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Review

Optimal use of blood and innovative approaches to stem cells, regenerative medicine and donor recruitment

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A B S T R A C T

The annual scientific meeting of the Scotblood National Blood Transfusion Service, (SNBTS), continues to enjoy success. Scotblood 2013 focused on the contemporary issues affecting the various essential areas of blood transfusion and transfusion medicine. Presentations ranged from the challenges of recruiting young donors, forecasting future blood demand and celebrating the success of the better blood transfusion program. The meeting also discussed potential future developments in regenerative medicine particularly the potential of mesenchymal stromal cells and discussion of the ongoing Bloodpharma project, the ultimate aim of developing cultured red blood cells. This commentary comprises summaries of the presentations, based in part on the abstracts provided by the speakers.

The Scotblood Conference began with the welcoming introduction by SNBTS Director Mrs. Mary Morgan, during which she updated the ongoing developments within SNBTS over the last year. Mrs. Morgan described how SNBTS met the challenges and obstacles that have been prevalent in all Blood Transfusion Services, whilst also meeting the transfusion needs of the people of Scotland. Mrs. Morgan then introduced the keynote speaker Dr. Aileen Keel CBE, Deputy Chief Medical Officer of Scotland. Dr. Keel's presentation was entitled "Twenty years in the Scottish Government-edited highlights" in which she described the various challenges that have presented themselves to her throughout her career. Dr. Keel highlighted how the various risks in the blood transfusion field (from HCV, HIV through to nvCJD) have arisen and then reduced to miniscule levels through hard work and perseverance. The highlights of the conference are summarised below.

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Contents

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1. Plenary I: optimal use of blood

This plenary session consisted of three presentations and was chaired by Prof. Marc Turner, SNBTS National Medical and Scientific Director. The first was entitled "Age of Blood" and was presented by Prof. Mark Vickers, SNBTS Research Development and Innovation (RDI) and University of Aberdeen. Prof. Vickers began by stating that red cell transfusion as a therapy can save or transform patients' lives, obviously so in rapid bleeding or bone marrow failure. Yet as Prof. Vickers explained, most blood is used to 'top up' patients and whether this actually benefits them has only been tested relatively recently. Prof Vickers discussed these recent trials highlighting the differing opinions within the field. For example in some studies benefits of transfusion have not been clear, while in others transfusion actually appeared to have been harmful. Prof. Vickers also alluded to other studies investigating the effects of the age of blood given to patients which have suggested that cells stored for longer periods of time may cause more adverse effects. As RBCs age, numerous changes take place: free haemoglobin is released, membranes and proteins become degraded and micro-vesicles are released. In addition as up to 25% of transfused old red cells disappear from the circulation within hours of transfusion, this may cause an acute inflammatory response that may be harmful. Prof. Vickers indicated that his group has been investigating the mechanism of how splenic macrophages recognise red cells as old or damaged. Such RBCs may express altered surface markers, such as degraded band 3, altered phospholipids, altered CD47 and/or loss of sialic acid. Surprisingly, it still remains unclear which changes are important for signalling end of life for an RBC, and also if any of these can cause adverse clinical events. Prof. Vickers concluded by explaining that once we understand these processes we might be able to address the potential side effects of stored red cells using new technology, or alternatively, look at altering the current practise of how we store and supply blood so that it would reduce the potential risk.

Unfortunately the next speaker was unable to attend to discuss the recent advances in red cell blood cell salvage but Prof Marc Turner stepped into the breach and delivered an engaging talk discussing the role of SNBTS in developing and delivering the next stage in regenerative medicine. He highlighted the success stories of the Corneal stem cell program, the islet cell program, and Bloodpharma. Prof. Turner described the Scottish Centre for Regenerative Medicine (SCRM) building and the purpose built GMP cell therapy laboratories SNBTS has in the building. The aim of these labs was to keep SNBTS and Scotland at the forefront of regenerative medicine utilising its unique skills to delivering better healthcare to Scottish patients.

The third speaker in the session was Mrs. Pauline Stewart, SNBTS Better Blood Transfusion Practitioner, discussing "A Decade of Better Blood Transfusion in Scotland". Mrs. Stewart explained that 2013 was the tenth anniversary of the introduction of the Better Transfusion Program in Scotland and her presentation was a celebration of the many achievements of this innovative program. The presentation detailed how the success of the program was and is based on the guiding principles of the program, namely, safe transfusion for the recipient and the effective and efficient use of the donor's gift. Following these principles has allowed the growth and evolution of better blood transfusion over the last ten years. Mrs. Stewart explained how the program team has developed partnerships throughout Scotland and in all NHS Scottish Boards. These partnerships, driven by SNBTS led initiatives, have resulted in numerous key achievements in the safe delivery of blood and have resulted in reduction in the overall use of blood in Scotland. The program achieved these goals by developing educational initiatives to support the safe use of blood whilst also aiding in the development of the first set blood transfusion standards in the UK. Mrs. Stewart emphasised that the success of the program is a direct result of the relationships and networks that have been established and nurtured between themselves, the users and all the stakeholders in the UK and beyond.

2. Plenary II: stem cells and regenerative medicine

This plenary session consisted of two presentations and was chaired by Dr. John Campbell, SNBTS Head of Research, Development and Innovation. The first speaker was Prof John Davies, University of Toronto, who gave a very entertaining talk on "The Therapeutic Promise of Wharton's Jelly Derived Mesenchymal Stem Cells". Prof Davies began by highlighting that there are currently over two hundred clinical trials worldwide employing mesenchymal stem/stromal cells (MSC). The majority of these studies are focusing on MSC derived from the connective tissue matrix, the bone marrow, adipose, and or from the Wharton's Jelly found in human umbilical cord.

Prof. Davies explained that the unique properties of MSC have driven their expanded use in potential therapies. MSCs provide not only the cells of the musculo-skeletal system, and therefore have wide applications in regenerative medicine; but they also are immuno-privileged, immuno-modulatory, anti-inflammatory and angiogenic. Thus, MSCs are employed in the treatment of a large number of immune and inflammatory conditions, and as wound healing therapeutics. In addition, further studies have shown that co-administration of MSC with haematopoietic stem cells can significantly enhance the engraftment of the latter.

The rapid increase in academic, clinical and corporate interest in MSC has lead to analysis and development of various sources of these cells. Prof. Davies compared the various qualities of different sourced MSC with particular focus on the benefits of umbilical cord-derived MSC. These cells meet all the criteria established by the International Society for Cellular Therapy for MSC, and have been shown to regenerate bone, cartilage and dermis. There are distinct differences between these cells and MSC derived from other tissues, not least of which are their high frequency at harvest and their biological potency. The former has enabled the first definitive experimental proof of the existence of a human mesenchymal stem cell; and that MSC

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