

Intramuscular hematoma of the vastus lateralis following percutaneous skeletal muscle micro-biopsy: a case report

Patrick Jonathan Drouin

Queen's University School of Kinesiology and Health Studies <https://orcid.org/0000-0001-7966-1319>

Hashim Islam

Queen's University School of Kinesiology and Health Studies

Craig Simpson

Queen's University School of Medicine

Brendon Gurd (✉ gurdb@queensu.ca)

Queen's University School of Kinesiology and Health Studies

Case report

Keywords: Intramuscular hematoma, Hemorrhage, Skeletal muscle biopsy, Recovery, Risk mitigation, Case report

Posted Date: May 6th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-469215/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background. Recently, percutaneous micro-biopsy needles have been used as a less invasive alternative to the Bergstrom needle for obtaining human skeletal muscle biopsy. Unlike the Bergstrom muscle biopsy procedure, potential complications associated with micro-biopsies of human skeletal muscle have not been documented. Therefore, the present case report follows a young male's recovery from a muscle biopsy induced hemorrhage/hematoma of the right vastus lateralis with the specific aims of 1) informing future participants, researchers and clinicians on expected time course of recovery and 2) informing methods to minimize future participant adverse event risk during and after the percutaneous micro-biopsy procedure.

Case Presentation. A 23-year-old male had a muscle biopsy completed on the right vastus lateralis. One day following the micro-biopsy procedure, the participant experienced severe sharp, shooting and throbbing pain. Rest, ice, compression and elevation was immediately advised. Five days later, the participant re-experienced severe sharp, shooting and throbbing pain. The participant could not walk and was driven to have an ultrasound completed of the anterolateral aspect of the right thigh. The ultrasound revealed a pulsatile mass in the deeper aspect of the right vastus lateralis, below the site of incision. We interpreted the ultrasonography images to suggest that the participant suffered from a muscle biopsy-induced hemorrhage of an artery in the right vastus lateralis leading to an intramuscular hematoma. Pain remained elevated until day 8 when pulsatile flow ceased. Thereafter, pain slowly began to fade away. 29 days after the micro-biopsy procedure, the participant was able to recommence participation in all athletic activities. A one-year follow-up confirmed no chronic consequences of the acute hemorrhage/hematoma.

Conclusions. The present case report demonstrates that the inadvertent hemorrhaging of a neighboring vessel by percutaneous micro-biopsy procedure can be debilitating. When feasible, to minimize the risk of muscle biopsy-induced hemorrhage/hematoma, we advise ultrasound to identify a biopsy location with minimal risk for arterial bleeding. Post biopsy compression is recommended for up to 15 minutes and post-biopsy follow-up should be completed for up to 72 hours. When there is indication of hematoma development, compression should be applied, and the participant should avoid exercise and physical activity.

Background

Skeletal muscle biopsies are commonly ordered diagnostic procedures (1) and are often undertaken to assess changes in protein content (2, 3), gene expression (4, 5), and enzymatic activities (6, 7) in response to exercise. The procedure is typically performed using the Bergstrom needle biopsy technique (8, 9), which is relatively less invasive compared to the open biopsy method and has a minimal complication rate (0.15% in > 13500 biopsies undertaken over a 21-year period) (10). Specifically, Bergstrom needle biopsies are associated with incidents of arterial bleeding (1 in 13,626), ecchymosis/hematoma (1 in 6,813), local skin infections (1 in 1,946), local numbness (1 in 2,725) and local pain (1 in 2,725) (10). Recently, percutaneous micro-biopsy needles have been used as an

alternative to the Bergstrom needle for obtaining human skeletal muscle biopsy (11). Although the micro-biopsy technique results in the extraction of a smaller piece of muscle tissue than the Bergstrom needle, it does not require a pre-biopsy incision of the skin, involves a lower gauge needle and is perceived as being less invasive and painful than the Bergstrom technique (11, 12).

Unlike the Bergstrom muscle biopsy procedure, potential complications associated with micro-biopsies of human skeletal muscle have not been documented. Further, due to the infrequency of complications associated with Bergstrom needle muscle biopsies (10) there is a deficiency of information regarding the development and progression of complications as well as the lived experiences of affected individuals. Therefore, the present case report follows a young male's recovery from a percutaneous muscle biopsy-induced hemorrhage/hematoma of the right vastus lateralis with the specific aims of 1) informing future participants, researchers and clinicians on expected time course of recovery and 2) informing methods to minimize future participant adverse event risk during and after the micro-biopsy procedure.

