

Diagnosis and Management of Pigmented Villonodular Synovitis: A Case Report

Johanna Patricia A. Cañal^{1,2} and Norberto A. Meriales^{1,3}

¹University of the Philippines - Philippine General Hospital

²San Juan de Dios Hospital

³Medical Center Manila

ABSTRACT

We present a case of pathologically confirmed, relatively rare Pigmented Villonodular Synovitis (PVNS). The patient presented with knee and thigh swelling. While initially misdiagnosed, he eventually underwent an MRI and a biopsy. The MRI was helpful but not definitive. The biopsy confirmed PVNS. The patient underwent synovectomy and was subsequently referred for radiotherapy and physical therapy. Post-treatment MRI showed no evidence of disease.

Key Words: Pigmented villonodular synovitis, synovectomy, radiotherapy

INTRODUCTION

Pigmented Villonodular Synovitis (PVNS) is a rare, benign, idiopathic, proliferative disease affecting the synovia of joints and tendon sheaths. The textbooks recognize two types: the localized and the diffuse.¹ In most cases, one joint is involved but this can spread to the adjacent muscles and soft tissues. It occurs equally in males and females, usually young adults in the third and fourth decade and has an annual incidence of approximately 2 per million persons. This condition is commonly seen (in decreasing incidence) in the knee, the hip, the ankle, the shoulder and the elbow, with an overwhelming majority found in the knee.^{2,3} Involvement of more than one joint is unusual and exceedingly rare.

Surgery is the definitive treatment for this case.^{2,3} However, recurrence rates are usually high, nearing 50%.¹ Therefore, radiotherapy may be used as adjuvant treatment.

To our knowledge, this is an uncommon case in the Philippines and this case is the first published case in the country.

CASE

Our patient is RJS, a 21-year-old male and a college student from Isabela. His condition started 3 years prior to admission, at age 18, when he first noted swelling of his right anterior thigh. There was no palpable mass but his right pant leg was tighter than the left. Having no other symptoms and being able to comfortably do all his activities of daily living, he opted not to consult a physician at this time.

A year later, at age 19, he consulted an orthopedic surgeon because of continued slow growth of the mass, specifically in the posterior part of the knee. An elevated uric acid level led to a diagnosis of gout. Gout medications were taken for 10 days with no perceived improvement. Medications

Corresponding author: Johanna Patricia A. Cañal, MD, MHA
Department of Radiology
College of Medicine
Philippine General Hospital
University of the Philippines Manila
Telephone: +632 5548471
Email: jdadevosocanal@up.edu.ph; joie_canal@yahoo.com

were stopped; likewise, with consults. Six months later, RJS experienced pain on knee bending. His gait was still normal and he could still engage in his sports activity (basketball).

Three years after the first symptom, at age 21, with continued growth of the mass, he consulted his orthopedic surgeon in Metro Manila for the first time. An MRI (Figure 1) was requested which showed the following:

...septated cystic soft tissue masses at the popliteal and deep anterior right distal thigh extending more medially. These measure 3.5 x 3.5 x 6 cm and 7 x 10 x 12 cm, respectively, with foci of thickened capsule and calcified nodularities.

The deep muscles (vastus intermedius and medialis) as well as the popliteus are displaced and partially compressed.

Based on “two areas of septated cystic masses in the deep area of the anterior distal right thigh and popliteal region,” the radiologist considered hemangiomas or cystic neoplasms. Biopsy was advised and eventually done. An aggregate specimen measuring 2.5 cm showed pigmented Villonodular Synovitis (PVNS).

Three weeks later, the patient underwent an intralesional excision of the right thigh and proximal leg mass under spinal anesthesia. Via a medial parapatellar arthrotomy, a near-total synovectomy with preservation of the vasculature was done

