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Case Report

Rupture of the brachioradialis muscle following blunt trauma. A case report☆

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ABSTRACT

A 50-year old healthy male lost control over the pull string of a milling machine, which strangulated his right elbow and forearm with high velocity. Magnetic resonance imaging of the right upper extremity revealed a substantial tear in the muscle belly of the musculus brachioradialis with multiple small defects in the surrounding musculature of the forearm. The affected arm was immobilized for 1 week with an above the elbow cast. In the following months, guided training and strengthening exercises were performed. The patient could return to his physically demanding work after 10 months and regained full function of his hand and wrist after 18 months. This case report demonstrates that short immobilization followed by extensive and guided strength training has been observed to result in persisting weakness of elbow flexion but good functional outcome for the wrist and hand.

Introduction

Acute traumatic injuries to muscles or tendons in the elbow mostly result from sudden eccentric physical stress or repetitive activity. In case of such injuries, the distal part of the musculus biceps brachii is most commonly affected [1], whereas multiple cases of ruptures in the brachialis muscle are described as well [2]. However, documentation on ruptures of the brachioradialis muscle or tendon is limited to only two case reports [3,4]. These previously reported injuries resulted from excessive physical loading and appeared not to be specific to age or certain physical activities. Yet, acute muscle ruptures following blunt trauma are not described in current literature. For this reason, this case report presents the story of a patient who suffered from an acute traumatic rupture of the brachioradialis muscle after blunt trauma.

Clinical case

A 50-year old, right-handed healthy male gardener was referred to the emergency department after he had been working in the

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Fig. 1. The patient's right elbow after the strangulation.

