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Hospital Authority

Cluster Presentation Programme – Hong Kong West Cluster
Recycled/Re-implanted Tumour-bearing Autograft Treated with Liquid Nitrogen for Reconstruction of Bone Defect in Limb Salvage Surgery

Advice Sought

Members are invited to note the development of the recycled/re-implanted tumour-bearing autograft treated with liquid nitrogen **(liquid nitrogen treated tumour bone recycling)** for reconstruction of bone defect in limb salvage surgery service at the Queen Mary Hospital **(QMH)** of the Hong Kong West Cluster **(HKWC)** of the Hospital Authority **(HA)**.

Background

2. Orthopaedic oncology is one of the subspecialties of orthopaedic surgery for treating patients with tumours in the limbs and spine, including both benign and malignant tumours of bone, soft tissue and skin. After the doctors resect the bone tumour, they will decide on the best way of reconstruction such as biological reconstruction or metal prosthesis reconstruction according to the needs and clinical conditions of the patients. Concerning the biological reconstruction, liquid nitrogen treated tumour bone recycling, details provided in the following paragraph, has become a popular option worldwide in recent years. Under this approach, the liquid nitrogen-treated tumor-bearing bone is re-implanted back to its original position after a freeze-thaw cycle.

3. The liquid nitrogen treated tumour bone recycling is based on a freeze-thaw cycle effect on the cell viability (minus 196 degrees Celsius). The doctor first resects the tumour bone segment from the patient and removes all soft tissue on it to reduce the number of tumour cells to be treated. The tumour bone segment is then soaked in the liquid nitrogen for about 20 minutes, then thawed at room temperature and soaked in the sterile water to kill all the tumour cells. After that, it is re-implanted back to the bone defect part of the patient.

Service Development

4. The liquid nitrogen treated tumour bone recycling for bone reconstruction after tumour bone resection was first launched in QMH in October 2015. With the support of HA Mechanism for the Safe Introduction of New Procedure/Technology **(HAMSINP)** and QMH Quality and Safety team, QMH Orthopaedic Department successfully performed the

first surgery on 20 October 2015. Since then, this option has become an additional option of recycled bone reconstruction in bone tumour surgery available to selected patients. Currently, QMH is the only centre providing such service in Hong Kong in both public or private settings. Between October 2015 and end of 2023, a total of 32 patients have received the treatment, including two patients with an intercalary bone defect referred by the Orthopaedics Department of Queen Elizabeth Hospital **(QEH)**. Under the special arrangement of the two hospitals, QEH orthopaedic surgeons came to QMH to perform the operations, and the surgeries were jointly completed by doctors from the two hospitals.

Advantages

5. In general, the advantages of liquid nitrogen treated tumour bone recycling include :

(a) The technology is relatively simple compared to other options (such as custom-made prosthesis);
(b) There is a low chance of immunological rejection (because patient's own tissue is used);
(c) There is a significant improvement in bone healing time in comparison with allograft bone reconstruction (from 71% in 12.1 months to 93% in 6.7 months);
(d) The treatment is a cost-effective option to other available options (e.g. the cost difference can be as much as ten-fold as compared to a recent case using the option of proximal femoral replacement); and
(e) The implant fits perfectly into the bone defect with no limb length discrepancy.

6. Moreover, according to laboratory and clinical case reports in the international medical journals, this technology can successfully eliminate all the tumour cells in the tumour bones, and tumour recurrence was not reported in the recycled bone segment in our literature review. The risk of local recurrence in the recycled tumour bone is therefore extremely low.

Challenges

7. Skill shortage is the major challenge we are currently facing. Liquid nitrogen treated tumour bone recycling requires specific surgical skills and experience. Medical staff, such as doctors or operating room nurses responsible for operating the liquid nitrogen, must undergo professional training before they can discharge their duties. With an aim to augmenting manpower supply to support the growing service demand, QMH is now actively providing training to more internal staff.

Staff Training

8. As the pioneer in the introduction of the liquid nitrogen treated tumour bone recycling service to HA patients, QMH also steers subsequent service development and provides staff training. Prior to service commencement, we arranged three orthopaedic specialists to visit the Kanazawa University Affiliated Hospital in Japan to learn how to

apply such technology in tumour patients. After coming back to Hong Kong, a team which consisted of orthopaedic surgeons and operating room nurses was set up to standardise the procedures in our operation room. The team has also made continuous efforts in providing regular in-service training to the new operation room staff. In addition, we also conduct regular self-audit through patients' records to explore room for service enhancement and ensuring favourable outcome.

9. With considerable accumulated experience in this treatment and as the only centre equipping with this technology, the Orthopaedic Oncology Division of Orthopaedics & Traumatology Department of QMH has also published two papers on the recycled tumour bone treated with liquid nitrogen in bone reconstruction in 2021 and 2023 to share the experience and knowledge on the clinical outcome of our patients in Hong Kong. The aim of these reports is to share our experience and facilitate knowledge exchange with other hospitals with similar technology, such as Beijing Ji Shui Tan Hospital and Shangdong Provincial Hospital Affiliated to Shandong Frist Medical University. In addition, we also reported our clinical outcome in international prestigious journals, including the International Journal of Surgery Case Reports and Journal of Orthopaedic Surgery and Techniques, to compare our clinical data with those from other renowned centres in overseas countries.

Way Forward

10. As the recycled tumour-bearing autograft technology continues to develop, QMH, as a pioneer of this service in Hong Kong, will further expand its services and consider introducing a new generation of liquid nitrogen treated tumour bone recycling to improve our patient care. HKWC will also continue to maintain close cooperation with the HA Head Office and other clusters to provide professional, high-quality recycled / re-implanted tumour-bearing autograft treated with liquid nitrogen for reconstruction of bone defect in limb salvage surgery to patients in need.

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