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Postoperative radiotherapy for pigmented villonodular synovitis (PVNS): case series and literature review

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Abstract

Purpose: Pigmented villonodular synovitis (PVNS) is a rare benign proliferative disease of the synovium with locally aggressive behaviour. We reviewed our experience using external beam radiotherapy (RT) in the treatment of PVNS.

Method: We report five cases of PVNS who underwent Arthroscopic Synovectomy followed by postoperative RT in National Oncology centre in Oman. The total dose RT ranges between 30 and 36 Gray (Gy) Three-dimensional radiotherapy technique.

Conclusion: Postoperative RT is effective in preventing disease recurrence and should be offered following maximal cytoreduction to enhance local control in PVNS.

Case Study

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Introduction

PVNS is a rare proliferative type of giant cell-rich tumours (GCTs). It commonly affects large joints such as knee, hip, ankle and elbow. MRI features of PVNS include different extent of synovial proliferation, joint effusion and erosion of bone, and in particular the deposit of hemosiderin within the synovial masses. There is no standard guideline or consensus on surgical procedure or postoperative therapy. The treatment is extrapolated from previous case series. Main stay of treatment is surgical intervention with arthroscopic synovectomy. However, rate of recurrence is high due to location and extent of the disease. Radiotherapy (RT) has a role in reducing risk of local recurrence.

Case Series

Five cases of PVNS were treated between 2012 and 2020 in our cancer centre. Patient's baseline characteristics are shown in Table 1. The age at diagnosis was between 21 and 46 years. All patients have left knee PVNS, and all underwent Arthroscopic Synovectomy followed by postoperative RT. The total dose RT ranges between 30 and 36 Gray (Gy). Three-dimensional RT technique with two opposite portals was used. There were no reported significant side effects during RT treatment. Mean follow-up time is 40 months. All patients were on annual MRI follow-up which showed stable disease. The reported chronic side effects were minimal ipsilateral joint tenderness in one patient. All patients are doing well to date with no local recurrence or restrictions of movement.

Discussion

GCTs are classified according to their site of origin, namely bone, soft tissue, synovium or tendon sheath. Those that arise from tendons and synovium are classified into two forms: localised (nodular tenosynovitis) mainly involves the digits and diffuse [pigmented villonodular synovitis (PVNS)] involving large joints such as knee, hip, ankle and elbow.[1,2] The latter is rare with incidence of 2 cases per million per year. It is a benign proliferative tumour that develops in the synovium with high risk of recurrence.[3] The aetiology and pathogenesis of PVNS are unknown, but it may be due to chronic inflammation.[4] There is no difference between genders with younger patients seem predominantly affected. The most common complaint is intermittent joint pain.[5]

There is no standard guideline or consensus on surgical procedure or postoperative therapy. The treatment is extrapolated from previous case series. A multimodality approach including MRI, evaluation of the knee and complete synovectomy, either as a single or a staged procedure with postoperative therapy results in a lower recurrence rate and fewer complications. MRI features of PVNS include different extent of synovial proliferation, joint effusion and erosion of bone, and in particular the deposit of hemosiderin within the synovial masses.[6]

Table 1.

Case	Age at diagnosis	Surgery	RT dose Gray/Fr	Follow-up (MO)	Outcome (NOM)
1	38/M	Arthroscopic synovectomy	36 Gy/18	108	NOM
2	21/M	Arthroscopic synovectomy	36 Gy/18	84	NOM
3	21/M	Arthroscopic synovectomy	30 Gy/15	49	NOM/ Tenderness
4	41/F	Arthroscopic synovectomy	30 Gy/15	36	NOM
5	37/F	Arthroscopic synovectomy	30 Gy/15	11	NOM

F, female; M, male; RT, radiotherapy; Fr, fraction; NOM, no restriction of movement.

PVNS of the knee is associated with a higher recurrence rate than PVNS at other joints[7] due to the anatomical limitation of the lesion; radical resection of diffuse PVNS is very difficult. Arthroscopic synovectomy is an appropriate treatment for knee PVNS. Extended synovectomy is recommended for diffuse PVNS.[8] This technique requires technical expertise, and complete excision is rarely achieved even by experienced arthroscopic surgeons.

The risk factors for recurrence include diffuse form of the disease, incomplete resection, location of the lesions, the experience and skills of the surgeon, and adjuvant therapy after surgery.[9]

Postoperative RT has been used to achieve better local control in patients with primary or recurrent PVNS.[10] It should also be considered for patients receiving a radical synovectomy to treat inaccessible or hidden disease sites.[11] A large number of reports have confirmed that adjuvant postoperative external beam RT can further reduce the recurrence rate. De Carvalho et al reported that 8 patients with diffuse PVNS of the knee who had synovectomy with subsequent local external beam RT had a recurrence rate of 12.5% at 8.6 years of follow-up.[12] Griffin et al treated 49 patients with a mean follow-up of 94 months, with no recurrence of the disease in 94% of the patients and had better joint function in 41 patients.[13] A German review analysed data where RT was applied in 39 cases (95.1%) with excellent or good functional outcome noted in 34 cases (82.9%). The use of RT was not associated with early or late toxicity larger than Radiation Therapy Oncology Group toxicity grade II. Total doses in the range of 30–36 Gy are recommended.[14]

There have been no studies on radiation dose-response relationships to date. At Asan Medical Center, patients have been given the conventional dose (32–34 Gy) or a lower dose (20 Gy) as postoperative treatment for diffuse PVNS of the knee, depending on the treating physicians who favoured different pathogenesis theories—neoplasia or chronic inflammation.[15]

Horoschak et al recommended that using 34 to 36 Gy radiation dose can achieve a better local control rate.[16] A retrospective study compared the clinical outcomes of patients who were treated with conventional or low-dose RT. It analysed the data of 23 patients who underwent Synovectomy followed by 4-MV or 6-MV external beam RT with a median dose of 20 (12–34) Gy in 10 fractions. At a median follow-up of 9 (0.8–12) years, 4 patients had recurrent disease, with a median disease-free interval of 5 years. Low-dose (20 Gy) RT appears to be as effective as moderate-dose treatment (around 35 Gy).[17]

The recent development and investigation of systemic therapies targeting the colony-stimulating factor one (CSF1) pathway represent an important advancement in the treatment of GCT. These therapies may play a major role in the treatment of advanced, recurrent and recalcitrant diseases for which surgery carries more morbidity than expected benefit. The efficacy of four different tyrosine kinase inhibitors of the CSF1 receptor has recently been tested. This includes nilotinib, imatinib, emactuzumab and pexidartininb.[18]

Conclusion

PVNS is a rare and locally aggressive disease which may involve any joints. Surgical resection plus adjuvant therapy is recommended for patients with risk factors of recurrence. Dose between 20 and 36 Gy is effective with minimal side effects.

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