2 diabetes involves insulin resistance, where elevated blood glucose stimulates islet β-cells to secrete more insulin, accompanied by increased C-peptide levels.

After infusion of concentrated bone marrow cells into the pancreas, islet cell function is modulated, insulin sensitivity improves, and blood glucose levels decrease. With reduced blood glucose, stimulation to islet cells decreases, leading to reduced insulin secretion and lower C-peptide levels. For patients with initially low C-peptide levels, indicating declined islet β-cell function, pancreatic infusion of concentrated bone marrow cells may differentiate into islet β-cells or activate existing β-cells, increasing insulin secretion and elevating C-peptide levels. Overall, the average C-peptide levels did not change significantly and showed no notable difference compared to the conventional treatment group. Some patients in the concentrated bone marrow cell treatment group did not show significant changes in blood glucose levels. This suggests that concentrated bone marrow cell therapy is not universally effective for type 2 diabetes, possibly due to factors such as lack of exercise, severe insulin resistance, and ongoing autoimmune damage to islet cells [21-23].

The mechanisms by which concentrated bone marrow cells treat diabetes may include:

1. **Protecting islet β-cells:** Concentrated bone marrow cells contain stem cells and various immune cells that can reduce damage caused by autoimmunity.
2. **Promoting β-cell regeneration:** The repair and regenerative functions support the differentiation of stem cells into islet cells, facilitating islet repair and structural improvement.
3. **Improving Insulin Resistance:** Acting on target organs such as the liver, skeletal muscle, and adipose tissue to increase insulin sensitivity and alleviate insulin resistance in diabetic patients.
4. **Immunomodulation:** Improving the tissue microenvironment. The paracrine effects of concentrated bone marrow cells can enhance the tissue microenvironment, promoting the repair of islet damage.
5. **Enhancing Blood Glucose Regulation:** Reducing damage to the vascular system, which may alleviate or delay diabetic complications.

Conclusion

Concentrated bone marrow cells contain stem cells, immune cells, platelets, and various growth factors. When infused into the pancreatic microenvironment, they can differentiate into islet cells or repair damaged islet cells, improve islet function, and alleviate or delay diabetic complications.

References

1. Banshi Saboo, Jothydev Kesavadev, Arun Shankar, Meera B Krishna, Shruti Sheth, et al. (2021) Time-in-range as a target in type 2 diabetes: an urgent need. Heliyon 7(1): e05967.
2. Low S, Lim SC, Yeoh LY, Yan L Liu, Jian J Liu, et al. (2017) Effect of long-term glycemic variability on estimated glomerular filtration rate decline among patients with type 2 diabetes mellitus: insights from the Diabetic Nephropathy Cohort in Singapore. J Diabetes 9(10): 908-919.
3. Danne T, Nimri R, Battelino T, Richard M Bergenstal, Kelly L Close, et al. (2017) International consensus on use of continuous glucose monitoring. Diabetes Care 40(12): 1631-1640.
4. Zhang X, Yang X, Sun B (2021) Perspectives of glycemic variability in diabetic neuropathy: a comprehensive review. Commun Biol 4(1): 1366.
5. Lu J, Ma X, Zhou J, Lei Zhang, Yifei Mo, et al. (2018) Association of time in range, as assessed by continuous glucose monitoring, with diabetic retinopathy in type 2 diabetes. Diabetes Care 41(11): 2370-2376.
6. Zhang S, Chen L, Zhang G, Bo Zhang (2020) Umbilical cord-matrix stem cells induce the functional restoration of vascular endothelial cells and enhance skin wound healing in diabetic mice via the polarized macrophages[J]. Stem Cell Res Ther 11(1): 39.
7. Zang L, Li Y, Hao H, Jiejie Liu, Yu Cheng, et al. (2022) Efficacy and safety of umbilical cord-derived mesenchymal stem cells in Chinese adults

with type 2 diabetes: a single-center, double-blinded, randomized, placebo-controlled phase II trial. Stem Cell Res Ther 13(1): 180.