Methods

Participant characteristics

The current case study involved a 23-year-old healthy and active Caucasian male (height: 187 cm; weight: 75.4 kg) male undertaking ~ 3 hours of moderate-to-vigorous physical activity (i.e., running, cycling) per week. The participant was a non-smoker, was not taking any medications, and was free of cardiometabolic disease.

Hematoma Imaging

A linear echo ultrasound probe operating at 13-MHz in 2D mode (Vivid-I GE Medical Systems, London Ontario, Canada) was used to record transverse and sagittal ultrasound images of the affected site.

Muscle biopsy procedure

A single muscle biopsy was obtained from the lateral portion of the vastus lateralis (right leg) while the participant lay in a supine position via the percutaneous micro biopsy technique (11) using a 14-gauge Medax Biofeather micro-biopsy disposable needle (San Possidonio, MO, Italy). The skin was punctured under local anesthesia (2% xylocaine with epinephrine) using a 12-gauge cannula inserted 4 cm deep into the muscle to guide the biopsy needle to a final depth of 8 cm. Three cuts (~ 10–20 mg each) were made with a ~ 90° rotation applied to the needle between each cut over a ~ 30 second period. Each piece of muscle was removed from the needle using a sterile disposable surgical blade before a subsequent cut was made.

Prior to the biopsy on the experimental day the participant had the biopsy procedure and potential risks re-explained to them in detail. Following the biopsy, the participant was informed that they were ok to perform exercise following the procedure, but they should limit their activity based on discomfort and their ability to tolerate movement. Following the biopsy, the participant was released from the lab and resumed their normal activities of daily living.

Pain Measurement

Pain was characterized using the Short-Form McGill Pain Questionnaire (SF-MPQ) completed five, six, seven, eight, twelve, thirteen, and nineteen days following the muscle biopsy (13). The SF-MPQ included 11 descriptors representing sensory dimensions (throbbing, shooting, stabbing, sharp, cramping, gnawing, hot/burning, aching, heavy, tender, splitting) and 4 descriptors representing affective dimensions (tiring/exhausting, sickening, fearful, punishing/cruel) of the pain experience. The intensity of each descriptor was ranked on a scale of 0 (none), 1 (mild), 2 (moderate), 3 (severe). Overall pain intensity was quantified using the Present Pain Inventory (PPI) and a Visual Analog Scale (VAS), included in the SF-MPQ.

Case Presentation

Unconfirmed Pulsatile Period

Day 0. The muscle biopsy was performed on the participants right leg at 08:30 on Day 0. Immediately following the muscle biopsy, the participant experienced stiffness and was favouring his right leg. In the afternoon, the participant played volleyball for 1.5-hrs and experienced difficulty jumping as well as moderate pain (self-reported recall) when flexing his right leg.

Day 1. The following day leg pain did not improve and the participant demonstrated an antalgic gait pattern, favoring his right leg. At 20:00 of the same evening, after having been seated for approximately 2hrs, the participant stood up and experienced immediate severe sharp, shooting and throbbing pain (self-reported recall). Visual inspection of the limb at this time revealed slight bleeding, swelling and warmth in the area surrounding the biopsy site. The participant contacted the primary investigator and was prescribed rest, ice, compression and elevation. That same evening the participant took 800mg of ibuprofen before bed but continued to experience moderate to severe sharp pain in the leg making it difficult for the participant to sleep.

Day 2–4. Pain in the participant's right leg was reduced to moderate (self-reported recall) and the participant was now able to flex his leg to slightly past 90° without external assistance. The participant maintained an antalgic gait pattern and reported moderate shooting pain throughout the entire length of his right leg upon transition from sitting to standing. Over the course of the next couple of days leg pain remained moderate and an antalgic gait pattern persisted. On day 4 the participant assisted with moving furniture for ~ 4-hrs. Severity of pain remained moderate throughout day 4, and in the evening tightness of the leg had increased.

