

Case Report
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Peronea Magna Artery Challenging Proximal Fibula Resection of Ewing's Sarcoma, Report of a Case

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ABSTRACT

Surgical resection of the fibula is commonly done for either to obtain structural bone graft or to respect the fibula if involved by bone tumor. The vascular anatomy around the popliteal fossa is complex and has to be studied prior to any attempt of surgical resection. We present a case of 11 years old female patient who was diagnosed as a Ewing's sarcoma of the fibula and her pre-operative CT angiography showed a vascular anomaly of Peronea magna artery. Following adjuvant chemotherapy, the patient was treated by wide local resection and the surgical procedure has to be modified in order to save the dominant peroneal artery the vascularity of the limb.

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Abbreviations

CT: Computerized Tomography

MRI: Magnetic Resonance Image

Introduction

Surgical procedures involving resection of the fibula are frequently performed for reconstruction where a source of vascularized autologous bone grafts is required. These flaps are based on the long pedicle of the peroneal artery [1]. This vessel tends to have a consistent anatomy and does not contribute significantly to the distal circulation [2,3].

In Orthopedic Oncology the proximal fibula is a rare location for both primary bone tumors and metastases. 2% of osteosarcomas and 8% of Ewing's Sarcoma originate from the fibula [4,5]. Surgical resection of malignant proximal fibula sarcomas involves wide local resection that violates the peroneal musculature. Vital structures such as the common peroneal nerve, lateral collateral ligament, the anterior tibial artery, and peroneal artery have to be assessed thoroughly preoperatively and an appropriate surgical plan constructed.

Anatomic variations of the vasculature of the lower leg exist which need to be taken into consideration before resection of the proximal fibular tumors. The Peroneal artery infrequently contributes to the distal pedal circulation. A dominant peroneal artery, known as the Peronea Magna, has been reported in up to 5% of any given leg and 10% of patients overall [3]. Ligating or clamping a Peronea Magna artery during resection of the fibula has been reported to lead to ischemia of the lower limb in such patients [6,7].

The diagnosis of such an aberrant vasculature has been shown in the literature to modify the surgical plan in 75% of cases of free fibular flap resections [8]. In such cases, a thorough history,

physical examination, and bilateral arterial mapping has been shown to be valuable in adequately assessing the vasculature of the lower limb and thereby mitigating the risk of peripheral ischemia. To the best of our knowledge, no previous reports of this vascular aberration exist with regarding to Orthopedic Oncological resections in the proximal fibula.

Case Presentation

We present a case of a 11-year-old girl who was referred to the orthopedic oncology clinic for further evaluation and management of a lesion in the proximal fibula presented with pain and swelling of 5 months duration. The pain was dull and progressive, eventually waking her up from sleep. There was no associated fever or night sweats. She had difficulty ambulating and eventually started to limp. Her examination revealed a localized swelling over the right proximal fibula. The mass was firm and of bony hard consistency. She had normal range of motion of the knee joint. Her popliteal, anterior tibial, and posterior tibial pulses were symmetrically palpable in both sides. Distal motor and sensory functions were also intact. The initial radiographs (Figure 1 A, B) revealed a permeative lesion of her right proximal fibula with a wide zone of transition and periosteal reactions and associated soft tissue mass signifying a malignant process of primary bone tumor.

She was admitted to expeditiously undergo local and systemic staging. MRI (Figure 1 C, D) revealed malignant neoplastic process of the right proximal fibula of approximately 12cm length starting 3cm distal to the proximal fibular physis. The mass was noted to encase the common peroneal nerve and the anterior tibial vasculature. CT guided tissue biopsy (Figure 1 E, F) revealed a diagnosis of Ewing's sarcoma. Following a multidisciplinary meeting she was planned to undergo neoadjuvant chemotherapy followed by repeat local staging.

Due to the location of the lesion and the close proximity to the vasculature of the lower leg, it was decided to perform preoperative CT angiographic evaluation of both lower limbs (Figure 1 A, B). Interestingly we discovered that the patient exhibited the rare Peronea Magna anomaly, whereby her pedal circulation was nearly entirely contributed for by the Peroneal artery. The anterior tibial artery remnant was found to be abutted by the tumor and the posterior tibial artery provided minimal contribution distally. The contralateral tumor-free limb exhibited a similar phenomenon whereby there was a negligible contribution by both the anterior and posterior tibial arteries.

This finding impacted our surgical management as for us to maintain our limb preserving goal and wide local resection, all efforts must be exercised to preserve the dominant peroneal artery and therefore the viability of the lower limb.

Patient underwent neoadjuvant chemotherapy and referred back to our service for local control surgery.

