

Effect and Potential Mechanism of Local Injection of Umbilical Cord Mesenchymal Stem Cells in the Treatment of Knee Injury

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ABSTRACT

Objective: To analyze the effect and potential mechanism of local injection of umbilical cord mesenchymal stem cells in the treatment of knee injury.

Methods: A total of 74 patients with knee joint injury were selected as research objects from March 2018 to December 2020. They were divided into the reference group (37 cases) and the study group (37 cases). The study group was treated with local injection of umbilical cord mesenchymal stem cells, while the reference group was treated with conventional treatment, and the therapeutic effect was compared.

Results: The FMA score of the experimental group was significantly better than that of the control group 1 month and 2 months after treatment, the difference was statistically significant ($P < 0.05$). The results showed that the scores of the study group were better (28.62 ± 4.45) and (34.54 ± 4.34). In addition, the effective rate of treatment in the study group was significantly higher than that in the reference group ($P < 0.05$). The score of pain degree after treatment in the study group was significantly lower than that in the reference group, and the difference was $P < 0.05$.

Conclusion: Local injection of umbilical cord mesenchymal stem cells in the treatment of knee injury can effectively enhance the limb function of patients, relieve clinical symptoms, eliminate pain, and increase the effective rate of treatment.

Keywords

Umbilical cord mesenchymal stem cells, Knee joint injury, Potential mechanism, Local injection.

Introduction

The internal structure of the knee joint is complex, and the injuries of the knee joint include the following conditions [1]: Firstly, the fracture around the knee joint, including the articular surface fracture, tibial fracture, patellar fracture, distal femur fracture, etc.

Secondly, knee ligament injury: the knee contains four ligaments, medial collateral ligament, lateral collateral ligament, anterior cruciate ligament and posterior cruciate ligament, among which any ligament injury can be called knee injury. Thirdly, knee meniscus injury: the knee contains two soft pads, including the medial meniscus and the lateral meniscus. Meniscus injury can occur in the front corner of the meniscus, the back corner, the middle or the edge of the part. Finally, it is knee joint capsule injury, which is also known as knee joint injury. Studies have shown that local injection of umbilical cord mesenchymal stem cells has a significant effect on knee injury. 74 patients from recent years (March 2018 to December 2020) were studied in this paper. Details are described as follows.

Data and Methods

General Information

Seventy-four patients with knee joint injury were selected as subjects. The study period was from March 2018 to December 2020. They were divided into 37 cases in the reference group and 37 cases in the study group. In the study group, 26 of them were males and 11 of those were females. Their ages are ranging from 43 to 67 years old (53.64 ± 5.62). On the other hand, the control group included 25 males and 12 females and their ages are ranging from 42 to 66 years old (53.95 ± 5.76). Inclusion criteria: All patients had clinical symptoms of bouncing, knee swelling and pain, and functional dysfunction, and were clearly diagnosed as knee injury and volunteered to participate in this study. Exclusion criteria: dysfunction of vital organs such as heart and lung, diabetes mellitus, hypertension, over 75 years of age, internal and external varus of knee, serious skin ulcers and lesions around the knee joint, incomplete data, poor compliance, do not cooperate with researchers, etc. Statistical comparative analysis of general data between the two groups showed that the difference between the two groups was significant ($P > 0.05$).

Methods

The research group patients were treated using local injection of umbilical cord mesenchymal stem cells. The human umbilical cord mesenchymal stem cells were cultured using umbilical cord specimens donated by others. The tissue patch method was used to obtain umbilical cord mesenchymal stem cells. Umbilical cord mesenchymal stem cells (2.5ml each time) were injected into the knee joint. The operation methods were as follows: keep seated, naturally droop the knee joint, eliminate the puncture site, use a syringe (10ml) to penetrate the joint cavity, pull back, and observe the joint effusion. If the patient had no effusion, the mesenchymal stem cells were directly injected into the joint cavity. If the patient has effusion, the needle direction is changed, the effusion is drained clean, and mesenchymal stem cells are injected. After the injection is completed, sterile dressing is used to bind the wound and prevent infection, and assist the patient to perform knee flexion and extension activities to ensure that the mesenchymal stem cells are evenly distributed on the internal surface of the joint.

The control group received conventional treatment: sodium hyaluronate was injected into the knee joint (H20000160; Shanghai

Jingfeng Pharmaceutical Co., LTD), 2.5ml each time, the operation method was the same as the experimental group.

Observation Indicators

All patients were followed up, FMA values were measured at 1 and 2 months after treatment, and limb function was assessed. The evaluation of the therapeutic effect of patients was divided into three grades: obvious, effective and ineffective. The obvious effect was defined as the disappearance of swelling and pain and normal joint activity. If swelling, pain and other symptoms improve and joint movement improves, it is effective. If the above conditions are not met, it is ineffective. All patients were followed up for 2 months to evaluate the degree of pain. The VAS scale was used for evaluation, with a total score of 0-10, with 10 indicating the most pain.

Statistical Analysis

SPSS21.0 was used to analyze the data in this study. T test was used for measurement data (\pm expression), and X2 test was used for counting data (% expression), $P < 0.05$, indicating statistical significance.