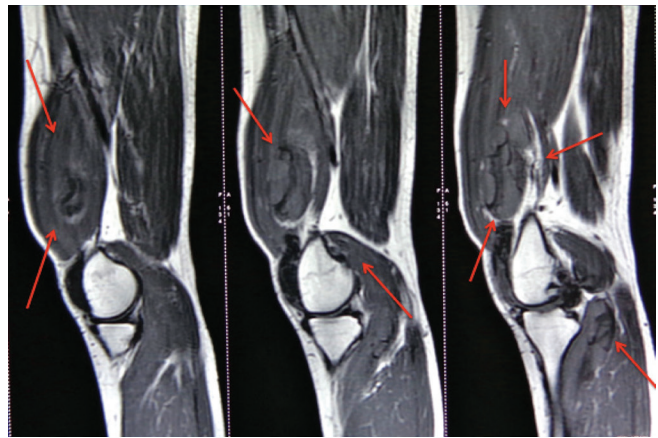


Figure 1. Representative MRI images of the right knee. Notable are the lobulated soft tissue mass in the anterior distal thigh and a smaller similar mass in the posterior to the proximal tibia.

and the mass was excised along its pseudocapsule at the suprapatellar region (Figures 2 and 3). Intralesional excision was performed at the medial and lateral compartments. Intra-operatively, there was a rust-colored intracapsular knee mass that extended from the distal thigh, crossing the knee joint and spreading toward the posterior leg. The cruciate ligaments, menisci, and articular cartilage all appeared

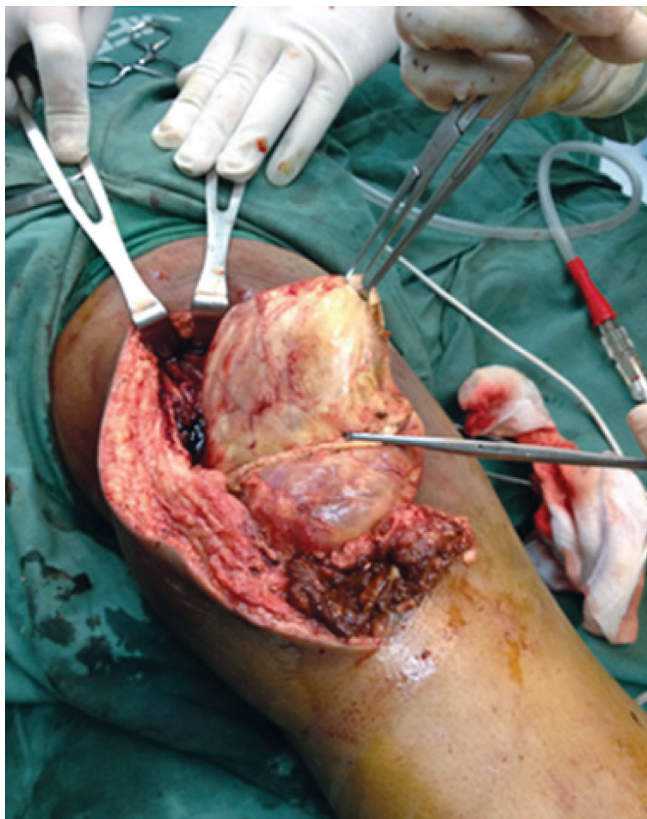


Figure 2. Main bulk of PVNS at suprapatellar area being excised.



Figure 3. Post-excision of anteriorly located mass.

normal. A separate posteromedial incision at the proximal leg was created in an attempt to remove more of the posteriorly located lesions, which were otherwise inaccessible through the anterior approach. Despite a separate incision, not all posterior lesions were excised due to the extent of the disease.

The final histopathologic report was as follows:

1. Specimen labeled "R thigh and knee mass" consists of a yellow, tan, irregular shaped cystic tissue measuring 12.5 x 9.5 x 4.5 cm. Cut section shows cream yellow to yellow brown cut surfaces, with yellow viscous fluid coming out of the cystic areas. In the same container are several yellow brown, irregular tissue fragments and has the same character with the larger tissue. These tissue fragments have an aggregate diameter of 12 cm.
2. Specimen labeled "Proximal leg mass" consists of a tan brown irregular tissue fragments with an aggregate diameter of 7 cm.

The patient was subsequently referred for external beam radiotherapy one month post-operatively. His treatment consisted of 180 cGy per day via 6 MV photons over 28 days, delivering a total dose of 5040 cGy. Immobilization of the entire right lower extremity was done. A strip of skin and soft tissue in the posterior thigh and leg was spared to ensure continued good lymphatic drainage. The patient was positioned "foot first" for ease and consistency of treatment (Figures 4 and 5).

