CLINICAL VIGNETTE

An Athlete with a Thigh Mass

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Introduction

Sarcomas are uncommon malignant tumors that arise from connective tissue, both skeletal and extraskeletal sources,[1] rarely including peripheral nervous system[2] and heart muscle.[3] Approximately, three quarters of sarcoma arise in soft tissues, and many of the others are found in different parts of the body, as random events. Some have questioned whether these are random, or whether there are common unidentified factors, including genetics, or predictable patterns. Elastofibroma dorsii, a benign sarcoma-like growth is classically found in the infrascapular region of elderly patients.[4]

We present a 47-year-old former professional athlete who developed a soft tissue sarcoma, deep in his left thigh. Some implications for trauma as a cause of sarcomagenesis are presented.

Case Presentation

A 47-year-old Samoan-American male with a past medical history of stage III chronic kidney disease, gout and hypertension noted a "splitting of the ways" of his left anterior thigh when doing quadriceps exercises. This was not present on the right side. He was a former professional football player with extensive muscular development, and noted persistent asymmetry in his thighs, prompting medical evaluation.

Physical exam revealed asymmetry of the upper legs and soft tissue US demonstrated "several oval hypoechoic lymph nodes with fatty hila measuring 2 x 0.5 x1.3cm. … felt to be morphologically normal". As clinical suspicion remained high, non-contrast CT of the thigh revealed "low-density mass within the left thigh that appears to be intermuscular between the vastus intermedius and iliopsoas muscles… measured 8.6 x 11.5cm with focal fat nodule within this mass measuring 1.4 x 1.1cm."

MRI thigh with and without contrast showed "a large, intermuscular, soft tissue mass in the proximal left thigh displacing the rectus femoris, iliopsoas, and vastus medialis and intermedialis muscles… measuring 9.1 x 9.3 x 14.5 cm… with heterogeneous enhancement on post contrast images… highly concerning for sarcoma, such as a myxoid liposarcoma."

Additional evaluation for metastases including CT chest, and abdomen and pelvis were unremarkable. The patient underwent ultrasound-guided biopsy of the mass with pathology consistent with myxiod liposarcoma, FISH positive for DDIT-3 gene rearrangeme. Surgical oncology performed successful removal of the tumor with complete salvage of the leg.

Discussion

Soft tissue sarcomas have a fascinating array of possible etiologies and associations. These include prior radiation therapy, chemotherapy, chemical carcinogens, chronic irritation, lymphedema, and trauma.[5] In addition, an association between viral infection and sarcoma has been shown for HIV and human herpes virus (HHV-8) including Kaposi's Sarcoma,[6] and smooth muscle tumors in immunocompromised patients.[7]

Genetic contributions are also being explored. Long standing examples of genetic causation are Ewing Sarcoma and Peripheral Primitive Neuroectodermal Tumors, which display a reciprocal exchange.[8] Genetic research is increasing understanding. One study of 1182 sarcoma patients, unselected for family history, concluded that approximately half of the patients had known or NOVEL cancer genes.[9] Another study found DNA amplification of chromosome 12q in 90% of patients with dedifferentiated liposarcoma. Genes amplified in well-differentiated and dedifferentiated liposarcomas included MDM2, HMGA2, YEATS4, CDK4, and SAS.[10]

A major development in organizing incomplete genetic factors involves use of DNA microarrays. One study used transcriptional profiling for 5520 different known genes to separate 41 soft tissue sarcomas into five distinct groups[11]:

- Gastrointestinal Stromal Tumors highly expressed a cluster of 125 genes distinct from other sarcomas. This was the best use of microarray analysis.
- Synovial sarcomas
- Neural tumors such as malignant peripheral nerve sheath tumors)
- Half of all leiomyosarcomas
- A remaining group containing all liposarcomas, in which molecular profiles were not predicted by histological features or immunohistochemistry. Our patient's tumor falls in this group.

With increasing understanding of the genetic framework, there is better identification of sarcomas associated with specific triggers. Trauma may be a factor in the development of soft tissue sarcoma, including Desmoid tumors. Occasionally, a

patient may have major trauma many months before a localized tumor appears. Commonly, there is trauma shortly before a mass is noted and some believe the trauma made the patient aware of an existing abnormality. However, there is evidence that injury promotes sarcoma development in animal models,[12] and additional clinical study is needed to determine whether injury could promote sarcogenesis.[13] Former professional football players may be a population for future studies on sarcoma pathogenesis.

Conclusion

Sarcomas are very rare, with only 13,000 new cases a year in the United States.[14] With limited incidence, individual data such as genetic footprint and case reports may contribute to understanding. This patient, who had a long history of tackling and trauma to the tumor site might provide additional information on the role of pre-existing trauma on sarcomagenesis. Another teaching point, is the variation in information obtained from non-invasive imaging.

