

RADIOFILAXIA OSIFICĂRILOR HETEROTOPICE DUPĂ ARTROPLASTIA DE ȘOLD

RADIATION THERAPY FOR PROPHYLAXIS OF HETEROTOPIC OSSIFICATION AFTER HIP REPLACEMENT

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Abstract:

Heterotopic ossification is defined as abnormal bone formation in extraskeletal soft tissues where bone normally does not exist, for example muscles tendons, skin and organs. In the last decades a great interest of this pathology was given to the heterotopic ossification what occur after hip replacement operations. This is due to the gradual increase in the frequency of such interventions and repercussions that this condition untreated may have. The two current main prophylactic methods widely used for heterotopic ossification prophylaxis are radiation therapy which can be used either preoperatively or postoperatively and prophylaxis with NSAIDs. Both prophylaxis methods can be effective but they can lead to some adverse effects to the patient.

Key-words: heterotopic ossification prophylaxis, radiation therapy

Introduction

Since 1958, Colley and Goss showed that irradiation of the fracture zone in mice within the first week after fracture, with a single radiation dose of 30 Gy prevent fracture healing, the same dose applied to more than a week after fracture does not influence bone healing. Other studies on the phenomenon were subsequently effectuate by Craven and Urist in 1971 by implanting demineralized bone matrix in laboratory mice. In order to determine the optimum irradiation interval that inhibits the development of heterotopic bone formation, repeated irradiations were carried out with 18 Gy single dose on the day 2, 4, 6, 8, 10 and 12 after implantation. The conclusions of the two was of great importance, such mice irradiated within the first week of demineralized bone matrix implantation was observed a marked reduction in the production of bone while the other mice irradiated during the 2nd week had ectopic bone formation rate similar to mice that did not was irradiated. [2, 6, 10]

Radiation therapy - mechanism of action.

Ionizing radiation action of the cells with higher division rate resulting in alteration of

their deoxyribonucleic acid. The negative effect on cellular DNA appears to interfere with pluripotent mesenchymal cell differentiation (which seems to be especially radiosensitive) in osteoblasts and thus inhibit the formation of osteoid and heterotopic ossification. The inhibitory effect of radiotherapy on the development and bone growth was observed in irradiated children where growth inhibition was observed. [1,2]

Besides altering cellular DNA, radiotherapy has an impact on local immune components observed by analysing patients with osteotomy of the femur hematoma, irradiated preoperatively. Thus there was a significant change in cytokine and immune cell composition of these hematomas compared with non-irradiated patients. Effect of preoperative radiation therapy is to increase the levels of cytotoxic T-lymphocytes, IL-6, IL-8, IFN-gamma and decreased vascular endothelial growth factor (VEGF - vascular endothelial growth factor). It appears that inhibition of VEGF secretion and increased local inflammatory activity contributes to the prevention of heterotopic ossification. [7]

Optimal dose and time for maximum of efficiency

Once the effectiveness of radiotherapy in preventing heterotopic bone formation was established, the next problem was to find an optimal dose of radiation that can be used to avoid their side effects.

Many studies have shown that postoperative irradiation with high dose of radiation for example 20 Gy in 10 sessions is as effective as irradiation of 10 Gy in 5 sessions. Another important aspect was the period in which irradiation is carried out, so the best results were obtained in patients who have undergone prophylactic radiotherapy within 4 days after surgery. [2, 6]

A reduction in the dose and frequency of irradiation reduces the risk of side effects, costs and increases patient comfort. [10]

Subsequent studies have shown that a single prophylactic dose of 700-800 cGy given within 72 hours to four days after surgery would have the optimum effect in preventing of heterotopic ossification formation, as evidenced by decreased success rates from 98% in the administration of radiation therapy within 4 days to 33% in the administration after this period. [2, 8, 9]

The principle on which early radiotherapy acts, is that after 72 hours pluripotent mesenchymal cells are differentiated and bone matrix synthesis starting which shows inefficiency of prophylactic radiotherapy after this interval. [3]

Risks and side effects

When choosing the radiation prophylaxis indication must take into account both the harmful effects of radiation on wound healing, possible costs and secondary malignancy that may develop. The radiation therapy can be used with great success in patients where the administration of steroidal or non-steroidal anti-inflammatory drugs is not possible. [2, 4]

Repeated prophylactic radiotherapy in patients with a history of treated heterotopic ossification after hip replacement requiring a new operation on the same hip is well tolerated without side effects. [3]

The risk of malignancy after prophylactic radiotherapy of heterotopic ossification is very low, although have been described in

literature osteosarcomas in patients who received prophylactic radiotherapy after acetabular fracture. It seems that younger patients have a higher risk of developing malignancies at the irradiated site. [5]

The possibility that radiation influence hip prosthesis integration by preventing bone growth was also studied. Kanski et al., by implanting porous prostheses in rabbits and irradiated with 10 Gy in 5 fractions observed that the force required to remove the irradiated implants was significantly lower compared to the uneradicated implants at an interval of 2 weeks, the difference becomes smaller at an interval of 3 weeks. The hypothesis was strengthened by the results of other studies that revealed a higher rate of instability and secondary mobilization of porous coated implants in irradiated patients, radiation protection was proposing porous coated implants. Some nonunion were observed in patients with trochanteric osteotomy. [3]

Conclusion

In conclusion, the use of radiotherapy for heterotopic ossification prophylaxis is effective with minimal risks. Using a single dose between 500-800 cGy in the first 72 h after surgery seems to have good results. It can also be used successfully in patients in which the use of NSAIDs is not possible. Repeated prophylactic radiotherapy is well tolerated without side effects. Prophylactic radiotherapy results are similar to prophylaxis with NSAIDs, the only difference consist in costs, NSAIDs side effects and patients comfort.

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