Midway through the radiotherapy, RJS was referred to Rehabilitation Medicine for physical therapy. From an initial angulation of <30 degrees, the patient was able to bend his right knee to 90° by the end of his adjuvant treatment. The patient was sent home improved and expecting to complete his last semester of college.

Two months after the completion of radiotherapy, the patient came for follow-up check up with a follow-up MRI. The MRI showed no evidence of disease.

DISCUSSION

Pigmented Villonodular Synovitis (PVNS) is an uncommon benign disease that occurs in the knee in the majority of documented patients, with the literature citing 75-80% in that area.²⁻⁴ It occurs equally in both men and women, usually in the 3rd and 4th decade of life, with a reported annual incidence of 1.8-2.0 per million persons.

A patient with Pigmented Villonodular Synovitis (PVNS) will present with joint pain and swelling. There may also be joint locking and instability.⁵ Its cause is, as yet, unknown. Grossly, the lesion of a Pigmented Villonodular Synovitis has been likened to a "shaggy red beard", that is, having villous or frond-like synovial projections that are reddish or rust colored.^{2,3} This coloration is a result of the iron pigment (hemosiderin) within the lesion.

Pathologically, PVNS is characterized by synovial hyperplasia with multinucleated giant cells and a characteristic pigmentation caused by both intra- and extracellular hemosiderin. Early lesions demonstrate large villi projecting into the joint space. Long standing lesions can show fibrosis and hyalinization.² Foam or xanthoma cells may also be seen in mature lesions.

Radiographically, there are typical but non-pathognomonic imaging findings on x-ray. There will be a non-calcified soft tissue mass, well-defined bone erosions on both sides of a joint and occasionally, joint effusion. The most characteristic are the multiple erosive lesions on both sides of the joint. Unfortunately, x-ray findings such as presence of osteophytes, sclerosis, cysts and joint narrowing



Figure 4. Right anterior oblique field to the right medial thigh.

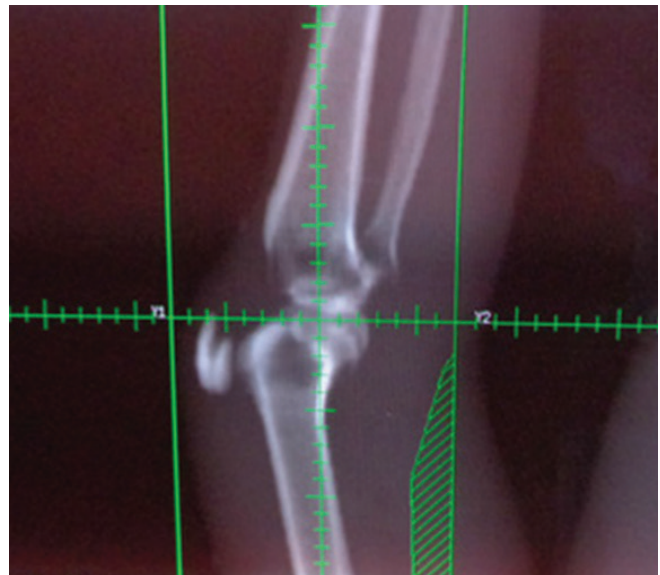


Figure 5. Left posterior oblique field to thigh and knee.

have also been reported. These are findings found in arthritic conditions and therefore, an x-ray diagnosis is difficult and non-specific.^{3,4} The presence of calcifications will generally indicate a diagnosis other than PVNS.

MRI, on the other hand, has pathognomonic findings for pigmented Villonodular Synovitis. Helms, Kaplan et al. indicate that a joint effusion with diffuse low signal lining hypertrophied synovium on T2W images is characteristic. T1W, T2W and gradient images are necessary to evaluate hemosiderin deposition, which is shown as large, globular areas of low signal intensity on all imaging sequences. Gradient echo imaging shows blooming of the hemosiderin elements, making them more prominent.⁶ The presence of hemosiderin makes the diagnosis of PVNS on MRI virtually pathognomonic. The decreased signal intensity is usually more pronounced on long spin echo sequences (TR/TE images) due to the preferential shortening of T2 relaxation times of hemosiderin.³ The lytic bone lesions seen on radiographs and joint effusions are typically well seen on MRI.