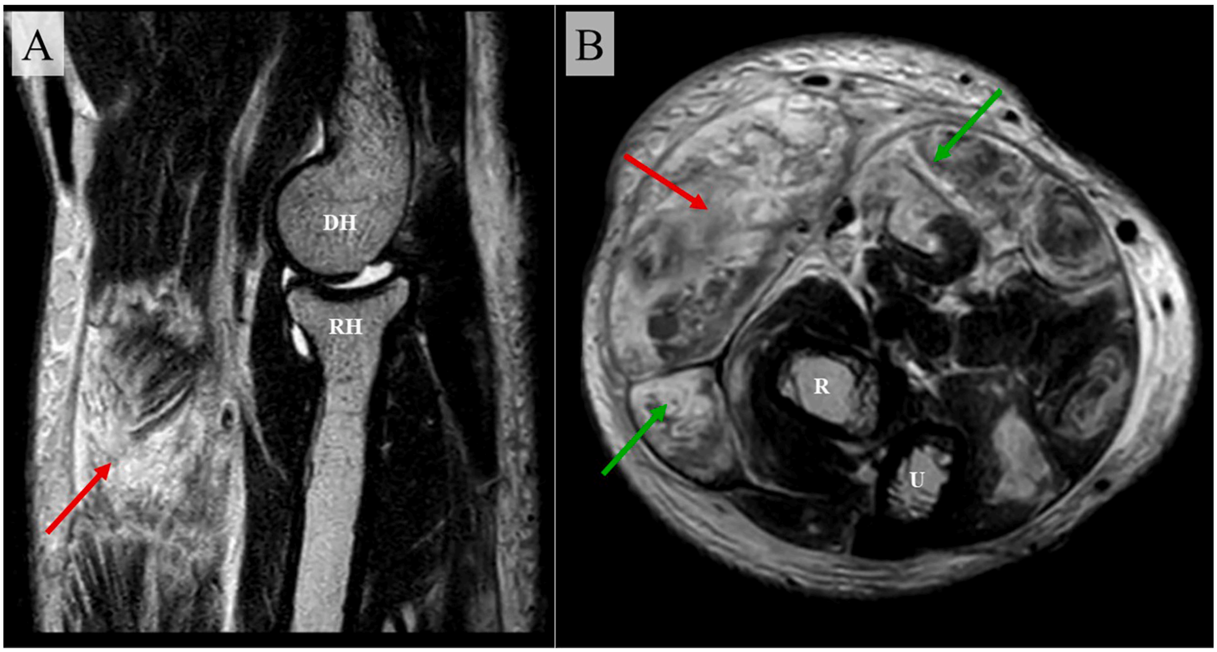

Fig. 2. T2-weighed magnetic resonance imaging scan of the right upper extremity showing a substantial tear in the muscle belly of the musculus brachioradialis, surrounded by a hematoma. A: sagittal view of the right elbow with the red arrow denoting the tear in the brachioradialis muscle. B: axial view of the forearm with the red arrow denoting the ruptured brachioradialis muscle and the green arrows indicating the small defects in the surrounding musculature of the forearm. DH: distal humerus, R: radius, RH: radial head, U: ulna.

garden and lost control over the pull string of a milling machine. The string subsequently strangulated his right elbow and forearm with high velocity. He presented with pain and swelling around the proximal part of his right forearm with an impairment of flexion in the right elbow.

Physical examination was limited due to pain, but showed localized tenderness and abrasions with mild swelling around the elbow and proximal part of the right forearm (Fig. 1). No neurological deficits in the distal part of the arm were witnessed. Radiographic

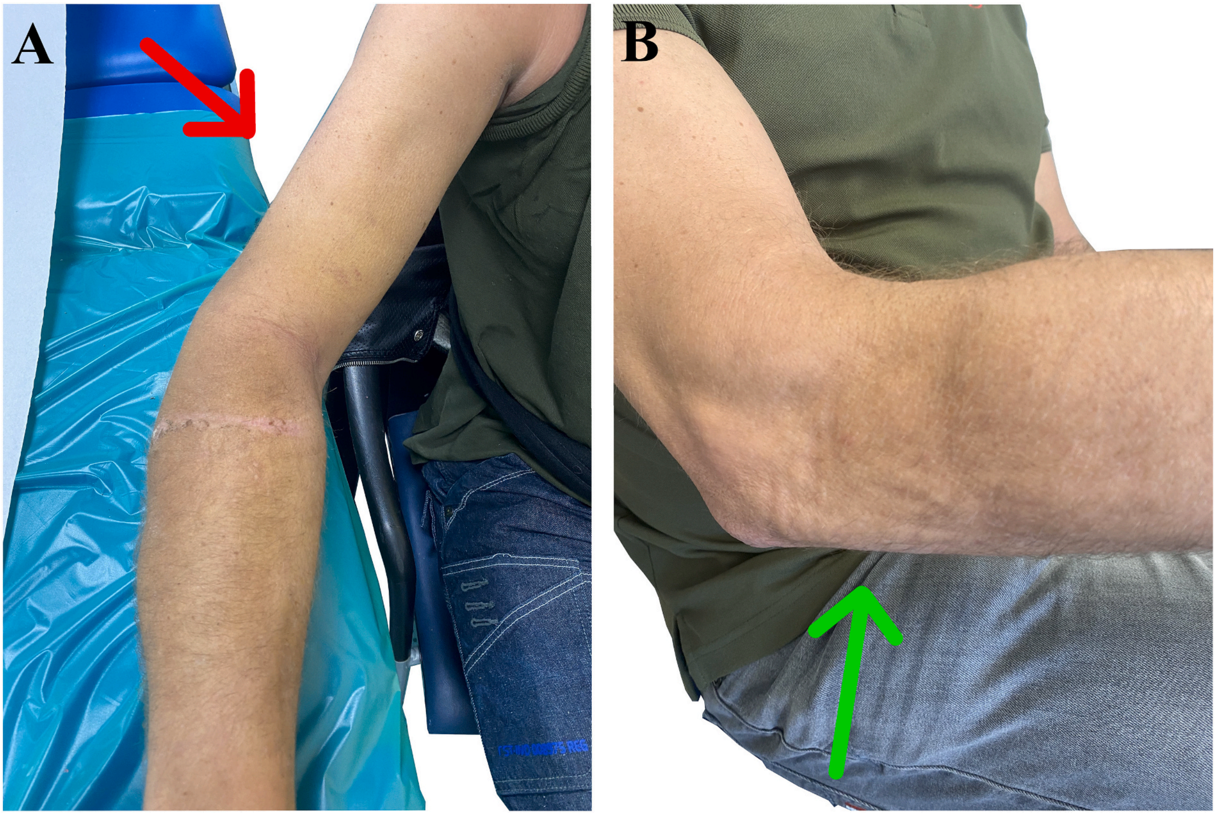

Fig. 3. The patient's right arm four weeks after the strangulation. A: Atrophy of the biceps brachii muscle of the upper arm, denoted by the red arrow. B: The indention at the brachioradialis muscle, indicated by the green arrow.