Confirmed Pulsatile Period

Day 5. On day 5 the participant reported a recurrence of the severe sharp, shooting and throbbing pain experienced on day 1. The participant could not walk or bend his leg without severe pain. The participant was driven to the School of Kinesiology and Health Studies where an ultrasound of the anterolateral aspect of the right thigh was completed. Although a pulsatile image was not saved, the ultrasound

revealed a pulsatile mass in the deeper aspect of the right vastus lateralis, below the site of incision (Fig. 1 and Fig. 2, panel A). The participant rested, began compression, iced his leg and took 800mg of ibuprofen. The participant was not instructed to abstain from strenuous exercise, though the participant reported that he was unable to complete even low-moderate exercise.

Day 6–8. On day 6, ultrasonography completed at 10am confirmed pulsatile flow of the heterogeneous mass in the right vastus lateralis (Fig. 1 and Fig. 2, panel B). The same day, the participant was referred to athletic therapy. The athletic therapist completed a thorough assessment but was unable to manipulate the site of interest due to severe tenderness. Passive stretching exercises were completed with assistance of the athletic therapist. The athletic therapist recommended passive stretching, compression and ice. By day 8, pulsatile flow was no longer present, and the heterogeneous mass appeared to have become stagnant (Fig. 1 and Fig. 2, panel C). Along with the absence of pulsatile flow, reported pain also decreased (Fig. 3). Despite the reduced pain, the participant maintained an antalgic gait pattern and was unable to participate in any physical activity more intense than walking.

Non-Pulsatile Period

Day 12–19. On day 12 and 13 pain was further reduced (Fig. 3 and Table 1), however, the site of incision remained tender, achy and the participant reported throbbing pain. The participant's antalgic gait pattern was now reduced, though still present, and he was still unable to participate in athletic activities. The following week, on day 19, pain had not changed (Fig. 3, Table 1), however, the participant attempted to participate in beach volleyball. The participant reported increased pain while attempting to run, however, it was not severe enough to force the participant to discontinue exercise.

Table 1

Type and severity of pain experienced over the course of recovery from muscle biopsy-induced artery hemorrhage.

		Day post-biopsy						
		Pulsatile Period				Non-Pulsatile Period		
Descriptor		Day 5	Day 6	Day 7	Day 8	Day 12	Day 13	Day 19
	Throbbing	3	2	2	2	1		1
	Shooting	3	1	1	1			
	Stabbing	3						
	Sharp	3	1	1	2			
	Cramping	2			1			
	Gnawing				1			
	Hot-Burning			1				
	Aching	3	2	2	2	1	1	1
	Tender	3	2	3	2	1	1	1

Ratings: 0 (empty cell) = none, 1 = mild, 2 = moderate, 3 = severe.

Day 28–29. On day 28, the participant had a referral to a clinical ultrasound at 08:30 and met with the orthopaedic surgeon on day 29. The radiologist, reported a heterogeneous mass within the deeper aspect of the right vastus lateralis measuring 3.1 x 4.3 x 1 cm. This same ultrasound demonstrated a vessel extending around the periphery of the heterogenous mass (Fig. 4). The orthopaedic surgeon saw no threat to the heterogenous mass and recommended no action. At this time, the participant reported no pain. The participant had recommenced participation in all athletic activities.

Case Interpretation

Analysis of the participants self-reporting and ultrasonography images suggests that the participant suffered from a muscle biopsy induced hemorrhage of an artery in the right vastus lateralis. This interpretation is supported by the pulsatile arterial flow evident in the heterogenous mass until day 8 (Fig. 2 and Fig. 3, panel B). Following day 8 the hemorrhage had likely closed thereby inhibiting further arterial inflow. Consequently, outflow was also inhibited thereby trapping blood intramuscularly leading to an intramuscular hematoma which persisted for another 20 + days.

Discussion

Muscle biopsy adverse advents are infrequent and unpredictable (10). While utmost care is taken to avoid major vessels and nerves of the lower limb, it is difficult to avoid smaller vessels or nerves. In the event a smaller vessel or nerve is hit, there are negative consequences for the participant. Unfortunately, to date,

there is limited information about 1) the recovery period following muscle biopsy adverse events and 2) possible methods to minimize risk of percutaneous muscle biopsy adverse events. To help shed some light on one of the possible muscle biopsy adverse events, we have followed the time course of recovery for an individual living with a percutaneous muscle biopsy induced hemorrhage/hematoma.