The possible radiologic differential diagnoses for cystic soft tissue masses include synovial hemangiomas, hemophilic arthropathy, synovial osteochondromatosis, gout, and rice bodies. Rice bodies are fibrin-filled villous structures associated with rheumatoid arthritis.^{4,7,8} All of these conditions are benign and present with some form of pain and swelling.

Synovial hemangiomas and hemophilic arthropathies occur in younger patients, with the literature citing childhood predilection. PVNS occurs in the 3rd and 4th decades of life. Synovial osteochondromatosis, gout and rice bodies occur in the more elderly population.

Calcifications within a mass are seen in synovial hemangiomas, synovial osteochondromatosis, gout and rice bodies. MRI-detectable hemosiderin deposits are seen in synovial hemangiomas, hemophilic arthropathy and PVNS. Joint effusions are uncommon with rice bodies and synovial osteochondromatosis, but can be seen in the other conditions at different times in the course of disease.

All of the aforementioned conditions will have some form of arthritis some time during the course of illness, especially if untreated. A common finding is cortical erosions. The simple table below (Table 1) will help tease out the diagnosis for painful swollen joint masses.

The lack of a definite radiologic diagnosis, however, will not change the surgical management in that a maximal resection is required. Surgical resection is generally indicated

for progressively growing masses associated with joint dysfunction such as pain and limitation of motion. Left alone it typically results in arthritic changes as well as progressive enlargement. However, PVNS tends to spread extensively in and around a joint such that complete excision of the mass is very difficult. As it tends to blend with adjacent normal synovium, a pseudocapsule within the joint cannot be defined in most instances. Almost always, the surgeon is left with little option but to proceed with intralesional margins, and will likely leave residual unexcised tissues. Local recurrence is very common.

In Radiation Oncology textbooks, the discussion on Pigmented Villonodular Synovitis is short and bare. In the literature, there have been only case reports and case series. One study out of Germany cited 7 patients with PVNS who underwent post-operative radiotherapy after having suspected or obvious synovial foci.⁹ All had diffuse PVNS. Their ages ranged from 14-75 years, 5 were males and 2 were females. All were treated with a linear accelerator using 6 MV photons, based on pre-operative MRI and post-operative CT simulation. The mean dose delivered was 40 Gy given over 20 fractions. With a follow-up period of between 3 and 112 months, there was a 100% success rate with this combined therapy.

Another paper out of Stanford in California was a case series of 17 patients with 18 sites of PVNS who were accrued from 1993 to 2007.¹⁰ The most common location was the knee (67%). Sixteen of the 18 sites underwent cytoreductive surgery, all with either proven or suspected residual disease. Radiation was delivered via linear accelerator using photons with an average total dose of 34 Gy. After follow-up (average 46 months), ultimate local control was 100%. The 2 cases wherein no surgery was initially done eventually had to undergo surgery after radiotherapy. The authors concluded that: post-operative external beam radiation is effective in preventing disease recurrence and should be offered following maximal cytoreduction to enhance local control in PVNS.

A third paper again from Germany shows the results of a National Patterns of Care Study done by the German Cooperative Group on Radiotherapy in Benign Diseases.¹¹ Complete information for 41 patients from 14 institutions was available. Total doses of radiation ranged from 30-50 Gy. Local control was achieved in 95.1%. The conclusion was therefore that radiation therapy is a safe and effective treatment for PVNS in the post-operative setting after incomplete resection, and also as a salvage option for treatment of recurrences it provides a high rate of local control.

Table 1. Diagnostic Aid for a Benign Knee Mass

Condition	Age predilection	Joint effusion	Arthritic changes	Hemosiderin deposits	Calcifications
PVNS	3 rd -4 th decade	+	+	+	none
Hemophilic arthropathy	Childhood	+	+	+	none
Gout	Elderly	+	+	None	+
Rice bodies	Elderly	uncommon	+	None	+
Synovial hemangioma	childhood	+	+	+	+
Synovial osteochondromatosis	4 th -5 th decade	uncommon	+	None	+

CONCLUSIONS AND RECOMMENDATIONS

We have a case of Pigmented Villonodular Synovitis in a young adult male who presented with knee swelling. There was slow, continuous growth over 3 years before the appropriate imaging and tissue studies were done. Surgical management was done as definitive treatment and radiotherapy provided adjuvant treatment.