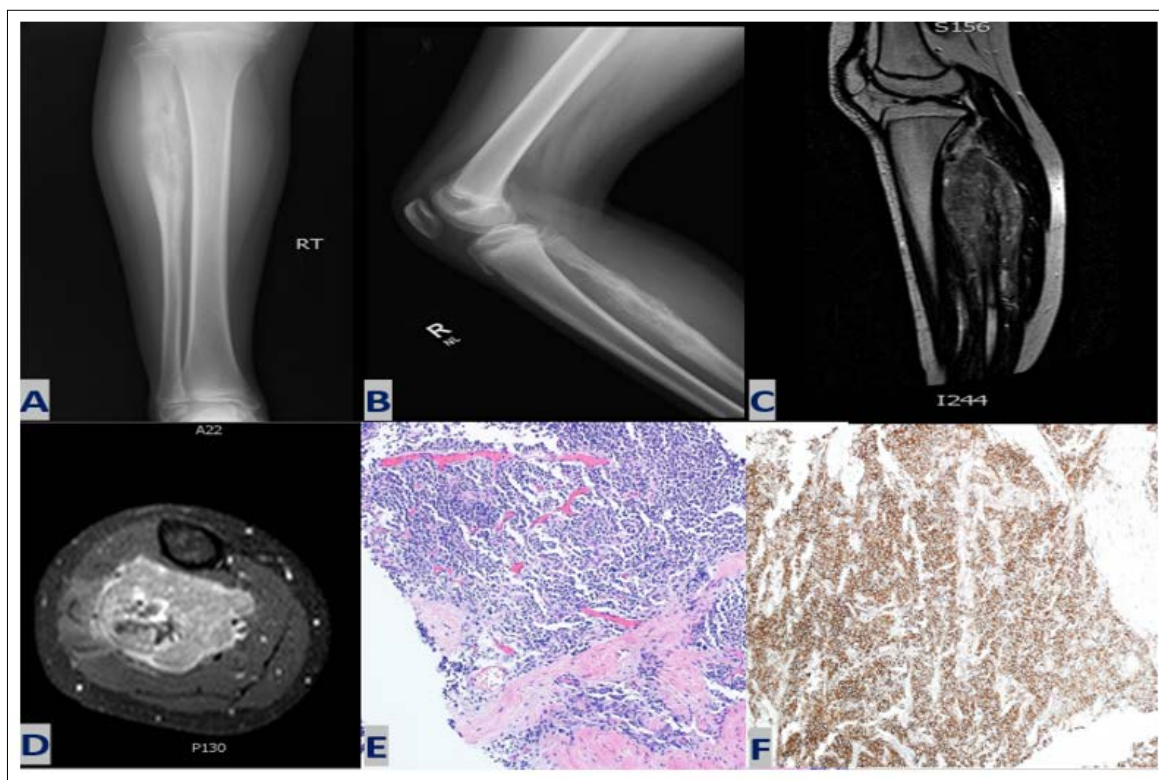


Figure 1: (A, B): Frontal and lateral radiographs of the right tibia showing permeative lytic bone lesion at the proximal fibular diaphysis with wide zone of transition and onion ring lamellated periosteal reaction as well as large extra-osseous soft tissue mass. (C, D) Coronal T2 weighted images (C) and Axial T1 weighted images with contrast (D) of MRI showing a large destructive bone lesion in the proximal fibular metadiaphysis with large extra osseous soft tissue component with heterogeneous bright T2 signal intensity and heterogeneous enhancement post gadolinium injection. (E, F) Tru-Cut biopsy and histological examination shows infiltration of the soft tissue by relatively monotonous round cells showing scanty clear cytoplasm, round nuclei with small nucleoli and scattered mitotic figures. The neoplastic cells are diffusely and strongly positive for CD 99 immunohistochemical stain (F). Diagnosis was confirmed by the cytogenetic test for EWSR1 Gene translocation by FISH.

Surgical Technique

The surgical procedure was planned as wide local resection with negative margin of the proximal fibula containing the tumor and including the common peroneal nerve to obtain negative margin. Patient was placed in supine position with a sandbag under her right buttock. Tourniquet was utilized. The patient underwent Type 2 resection of the proximal fibula as described by Malwer with the utilitarian approach to the fibula employed. The common peroneal nerve identified, tracked cut and ligated proximally. The lateral gastrocnemius head was released off the distal femur and the proximal and distal extent of the tumor marked. The popliteal space was approached laterally and the anterior tibial artery was identified and ligated (Figure 2 C, D). The posterior tibial artery was found very small and with a short course was freed of the posterior aspect of the tumor and preserved all through the surgery. The Peronea magna artery was as well preserved in its origin from the Tibio peroneal trunk and all through during the surgery as well and the pulse was verified by using intraoperative doppler ultrasound. Proximally the fibula was resected 1cm distal to the physis. The tumor was then proceeded to be resected with a surrounding normal cuff of tissue – soleus posteriorly, extensor hallucis longus anteriorly, and peroneal musculature laterally. The remnants of the anterior tibial artery were found to be coursing through the tumor and therefore were ligated. The posterior tibial nerve was preserved during the surgery. The tumor was excised and sent to the histopathology who later confirmed the specimen with negative surgical margins. Immediate post-operative clinical examination showed palpable posterior tibial pulses and capillary refill.