Pain. The discomfort associated with the muscle biopsy induced hemorrhage/hematoma appears to have been most severe for the participant while the heterogeneous mass was pulsatile (Table 1). During the pulsatile period (Day 0–8), pain was described most as throbbing, aching and tender with periods of sharp and shooting pain (see Table 1). Following the pulsatile period (non-pulsatile period = Day 9+) pain dropped dramatically (Fig. 3) and was described primarily as throbbing, aching and tender. Sharp and shooting pain was absent during the non-pulsatile period (Table 1).

Physical activity. During the pulsatile phase, any physical activity requiring the lower limb was severely limited. The participant was limited to walking on flat surfaces. Despite the reduced pain during the non-pulsatile period, physical activity remained challenging for 20 days post-cessation of the pulsatile flow. It is likely that the hematoma led to increased intramuscular pressure, making leg flexion more difficult and uncomfortable.

No chronic consequences. 28 days after the muscle biopsy induced hemorrhage/hematoma the participant was back to his normal routine. A one year follow up was conducted where the participant reported no noticeable limitations and the hematoma was no longer noticeable via ultrasonography. Therefore, there appears to be no chronic consequences to a muscle biopsy-induced hemorrhage/hematoma.

Muscle biopsy adverse event risk mitigation. Although the prevalence of the muscle biopsy-induced hemorrhage/hematoma is low (10), it can be debilitating and therefore adverse event risk mitigation is warranted. To help mitigate biopsy-mediated adverse events, ultrasound guided biopsy needle insertion is commonly used (14, 15). With direct visualization of the target muscle during the biopsy procedure, the risk of adverse events should be minimized (14, 15). We therefore advise that, when feasible, ultrasound should be used to identify areas of muscle with minimal risk for arterial bleeding. Unfortunately for many, the ultrasound guided technique may not be feasible. When ultrasound guidance is not feasible (and even when it is), we recommend that compression of the biopsy site be completed for up to 15 minutes (16) immediately post biopsy needle removal – minimizing bleeding and hematoma development. Participants should be closely monitored for up to 72 hours, paying close attention for swelling, increased pain, extension of tenderness from the biopsy site and prolonged restricted range of motion (17). These symptoms would indicate the development of a hematoma, and therefore exercise and physical activity should be discouraged until the participant can move their limb while respecting their pain (17). Additionally, while the mass is pulsatile, compression should be applied immediately to minimize the size of the developed hematoma (16).

Conclusion And Key Clinical Messages

Although the micro-biopsy technique makes smaller cuts in the muscle compared to the Bergstrom technique, there remains a risk of unintentional damage to neighboring vessels or nerves. The present case report demonstrates that the inadvertent hemorrhaging of a neighboring vessel can be debilitating. The recovery of the hemorrhaged vessel can be rapid, though the recovery from the remaining intramuscular hematoma can take much longer. Although chronic consequences do not appear to be evident, the acute consequences were severe for this individual and therefore risk minimization for future participants is warranted. When feasible, to minimize the risk of muscle biopsy-induced hemorrhage/hematoma, we advise ultrasound to identify a biopsy location with minimal risk for arterial bleeding. When ultrasound guided biopsy needle insertion is not feasible, post biopsy compression is recommended for up to 15 minutes and careful post-biopsy follow-up should be completed for up to 72 hours – paying close attention for swelling, increased pain, extension of tenderness from the biopsy site and prolonged restricted range of motion (17). When any of these symptoms are evident, the participant should avoid exercise and physical activity and compression should be applied while the mass is pulsatile – minimizing the size of the developed hematoma.

List Of Abbreviations

PPI – Present Pain Inventory

SF-MPQ – Short-Form McGill Pain Questionnaire

VAS – Visual Analog Scale

Declarations

Ethics approval and consent to participate. Experimental procedures for both the original study the participant enrolled in and the current report were approved by the Health Sciences Human Research Ethics Board at Queen’s University in accordance with the Declaration of Helsinki. The participant was provided with verbal and written explanation of experimental procedures and associated risks prior to giving written informed consent.

Consent for publication. Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and materials. The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests. No competing interests, financial or otherwise, are declared by the authors.