imaging did not reveal any fractures, dislocation or elbow joint effusion. The patient received compression bandages. The next day telephone consult did not reveal any signs of acute compartment syndrome.

One week after the trauma the patient's arm was reevaluated by a trauma surgeon. The previously described functional impairments had deteriorated as active flexion in the elbow and pronation or supination of the forearm were clearly hampered. However, the Hook test was negative. Magnetic resonance imaging (MRI) of the right upper extremity revealed a substantial tear in the muscle belly of the musculus brachioradialis, surrounded by a hematoma (Fig. 2). In addition, multiple small defects in the surrounding musculature of the forearm were seen. The distal biceps brachii or musculus brachialis did not show to have abnormalities of defects.

The patient's affected arm was immobilized for 1 week with an above the elbow cast in a neutral pronosupination position of the forearm. The cast was then removed after consultation of a upper extremity surgeon, allowing for permissive weight bearing and gentile mobilization of the elbow and wrist. After almost three weeks of guided training, function of the elbow seemed to return, though weakness of the muscles in the elbow and forearm persisted and the musculus biceps brachii appeared atrophic (Fig. 3).

In order to further evaluate the cause of the muscle atrophy of the biceps brachii, a new MRI was performed one month after strangulation. The previously reported rupture of the brachioradialis and small defects in surrounding muscles of the forearm were reconfirmed, without damage to the biceps muscle or tendon. A consultant neurologist excluded potential neuropraxia or nerve damage to the brachioradialis. It was concluded that damage to the radial nerve was unlikely given the absence of sensory deficits on the posterior side of the forearm and normal functioning of the triceps, wrist extensors and finger extensors. The patient did indicate to experience some minor sensory deficit on the lateral side of the forearm, explained by the direct impact of the strangulation on some terminal branches of the lateral antebrachial cutaneous nerve.

The consecutive months were used for unrestricted strengthening exercises, after which muscle strength and elbow function improved. The patient could return to his physically demanding work after 10 months, though heavy weight lifting still had to be avoided. After 12 months he regained full function of his hand and wrist and could perform without pain. The strength of the elbow and the atrophy of the biceps improved at this point (Fig. 4), but did not yet fully return to the level prior to this injury. Also, the patient still reported to have some minor sensory deficits of the skin on the lateral side of the forearm. For this reason, a hand therapist was consulted for progressive resistance training and stretching exercises. This improved the grip strength of the right hand in both supination (before 30 kg, after 35 kg) and pronation (before 24 kg, after 36 kg). In neutral position the grip strength remained comparable (before 36 kg, after 37 kg). These results, however, were still lower compared to the unaffected, contralateral side (left; supination 46 kg, neutral 53 kg, pronation 58 kg).