8. Quagliaro L, Piconi L, Assaloni R, Lucia Martinelli, Enrico Motz, et al. (2003) Intermittent high glucose enhances apoptosis related to oxidative stress in human umbilical vein endothelial cells: the role of protein kinase C and NAD(P)H-oxidase activation. Diabetes 52(11): 2795-2804.
9. Xie Z, Hao H, Tong C, Yu Cheng, Jiejie Liu, et al. (2016) Human umbilical cord-derived mesenchymal stem cells elicit macrophages into an anti-inflammatory phenotype to alleviate insulin resistance in type 2 diabetic rats. Stem Cells 34(3): 627-639.
10. Hammer MJ, Casper C, Gooley TA, Paul V ODonnell, Michael Boeckh, et al. (2009) The contribution of malglycemia to mortality among allogeneic hematopoietic cell transplant recipients. Biol Blood Marrow Transplant 15(3): 344-351.
11. Kong D, Zhuang X, Wang D, Huiting Qu, Yang Jiang, et al. (2014) Umbilical cord mesenchymal stem cell transfusion ameliorated hyperglycemia in patients with type 2 diabetes mellitus. Clin Lab 60(12): 1969-1976.
12. Guan LX, Guan H, Li HB, Cui Ai Ren, Lin Liu, et al. (2015) Therapeutic efficacy of umbilical cord-derived mesenchymal stem cells in patients with type 2 diabetes. Exp Ther Med 9(5): 1623-1630.
13. Yin Y, Hao H, Cheng Y, Li Zang, Jiejie Liu, et al. (2018) Human umbilical cord-derived mesenchymal stem cells direct macrophage polarization to alleviate pancreatic islets dysfunction in type 2 diabetic mice. Cell Death Dis 9(7): 760.
14. Maxwell KG, Millman JR (2021) Applications of iPSC-derived beta cells from patients with diabetes. Cell Rep Med 2(4): 100238.
15. Diane A, Allouch A, MuUMin RBA (2024) Endoplasmic reticulum stress in pancreatic β-cell dysfunctionality and diabetes mellitus: a promising target for generation of functional hPSC-derived β-cells *in vitro*. Front Endocrinol (Lausanne) 15: 1386471.
16. Campo F, Neroni A, Pignatelli C, Silvia Pellegrini, Ilaria Marzinotto, et al. (2025) Bioengineering of a human iPSC-derived vascularized endocrine pancreas for type 1 diabetes. Cell Rep Med 6(2): 101938.
17. Li Y, Teng D, Shi X, Guijun Qin, Yingfen Qin, et al. (2020) Prevalence of diabetes recorded in mainland China using 2018 diagnostic criteria from the American Diabetes Association: national cross-sectional study. BMJ 369: m997.
18. Liu X, Zheng P, Wang X, Guanghui Dai, Hongbin Cheng, et al. (2014) A preliminary evaluation of efficacy and safety of Wharton's jelly mesenchymal stem cell transplantation in patients with type 2 diabetes mellitus. Stem Cell Res Ther 5(2): 57.
19. Baochi Liu, Xiong Gao, Yuanhuai Chen, Ruping Zheng, Qiqiang Dong, et al. (2024) Analysis of Clinical Data on the Treatment of Type 2 Diabetes with BMPRP. American Journal of Bioscience and Bioengineering 12(6): 128-134.
20. Liu Baochi, Cheng Mingrong, Lin Lang, Li Lei, Yanhui Si, et al. (2021) Autologous bone marrow infusion in the treatment of decompensated cirrhosis with type 2 diabetes Mellitus. Front Physiol 12: 730797.
21. Baochi Liu, Qiqiang Dong, Ruping Zheng, Xiong Gao, Huaiyuan Chen, et al. (2025) Clinical Study on the Treatment of Type 2 Diabetes with BMPRP. J Stem Cell Ther Transplant 9(2): 027-030.
22. Sopfe J, Pyle L, Keating AK, Kristen Campbell, Arthur K Liu, et al. (2019) Malglycemia is associated with poor outcomes in pediatric and adolescent hematopoietic stem cell transplant patients. Blood Adv 3(3): 350-359.
23. Croteau D, Buckley M, Mantay M, Brannan C, Annelise Roy, et al. (2024) A Novel Dehydrated Human Umbilical Cord Particulate Medical Device: Matrix Characterization, Performance, and Biocompatibility for the Management of Acute and Chronic Wounds. Bioengineering (Basel) 11(6): 588.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2026.64.010112

Liu Baochi. Biomed J Sci & Tech Res

Submission Link: https://biomedres.us/submit-manuscript.php