Funding. This project was supported by a discovery grant by the Natural Sciences and Engineering Research Council of Canada (NSERC) awarded to B.G (grant number: 402 635). P.J.D was funded by an

NSERC Alexander Graham Bell CGS Doctoral Scholarship. H.I was funded by an NSERC PGS-D

Authors' contributions. *P.J.D, H.I, C.A.S, B.J.G*, Conceived and designed research, *P.J.D* completed patient interview, *P.J.D, H.I* collected self-reported pain questionnaires, *P.J.D, H.I, C.A.S, B.J.G* interpreted the case *P.J.D* synthesized all data, *P.J.D* prepared figures drafted manuscript, *P.J.D, H.I, C.A.S, B.J.G* edited and revised manuscript, *P.J.D, H.I, C.S, B.J.G* approved final version of manuscript.

Acknowledgements. Not applicable.

References

1. Joyce NC, Oskarsson B, Jin LW. Muscle biopsy evaluation in neuromuscular disorders. *Phys Med Rehabil Clin N Am.* 2012;23(3):609-31.
2. Egan B, O'Connor PL, Zierath JR, O'Gorman DJ. Time course analysis reveals gene-specific transcript and protein kinetics of adaptation to short-term aerobic exercise training in human skeletal muscle. *PLoS One.* 2013;8(9):e74098.
3. Little JP, Safdar A, Wilkin GP, Tarnopolsky MA, Gibala MJ. A practical model of low-volume high-intensity interval training induces mitochondrial biogenesis in human skeletal muscle: potential mechanisms. *J Physiol.* 2010;588(Pt 6):1011-22.
4. Mahoney DJ, Parise G, Melov S, Safdar A, Tarnopolsky MA. Analysis of global mRNA expression in human skeletal muscle during recovery from endurance exercise. *FASEB J.* 2005;19(11):1498-500.
5. Islam H, Edgett BA, Bonafiglia JT, Shulman T, Ma A, Quadrilatero J, et al. Repeatability of exercise-induced changes in mRNA expression and technical considerations for qPCR analysis in human skeletal muscle. *Exp Physiol.* 2019;104(3):407-20.
6. MacDougall JD, Hicks AL, MacDonald JR, McKelvie RS, Green HJ, Smith KM. Muscle performance and enzymatic adaptations to sprint interval training. *J Appl Physiol (1985).* 1998;84(6):2138-42.
7. Carter SL, Rennie CD, Hamilton SJ, Tarnopolsky MA. Changes in skeletal muscle in males and females following endurance training. *Canadian Journal of Physiology and Pharmacology.* 2001;79(5):386-92.
8. Ekblom B. The muscle biopsy technique. Historical and methodological considerations. *Scand J Med Sci Sports.* 2017;27(5):458-61.
9. Shanely RA, Zwetsloot KA, Triplett NT, Meaney MP, Farris GE, Nieman DC. Human skeletal muscle biopsy procedures using the modified Bergstrom technique. *J Vis Exp.* 2014(91):51812.
10. Tarnopolsky MA, Pearce E, Smith K, Lach B. Suction-modified Bergström muscle biopsy technique: Experience with 13,500 procedures. *Muscle Nerve.* 2011;43(5):717-25.
11. Hughes MC, Ramos SV, Turnbull PC, Nejatbakhsh A, Baechler BL, Tahmasebi H, et al. Mitochondrial Bioenergetics and Fiber Type Assessments in Microbiopsy vs. Bergstrom Percutaneous Sampling of Human Skeletal Muscle. *Front Physiol.* 2015;6:360.

12. Bonafiglia JT, Islam H, Preobrazenski N, Drouin P, Ma A, Gerhart A, et al. A comparison of pain responses, hemodynamic reactivity and fibre type composition between Bergström and microbiopsy skeletal muscle biopsies. *Current Research in Physiology*. 2020;3:1-10.
13. Melzack R. The short-form McGill Pain Questionnaire. *Pain*. 1987;30(2):191-7.
14. Lindequist S, Larsen C, Schrøder HD. Ultrasound guided needle biopsy of skeletal muscle in neuromuscular disease. *Acta Radiologica*. 1990;31(4):411-3.
15. Raithatha A, Ashraghi MR, Lord C, Limback-Stanic C, Viegas S, Amiras D. Ultrasound-guided muscle biopsy: a practical alternative for investigation of myopathy. *Skeletal Radiol*. 2020;49(11):1855-9.
16. Thore V, Berder V, Houplon P, Preiss JP, Selton-Suty C, Juilliere Y. Role of manual compression time and bed rest duration on the occurrence of femoral bleeding complications after sheath retrieval following 4Fr left-sided cardiac catheterization. *J Interv Cardiol*. 2001;14(1):7-10.
17. Smith TO, Hunt NJ, Wood SJ. The physiotherapy management of muscle haematomas. *Phys Ther Sport*. 2006;7(4):201-9.