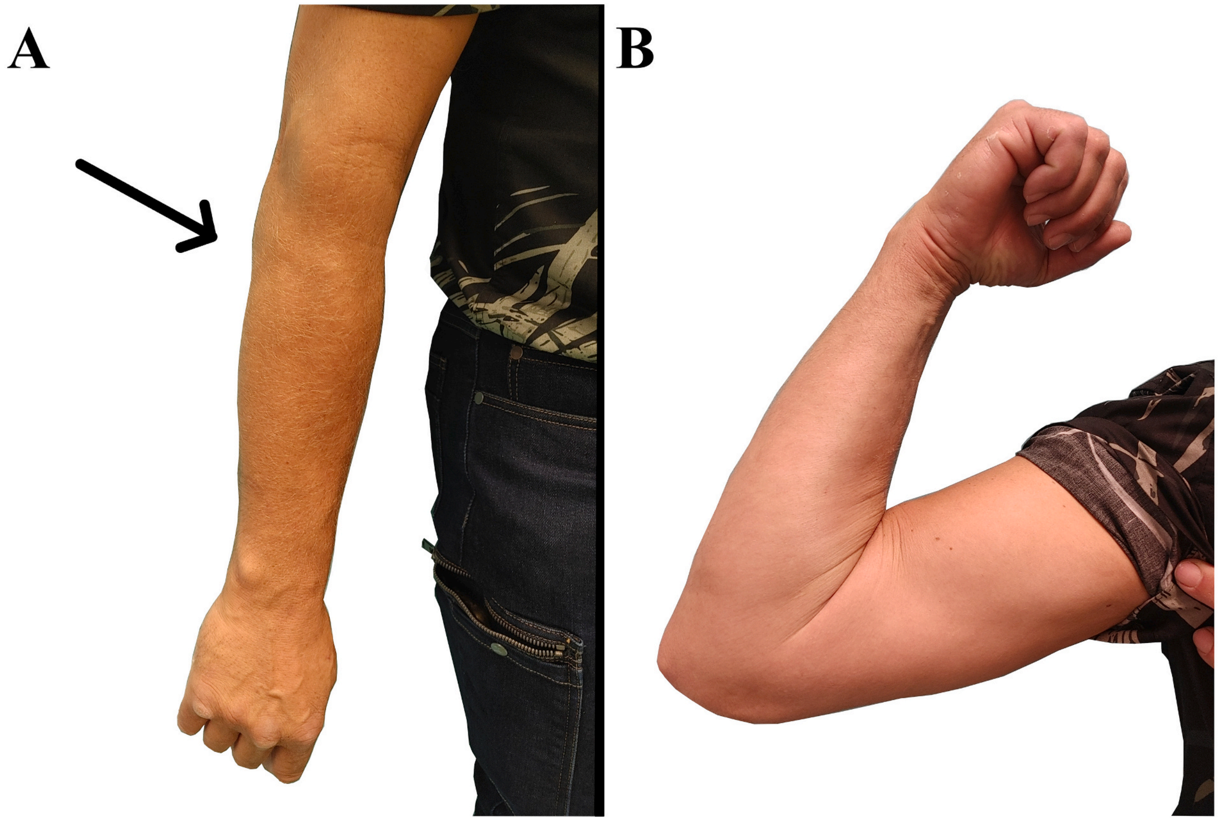

Fig. 4. The patient's right arm twelve months after the strangulation. A: The indention at the brachioradialis muscle is still visible, distal from the elbow (black arrow). B: The contours of the biceps brachii muscle are restored.

Discussion

The brachioradialis muscle, originating from the lateral ridge of the distal humerus and inserting on the radial styloid process, is located in the mobile wad compartment of the forearm and innervated by a branch of the radialis nerve [5]. Together with the biceps brachii and brachialis muscle, the brachioradialis muscle is considered one of the main elbow flexors, when the forearm is positioned in a neutral position. With the forearm in pronation or supination, the brachioradialis muscle also appears to have a role as supinator or pronator, respectively [6,7]. Yet, this role is not considered essential, as previous studies revealed that a surgical release of this muscle during internal fixation of distal radial fractures did not adversely affect elbow flexion strength or wrist function [8].

These findings, however, contradict the functional impairments encountered in the presented case, as our patient experienced significant weakness in elbow flexion after the traumatic rupture of the brachioradialis. This difference is possibly explained by the specific localization of the muscle defect; with a surgical release the distal tendon of the brachioradialis is detached from its insertion, whereas the presented traumatic rupture was located in the muscle belly.

Another reason potentially explaining the reported elbow weakness could be the development of atrophy of the bicep brachii muscle. As damage to the brachioradialis nerve and a rupture of the distal inserting tendon of the biceps were ruled out earlier in the diagnostic work-up, this atrophy was thought to develop secondary to the muscle tear in the brachioradialis and the surrounding musculature. The patient clearly reported pain upon flexion of the elbow, which discouraged movement in the first weeks after immobilization. The inactivity of musculature in the upper arm might have resulted in the witnessed atrophy of the biceps muscle. Therefore, the subsequent loss of strength of the bicep brachii muscle can be responsible for the reported weakness of the elbow, rather than the actual traumatic tear of the muscle belly of the brachioradialis itself.

