Intracoronary infusion of Wharton's jelly-derived mesenchymal stem cells: a novel treatment in patients of acute myocardial infarction

Muhammad Bilal,[1] Abdul Haseeb,[2] Muhammad Ahad Sher Khan[3]

Madam, the substantial loss of cardiomyocytes as a result of an acute myocardial infarction (MI), eventually leads to ischaemic heart failure, with the forefront cause being coronary artery disease. The morbidity and mortality rates have been speculated to show improvement with further advancements in techniques to treat the damage. One such improvement has been seen with the development and use of Wharton's jelly-derived mesenchymal stem cells (WJMSCs) to treat acute MI. These particular stem cells have been detached from the sub-amnion to the perivascular region of the umbilical cord, with its origin being extra-embryonic or embryonic mesoderm.[1] WJMSCs differentiate into cardiomyocytes and combine with the ischaemic cardiac tissues which helps to improve cardiac function.[2]

A study was carried out in which it was discovered that the use of WJMSCs had favourable results on patients suffering from acute MI. During this randomised, double-blind, multi-centre clinical trial, one hundred and sixteen patients with acute ST-elevation MI were either administered WJMSCs or a placebo in the coronary artery, via intracoronary infusion.[3] The inclusion and exclusion criteria included parameters such as age limits, ST-elevation MI and reperfusion with stent implantation within 12 hours of onset of symptoms. Twenty one umbilical cords from healthy donors were used to produce the WJMSCs. 8 000 units of heparin was administered following arterial puncture, after which either 6 × 10^6 WJMSCs dispersed in 10 ml heparinised saline, or the placebo, was administered.[3] Myocardial viability and perfusion of the infarcted region and left ventricular ejection fraction (LVEF), were measured using F-18-fluorodeoxyglucose positron emission computed tomography (F-18-FDG-PET) and 99mTc-sestamibi single-photon emission computed tomography (99mTc-SPECT), and two-dimensional echocardiography respectively.[4] After a passage of eighteen months there was no significant difference in adverse effects seen between the two groups. Myocardial viability and perfusion, along with LVEF was greater in the WJMSC group as compared to the placebo group. These results suggest a decrease in infarct size could prevent adverse left ventricular (LV) remodeling effectively and improve heart function. The mechanism of action behind the usage of WJMCS is that they secrete pro-angiogenic factors, such as vascular endothelial growth factor (VEGF), angiopoietin-1, hepatocyte growth factor (HGF) and transforming growth factor β1 (TGF-β1), and early cardiac transcription factors to work effectively. WJMSs are also naturally chemoattracted to cardiac tissues, and as a result they are highly specific to cardiac tissues.[5] Previous studies have shown that the transfer of bone marrow mononuclear cells (BMMCs) had no significant impact on left ventricular end diastolic volume (LVEDV), suggesting that BMMCs may have a limited effect on LV remodeling after acute MI.[6]

Clinical trials are underway to prove the use of WJMSCs to be a safe method of treatment for acute MI. Further research studies need to be conducted to establish the efficacy of this technique, any adverse effect and to establish safety factors associated with this technique.

[1,3]Medical Students, [2]MBBS, Dow Medical College, Dow University of Health Sciences, Karachi.
Correspondence: Muhammad Bilal. Email: bilalmemon_744@hotmail.com

References

1. Troyer DL, Weiss ML. Wharton's jelly-derived cells are a primitive stromal cell population. Stem Cells 2008; 26: 591-9.
2. Nartprayut K, U-Pratya Y, Kheolamai P, Manochantr S, Chayosumrit M, Issaragrisil S, et al. Cardiomyocyte differentiation perinatally-derived mesenchymal stem cells. Mol Med Rep 2013; 7: 1465-9.
3. Gao LR, Chen Y, Zhang NK, Yang XL, Liu HL, Wang ZG, et al. Intracoronary infusion of Wharton's jelly-derived mesenchymal stem cells in acute myocardial infarction: double-blind, randomized controlled trial. BMC Med 2015; 13: 162.
4. Gao LR, Wang ZG, Zhu ZM, Fei YX, He S, Tian HT, et al. Effect of intracoronary transplantation of autologous bone marrow-derived mononuclear cells on outcomes of patients with refractory chronic heart failure secondary to ischemic cardiomyopathy. Am J Cardiol 2006; 98: 597-602.
5. Musialek P, Mazurek A, Jarocha D, Tekieli L, Szot W, Kostkiewicz M, et al. Myocardial regeneration strategy using Wharton's jelly mesenchymal stem cells as an off-the-shelf 'unlimited' therapeutic agent: results from the Acute Myocardial Infarction First-in-Man Study. Postepy Kardiol Interwencyjnej 2015; 11: 100-7.
6. Schächinger V, Erbs S, Elsässer A, Haberbosch W, Hambrecht R, Hölschermann H, et al. Intracoronary bone marrow-derived progenitor cells in acute myocardial infarction. N Engl J Med 2006; 355: 1210-21.