Table

Table 1. Type and severity of pain experienced over the course of recovery from muscle biopsy-induced artery hemorrhage.

		Day post-biopsy						
		Pulsatile Period				Non-Pulsatile Period		
		Day 5	Day 6	Day 7	Day 8	Day 12	Day 13	Day 19
Descriptor	Throbbing	3	2	2	2	1		1
	Shooting	3	1	1	1			
	Stabbing	3						
	Sharp	3	1	1	2			
	Cramping	2			1			
	Gnawing				1			
	Hot-Burning			1				
	Aching	3	2	2	2	1	1	1
	Tender	3	2	3	2	1	1	1

Ratings: 0 (empty cell) = none, 1 = mild, 2 = moderate, 3 = severe.

Figures

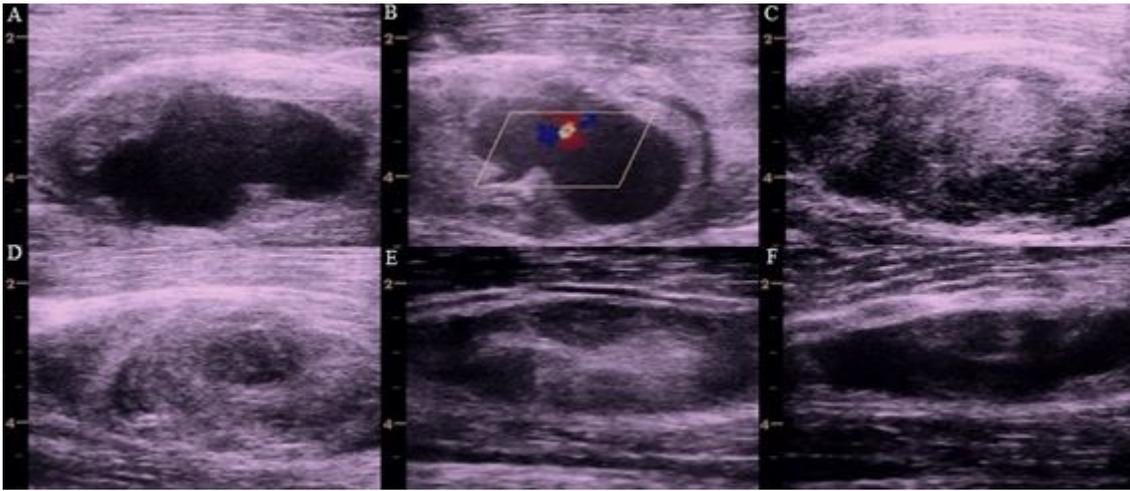


Figure 1

Transverse ultrasound images of right vastus lateralis showing the intramuscular hematoma five (A), six (B), eight (C), nine (D), twelve (E), and nineteen (F) days after percutaneous micro-biopsy. Y-scale is measured in cm.