During the reevaluation of the injured the arm in the first weeks following the strangulation, both conservative and surgical treatment of the muscle tear was considered. Previously reported treatments of ruptures after blunt trauma in the brachioradialis either comprised a four weeks splint immobilization for a partial rupture [3] or a surgical repair followed by short immobilization for a complete rupture [4]. However, in both cases the traumatic rupture was located in the muscle tendon, whereas the current patient suffered from a defect in the muscle belly. The overall better blood supply of the muscle belly compared to tendons together with the negative effect of long-term immobilization on muscle strength motivated the authors to continue with conservative treatment and limit immobilization for this specific case. The anatomic localization of the traumatic injury therefore seems to legitimize the type and duration of treatment.

The one-year follow up revealed that this patient did not fully recover and still experienced limitations due to loss of strength of the biceps brachii muscle. The cases presented in previous literature reported not to have any symptoms at 9 months follow up [3,4]. Again, this difference might be explained by the localization of the muscle rupture (muscle belly versus tendon) and perhaps also the mechanism of injury (excessive physical loading versus blunt trauma). Reports comparable to the current case are to the best of our knowledge not available and thereby impede a prediction of long-term outcome for this case. However, continued strength training is still expected to improve the functioning of the elbow in the near future.

Conclusion

A rupture of the brachioradialis muscle due to blunt trauma can result in a painful elbow and long term functional impairments in elbow flexion. An MRI can be used to rule out damage to the more commonly affected biceps brachii and brachialis muscles. This case report demonstrates that short immobilization followed by extensive and guided strength training has been observed to result in persisting weakness of elbow flexion but good functional outcome for the wrist and hand.

References

[1] R.A. Magnussen, P.Y. Chong, L.S. Oh, G. Walch, Acute biceps brachii injuries, in: G.M.M.J. Kerkhoffs, E. Servien (Eds.), Acute Muscle Injuries, Springer International Publishing, Cham, 2014, pp. 105–116.

[2] C.M. Forsythe, M.T. Burtis, D.C. Pfeiffer, G.R. Spurling, D.B. Ashby, Acute brachialis muscle tear in a pediatric patient, Radiol. Case Rep. 15 (5) (2020) 498–501, https://doi.org/10.1016/j.radcr.2020.01.041 [published Online First: Epub Date].

[3] D. Armstrong, J. Arrowsmith, F. Burke, Closed rupture of brachioradialis during exercise, J. Hand Surg. Eur. Vol. 36 (8) (2011) 704–705, https://doi.org/10.1177/1753193411419947 [published Online First: Epub Date].

[4] I.A. Khan, L.J. Bonato, A. Chehata, Complete closed brachioradialis tendon rupture: a case report, Hand Surg. 20 (1) (2015) 141–143, https://doi.org/10.1142/s0218810415720028 [published Online First: Epub Date].

[5] B.E. Lung, J. Ekblad, M. Bisogno, Anatomy, Shoulder and Upper Limb, Forearm Brachioradialis Muscle. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2020, StatPearls Publishing LLC, 2020.

[6] B. Caufriez, P.M. Dugailly, E. Brassinne, F. Schuind, The role of the muscle brachioradialis in elbow flexion: an electromyographic study, J. Hand Surg. Asian-Pac. Volume 23 (1) (2018) 102–110, https://doi.org/10.1142/s2424835518500145 [published Online First: Epub Date].

[7] M.R. Boland, T. Spigelman, T.L. Uhl, The function of brachioradialis, J. Hand Surgery 33 (10) (2008) 1853–1859, https://doi.org/10.1016/j.jhsa.2008.07.019 [published Online First: Epub Date].

[8] T.F. Tirrell, O.I. Franko, S. Bhola, E.R. Hentzen, R.A. Abrams, R.L. Lieber, Functional consequence of distal brachioradialis tendon release: a biomechanical study, J. Hand Surg. 38 (5) (2013) 920–926, https://doi.org/10.1016/j.jhsa.2013.01.029 [published Online First: Epub Date].