In a case such as this, the recommended imaging studies include x-rays and an MRI. There are pathognomonic findings on MRI, however, these are seen on gradient echo sequences. Without this MRI sequence, differential diagnoses include synovial hemangiomas and hemophilic arthropathy. Regardless, the appropriate surgery for patients who present with cystic and synovial masses is a total synovectomy. Because of the tendency of PVNS to recur, adjuvant treatment with radiotherapy is the prudent course of action. Post-treatment monitoring is best done with MRI.¹²

Important in cases such as these is the high index of suspicion, aggressive pursuit of a diagnosis and the correct definitive and adjuvant treatment. These cases are benign but left untreated, they will cause debilitation and disability.

Acknowledgements

The authors thank Dr. Jose Ma. Avila for being the pathologist for this case.

Statement of Authorship

All authors have approved the final version submitted.

Author Disclosure

All authors declared no conflict of interest.

Funding Source

This paper was funded by the individual authors.

REFERENCES

1. Seegenschmiedt MH. Radiotherapy of Nonmalignant Disease. In: Halperin E, Perez C and Brady L. *Perez and Brady's Principles and Practice of Radiation Oncology*. 5th ed. Philadelphia: Lippincott, Williams & Wilkins; 2008. pp. 1954-5.
2. Kransdorf M, Murphey M. Synovial Tumors. In: Kransdorf M and Murphey M. *Imaging of Soft Tissue Tumors*, 2nd ed. Philadelphia: Lippincott, Williams & Wilkins; 2006. pp. 384-5.
3. Kransdorf MJ, Berquist TH. Musculoskeletal Neoplasms. In: Berquist, T. *MRI of the Musculoskeletal System* 5th ed. Philadelphia: Lippincott, Williams & Wilkins; 2006. pp. 841-2.
4. Resnick D. Tumors and Tumor-like Lesions of Soft Tissues. In: Resnick D. *Bone & Joint Imaging*, 3rd ed. Philadelphia: Elsevier Inc.; 2005. p. 1236.
5. Website of the American Academy of Orthopedic Surgeons. Topic: Pigmented Villonodular Synovitis. Available from: <http://orthoinfo.aaos.org/topic.cfm?topic=a00506>.
6. Helms C, Kaplan P et al. Arthritis and Cartilage. In: Helms C, Kaplan P, Dussault R, Anderson M, Major N. *Musculoskeletal MRI* 2nd ed. Philadelphia: Elsevier WB Saunders; 2009. pp. 118-9.
7. Stoller DW, Tirman PFJ, Bredella MA. Pigmented Villonodular Synovitis, Knee. In: Stoller DW, Tirman PFJ, Bredella MA. *Diagnostic Imaging: Orthopedics*. Utah: Amirsys; 2004. pp. 5:140-2.
8. McGrath JR. Pigmented Villonodular Synovitis Imaging [Online]. Updated 2017 May. Available from: <http://emedicine.medscape.com/article/394649-overview>.
9. Berger B, Ganswindt U, Bamberg M, Hehr T. External Beam Radiotherapy as Post-Operative Treatment of Diffuse Pigmented Villonodular Synovitis. *Int J Radiation Oncology Biol Phys*. 2007;67(4):1130-4.
10. Horoschak M, Tran PT, Bachireddy P, et al. External Beam Radiation Therapy Enhances Local Control in Pigmented Villonodular Synovitis. *Int J Radiation Oncology Biol Phys*. 2009;75(1):183-7.
11. Heyd R, Micke O, Berger B, Eich HT, Ackermann H & Seegenschmiedt MH (for the German Cooperative Group on Radiotherapy for Benign Diseases (GCG-BD)). Radiation Therapy for Treatment of Pigmented Villonodular Synovitis: Results of a National Patterns of Care Study. *Int J Radiation Oncology Biol Phys*. 2010;78(1):199-204.
12. Winkfield KM, Bazan JG, Gibbs IC et al. Pigmented Villonodular Synovitis. In: Halperin ED, Wazer DE, Perez CA and Brady LW, eds. *Perez & Brady's Principles and Practice of Radiation Oncology*. 6th ed. Philadelphia: Lippincott, Williams & Wilkins; 2013. p. 1750.