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Reconstruction with Extracorporeal Irradiation and Re-implantation following Intercalary Resection of Malignant Bone Tumor

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Abstract : Limb salvage surgery is the standard of care in extremity bone sarcomas. There are various techniques that are being used for reconstruction. A biological reconstruction option is the technique of resection and reconstruction with extracorporeal irradiation and re-implantation of the involved bone. We report a case of Non metastatic Ewings Sarcoma of the left middle third femur for which we performed limb salvage surgery and reconstruction with extracorporeal irradiation and reimplantation of the resected bone, following Neoadjuvant chemotherapy.

Keyword : Bone sarcoma, Extracorporeal irradiation, Limb salvage surgery

INTRODUCTION

The management of extremity bone sarcomas has evolved into a multidisciplinary treatment, which consists of optimal use of surgery, chemotherapy, and radiotherapy. Limb salvage procedures are being favored all over the world. Over the past 3 decades, various reconstructive options have been tried out and are being practiced. Despite that, the precise fit, stability, risk of fracture of the prosthesis, rejection of the allograft and expensive materials used cause real concerns to the reconstruction.

Spira et al, in 1968, first described the technique of reconstruction with extracorporeal irradiation of the resected bone1. It is a useful, convenient, and cost effective method. It consists of enbloc removal of the tumor bearing bone segment, removal of the tumor and the soft tissues from the bone, irradiation and re-implantation back in the body. The use of irradiated bone can provide the anatomical precision of the re-implanted bone segment, avoid immunological rejection, and reduce the risk of postoperative infection. It allows effective re-attachment of tendons and produces a lasting biological reconstruction.

CASE HISTORY:

14 year old girl presented with swelling in the left thigh of 4 months duration. On evaluation she was diagnosed with Ewings Sarcoma of the shaft of left femur. Metastatic work up was negative. She then received 6 cycles of VAC/IE chemotherapy (Vincristine / Adriamycin / Cyclophosphamide alternate with Ifosfomide / Etoposide) and had a good response to chemotherapy clinically as well as radiologically. Four weeks later, she was taken up for surgery. She underwent limb salvage surgery and reconstruction with extracorporeal irradiation and re-implantation of the irradiated bone.

TECHNIQUE :-

Enbloc intercalary resection of the tumor was done giving 3cm bony margin and adequate soft tissue margins all around (fig 1). Frozen section sent from the marrow cut ends were reported negative for malignancy. Soft tissue and periosteum were stripped off the resected bone segment (fig 2). The bone was given a lavage with normal saline and then wrapped in antibiotic soaked mops, sterile covers and placed in a sterile container and taken for radiation (fig 3). Total 50Gy was delivered equally in parallel opposing fields over 25 minutes in LINAC machine delivering 4MeV photons. Irradiated bone was taken back to the operating room, marrow contents reamed and lavaged and then fixed by extramedullary internal fixation plates (fig 4) and closure done in layers over suction drains.

FOLLOW UP:

Patient is remaining disease free for over 2 years now. But there was non union in the proximal end for which she recently underwent Open reduction and internal fixation with plating and augmentation with vascularised free fibular graft. Post operatve period was uneventful and patient is presently on routine hospital protocol rehabilitation.

DISCUSSION:

Delivering 50Gy Radiation continuously at the rate of 2Gy/min is equivalent to delivering 250Gy by conventional fraction 1. With that high dose, there is 100% tumor kill and only remote chance of local recurrence and development of second cancer2. It has also been proved that there is no further benefit with a higher dose2. Intercalary re-implantation get revascularised from both proximal as well as distal ends and hence they usually do well2.

Advantages include the fact that this reconstructive option acts as a lifelong biological solution which renders a perfect match for size 2. It also allows better reconstruction of the soft tissues as well by means of providing more precise muscular reattachments2. Natural joints are preserved and also this method is free of problems related to the wear and tear of the prosthesis3

. It also excludes problems like immunological rejection and post operative infection following allograft usage 3. Disadvantages of using extracorporeal irradiated bone includes Non union which is reported as the most common complication in many series next only to skin or soft tissue healing problems4. Ceruso et al achieved a high rate of union of 96% in 59 reconstructions when using allograft combined with a vascularised fibular graft5. This concept was used in the repeat surgery for non union of the proximal end in our patient. An Australian study by Davidson et al. has reviewed 50 of their cases of extracorporeal irradiation and reimplantation and has found out that osteolysis of some form as a common complication 6. Other complications include infection, avascular necrosis & graft reabsorption, lack of material for pathological examination, analysis of chemo response & resection margins 7. Although there are reports of local recurrence in few series, there were no actual recurrences in the irradiated bone and even the rates of soft tissue recurrence that have been recorded are comparable to the local recurrence rates of any other mode of reconstruction8. The survival rates are also similar to that of the conventional prosthesis usage 4.

CONCLUSION:

Extracorporeal irradiation and re-implantation is an effective method of reconstruction in limb salvage surgeries and has various advantages compared to the routine prostheses reconstruction. It helps to provide a near normal match following resection which is also an inexpensive one. Having similar local recurrence rates and survival and a fairly acceptable complication profile compared to other standard reconstruction options, Extracorporeal irradiation and re-implantation continues to be a rewarding reconstruction technique.

IMAGES:

Fig 1 – Resection of the tumor

Fig 2 – Stripping the tumor and periosteum

Fig 3 – Resected bone placed in the container for Radiation

Fig 4 – Irradiated bone fixed with plates

Fig 5 – Post op Xray.

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