Results

Comparison of Limb Function Between the Two Groups

For the FMA scores 1 month and 2 months after treatment, the indexes of the research group were higher than those of the reference group, $P < 0.05$, and the difference was statistically significant ($T = 7.6792$, $T = 6.6734$). As shown in Table 1.

Table 1: Lime Fuction Comparasion ($X \pm S$).

Group	n	1 day after treatment	1 month after treatment	2 months after treatment
Control Group	38	12.78 \pm 2.56	21.12 \pm 4.69	28.74 \pm 4.17
Research Group	38	12.35 \pm 2.42	28.62 \pm 4.45	34.54 \pm 4.34
T	/	0.4583	7.6792	6.6734
P	/	0.7692	0	0

Comparison of treatment effects between the two groups

The effective rate of the study group (97.37%) was higher than that of the reference group (81.58%), $P < 0.05$, and the difference was statistically significant ($T = 4.8923$). As shown in Table 2.

Table 2: Comparison of therapeutic effects between the two groups (n%).

Group	n	Apparent effect	Effective	Invalid	Efficacy Rate
Control Group	38	15 (39.47%)	16 (42.11%)	7 (18.42%)	31 (81.58%)
Research Group	38	19 (50.00%)	18 (4.37%)	1 (2.63%)	37 (97.37%)
X ²	/	/	/	/	4.8923
P	/	/	/	/	0.0417

Comparison of pain degree between the two groups

The score of pain degree in the study group was significantly lower than that in the reference group, and the difference was statistically significant ($P < 0.05$). As shown in Table 3.

Table 3: Comparison of pain degree ($X \pm S$).

Group	n	1 day after treatment	1 month after treatment	2 months after treatment
Control group	38	3.67 ± 0.45	2.67 ± 0.38	2.09 ± 0.28
Research Group	38	3.59 ± 0.63	1.31 ± 0.45	0.87 ± 0.43
T	/	0.3895	7.1274	6.0956
P	/	0.7896	0	0

Discussion

Sodium hyaluronate belongs to natural non-sulfated glycosaminoglycan. Local injection for the treatment of knee joint injury can provide viscoelasticity for joint fluid, improve the level of sodium hyaluronate in joints, and inhibit the reduction of average molecular mass distribution [2]. Sodium hyaluronate has the functions of improving soft matrix, synthesizing proteoglycan, relieving pain, anti-inflammatory, lubricating joint, damping and protecting cartilage, etc. It is widely used in the treatment of patients with knee injury and has significant therapeutic effect. Mesenchymal stem cells are widely used in the treatment of autoimmune diseases, inflammatory response and other diseases. They have multiple differentiation abilities, repair tissue damage, and regulate inflammatory response. Some scholars [3] proposed that there was cell infiltration in the synovium of patients with knee osteoarthritis who were treated with equine umbilical cord Huatong gel mesenchymal stem cells, and that the levels of matrix metalloproteinase 13, matrix metalloproteinase 3 and matrix metalloproteinase 1 in the synovium of patients in the early cell treatment group decreased 56 days after treatment. In vitro experiments, umbilical cord Huatong gel mesenchymal stem cell conditioned medium showed that synovium cells could exert anti-catabolic and anti-inflammatory effects after pro-inflammatory pretreatment. Other scholars [4] selected miniature pig arthritis as the object and treated it with sodium hyaluronate (4%) and umbilical cord mesenchymal stem cells, and the results showed that the regeneration of transparent soft tissue was significantly improved. Still other scholars [5] selected knee osteoarthritis patients as objects and used umbilical cord mesenchymal stem cells for articular cavity injection treatment. After treatment, the joint function of the patients was effectively improved, and the degree of pain was reduced without obvious adverse events. Moreover, the therapeutic effectiveness of the umbilical cord mesenchymal stem cell treatment group was significantly higher than that of the conventional treatment group. The results of this study showed that FMA scores of 1 month and 2 months after treatment were better in the study group (28.62 ± 4.45) and (34.54 ± 4.34), respectively ($P < 0.05$). The effective rate of the study group (97.37%) was higher than that of the control group (81.58%), $P < 0.05$. The score of pain

degree after treatment in the study group was significantly lower than that in the reference group, and the difference was significant ($P < 0.05$). The possible mechanism of the action of umbilical cord mesenchymal stem cells is as follows: Human umbilical cord mesenchymal stem cells inhibit T lymphocyte proliferation and up-regulate the proportion of regulatory T cells. On the one hand, human umbilical cord mesenchymal stem cells were used to treat knee injury, and on the other hand, T cells could induce the release of synovial matrix metalloproteinases in knee and destroy cartilage. At the same time, regulatory cells are anti-inflammatory and maintain the immune tolerance characteristics of the body [6].

In summary, local injection of umbilical cord mesenchymal stem cells for knee injury patients can not only effectively improve the function of the limbs, relieve clinical symptoms, but also can eliminate pain, improve treatment efficiency and the quality of life. The therapeutic effect is significant, and can be widely used in clinical practice.

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