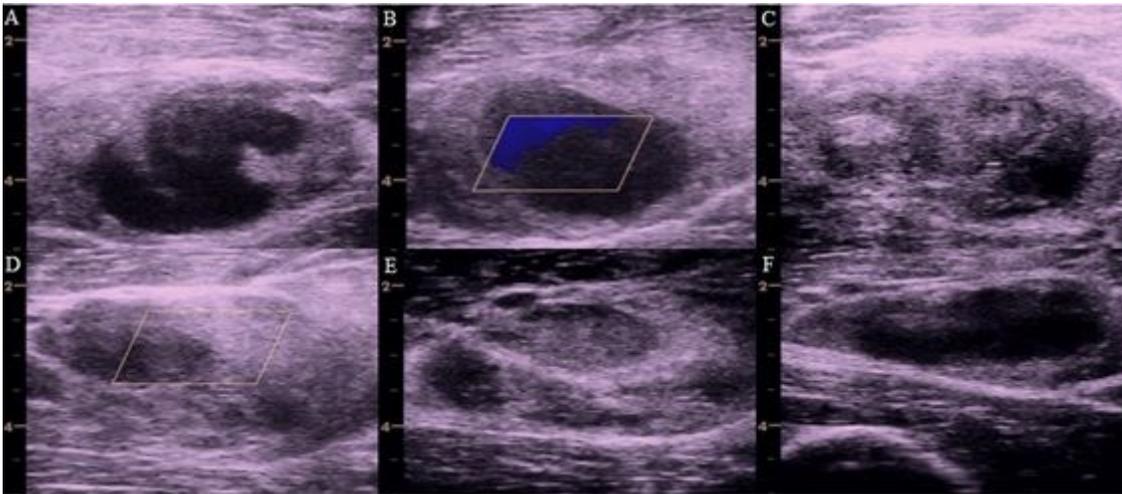


Figure 2

Sagittal ultrasound images of right vastus lateralis showing the intramuscular hematoma five (A), six (B), eight (C), nine (D), twelve (E), and nineteen (F) days after percutaneous micro-biopsy. Y-scale is measured in cm.

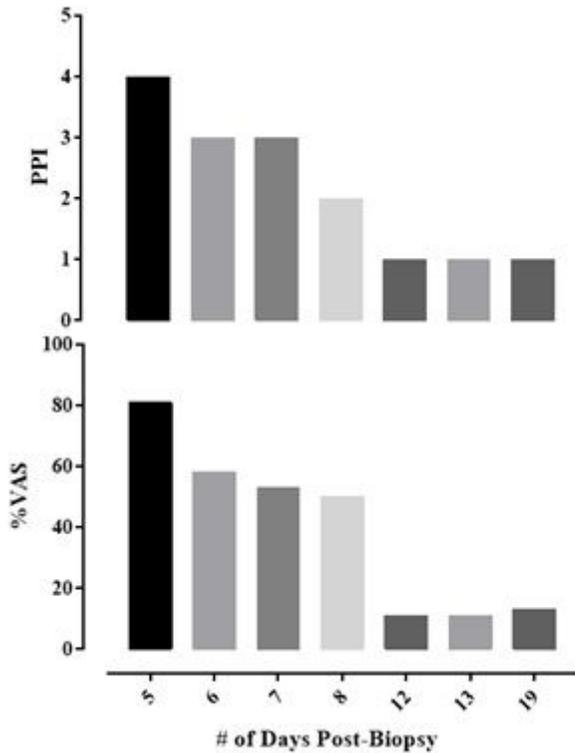


Figure 3

Present pain inventory (PPI; panel A) and intensity of pain (panel B) assessed using a visual analog scale (VAS) as part of the short-form McGill Pain Questionnaire. 0% = no pain, 100% = worst possible pain.

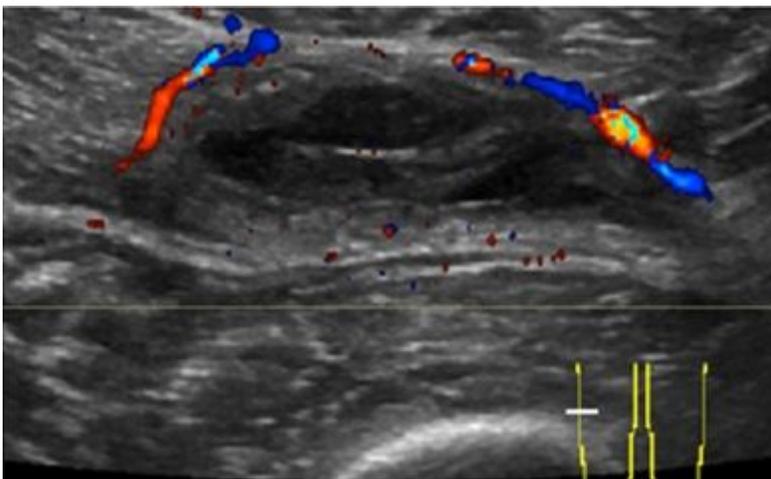


Figure 4

Transverse ultrasound image of the right vastus lateralis showing a vessel extending around the periphery of the intramuscular hematoma.