Figure 2: (A, B), CT Angiogram of both lower limbs showing in both sides, the popliteal artery bifurcates into anterior tibial artery and tibioperoneal artery. Then, the posterior tibial artery (blue arrow) is almost absent coming as small branch terminating at upper leg. While the peroneal artery (yellow) is dominant and continues distally to give the supply to all of the foot arteries, starting to branch at ankle level (peroneal artery magna). (C, D) Intraoperative images showing lateral approach to the popliteal fossa, the main popliteal artery was identified (C) and after resection of the tumor (D) the peroneal artery was preserved (yellow arrow) and the posterior tibial artery was found to be very small and with a short course (yellow arrow).

Discussion

The mainstay of surgical management of malignant primary bone tumors is to strive for limb preservation when possible. Concurrently local control should not be compromised by failing to achieve wide local resection [9]. MRI imaging is a necessity to assess the respectability of a tumor. The relationship of the tumor to neurovascular structures is a key component of preoperative imaging evaluation.

With proximal fibula and other primary tumors of the leg, it is advisable to further evaluate the vasculature preoperatively due to the variety of anomalies as initially described by Kim [10]. Screening of these variations by routine clinical history and examination has been found to be unreliable and depending solely on them can lead to ominous surprises intraoperatively [11,12]. Doppler evaluation is also an insensitive tool to evaluate for vascular abnormalities as deficient vessels are often compensated for by the dominant vessels distally [13,14].

Much of the information we have regarding preoperative vascular mapping of the lower extremity prior to resectional surgeries around the fibula came from the reconstructive literature regarding free fibular flaps [3,8]. The same systematic review demonstrates that the majority of surgeons prefer to alter their operative plan when a vascular anomaly such as a Peronea Magna is encountered. When the surgery is being performed for a free fibular graft, surgeon often tend to graft from the contralateral leg if normal, alter their design/method of harvest, or abandon the graft in favor of another alternative [15,16]. Unfortunately, this luxury is not afforded to oncological resections of the proximal fibula where the surgery is of necessity. Meticulous preoperative vascular mapping can empower us with the knowledge necessary to maximize the viability of a limb after such a critical resection.

Preoperative vascular mapping is a technique of assessing the adequacy of perfusion of a lower limb as well as the method by which it is perfused. Variations of the vasculature have been noted in as many as 10% of the population and in those undergoing surgery, the operation was altered in 25-75% of patients [3,8,17,18]. These imaging modalities can provide valuable information regarding the vascular anatomy, fibular blood supply,

and cutaneous perforators. Vascular malformations, arteriovenous fistulas, low/high bifurcations of the tibioperoneal trunk, vascular stenosis, and absence or hypoplasia of the arteries of the lower leg are critical surgically important findings prior to undertaking resection surgeries in the lower leg [15,17,19-21].

The ideal modality of vascular mapping is still controversial [22]. Prior to 2003, catheter arteriography was the mainstay of the preoperative evaluation [8]. Advances in medical technology have since made it possible to image these patients accurately with less invasive and equally efficacious methods such as computed tomographic (CT) angiography [23,24], magnetic resonance angiography, and Color Doppler ultrasound [25-27]. Though these techniques are convenient and becoming increasingly cost effective, the literature currently does not contain enough data from which a reliable conclusion can be pooled.

The senior author of this paper opted to undergo preoperative vascular evaluation of both lower limbs by CT angiography. The findings of the bilateral Peronea Magna anomaly as well as abutment of the right hypoplastic anterior tibial artery by the neoplastic process, allowed us to develop a sound and detailed operative walk through. We believe that without such an approach, we would have had a lower threshold towards sacrificing the peroneal artery and therefore inherently compromising the viability of the limb.

Conclusion

Primary bone tumors of the proximal fibula are rare entities faced in Orthopedic surgery. When encountered, a methodical approach with an emphasis on determining the regional anatomy and its relationship to the tumor should be employed. In the advent of the numerous possible vascular anomalies of the lower extremity and their infrequent incidences, we recommend that such cases undergo routine vascular mapping prior to planning surgical management. To the best of our knowledge this is the first report of the Peronea Magna anomaly being encountered with a malignant proximal fibula lesion.

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