REFERENCES

1. **Zahm SH, Fraumeni JF Jr**. The epidemiology of soft tissue sarcoma. *Semin Oncol*. 1997 Oct;24(5):504-14. Review. PubMed PMID: 9344316.
2. **Turc-Carel C, Aurias A, Mugneret F, Lizard S, Sidaner I, Volk C, Thiery JP, Olschwang S, Philip I, Berger MP, et al**. Chromosomes in Ewing's sarcoma. I. An evaluation of 85 cases of remarkable consistency of t(11;22)(q24;q12). *Cancer Genet Cytogenet*. 1988 Jun;32(2):229-38. PubMed PMID: 3163261.
3. **Hammer T, Manthripragada G**. Cardiac angiosarcoma. *Proceedings of UCLA Health*. 2017;22.
4. **Hammer T**. An uncommon tumor localized to the back. *Proceedings of UCLA Health*. 2019;23.
5. **Lawrence W Jr, Donegan WL, Natarajan N, Mettlin C, Beart R, Winchester D**. Adult soft tissue sarcomas. A pattern of care survey of the American College of Surgeons. *Ann Surg*. 1987 Apr;205(4):349-59. PubMed PMID: 3566372; PubMed Central PMCID: PMC1492738.
6. **Dittmer DP, Damania B**. Kaposi sarcoma-associated herpesvirus: immunobiology, oncogenesis, and therapy. *J Clin Invest*. 2016 Sep 1;126(9):3165-75. doi: 10.1172/JCI84418. Epub 2016 Sep 1. Review. PubMed PMID: 27584730; PubMed Central PMCID: PMC5004954.
7. **Lee ES, Locker J, Nalesnik M, Reyes J, Jaffe R, Alashari M, Nour B, Tzakis A, Dickman PS**. The association of Epstein-Barr virus with smooth-muscle tumors occurring after organ transplantation. *N Engl J Med*. 1995 Jan 5;332(1):19-25. PubMed PMID: 7990861.
8. **Mertens F, Rydholm A, Bauer HF, Limon J, Nedoszytko B, Szadowska A, Willén H, Heim S, Mitelman F, Mandahl N**. Cytogenetic findings in malignant peripheral nerve sheath tumors. *Int J Cancer*. 1995 Jun 9;61(6):793-8. PubMed PMID: 7790113.
9. **Ballinger ML, Goode DL, Ray-Coquard I, James PA, Mitchell G, Niedermayr E, Puri A, Schiffman JD, Dite GS, Cipponi A, Maki RG, Brohl AS, Myklebost O, Stratford EW, Lorenz S, Ahn SM, Ahn JH, Kim JE, Shanley S, Beshay V, Randall RL, Judson I, Seddon B, Campbell IG, Young MA, Sarin R, Blay JY, O'Donoghue SI, Thomas DM; International Sarcoma Kindred Study**. Monogenic and polygenic determinants of sarcoma risk: an international genetic study. *Lancet Oncol*. 2016 Sep;17(9):1261-71. doi: 10.1016/S1470-2045(16)30147-4. Epub 2016 Aug 4. PubMed PMID: 27498913.
10. **Italiano A, Bianchini L, Keslair F, Bonnafous S, Cardot-Leccia N, Coindre JM, Dumollard JM, Hofman P, Leroux A, Mainguené C, Peyrottes I, Ranchere-Vince D, Terrier P, Tran A, Gual P, Pedeutour F**. HMGA2 is the partner of MDM2 in well-differentiated and dedifferentiated liposarcomas whereas CDK4 belongs to a distinct inconsistent amplicon. *Int J Cancer*. 2008 May 15;122(10):2233-41. doi: 10.1002/ijc.23380. PubMed PMID: 18214854.
11. **Nielsen TO, West RB, Linn SC, Alter O, Knowling MA, O'Connell JX, Zhu S, Fero M, Sherlock G, Pollack JR, Brown PO, Botstein D, van de Rijn M**. Molecular characterisation of soft tissue tumours: a gene expression study. *Lancet*. 2002 Apr 13;359(9314):1301-7. PubMed PMID: 11965276.
12. **Martins-Green M, Boudreau N, Bissell MJ**. Inflammation is responsible for the development of wound-induced tumors in chickens infected with Rous sarcoma virus. *Cancer Res*. 1994 Aug 15;54(16):4334-41. PubMed PMID: 7519120.
13. **Delaney T, Kirsch DG**. Pathogenic factors in soft tissue and bone sarcomas. In: *UpToDate*, Post TW (Ed), *UpToDate*, Waltham, MA, 2020.
14. **Siegel RL, Miller KD, Jemal A**. Cancer statistics, 2020. *CA Cancer J Clin*. 2020 Jan;70(1):7-30. doi: 10.3322/caac.21590. Epub 2020 Jan 8. PubMed PMID: 31912902.