Case report

Electrophysiological evidence of the Riche–Cannieu anastomosis in the hand and its diagnostic implications; 2 case reports

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ABSTRACT

Introduction: Anomalous anastomoses between the nerves of the hand are not as rare as thought to be. Amongst these, the Riche–Cannieu anastomosis (RCA) is a connection between the ulnar nerve and median motor nerve in the palm. Presence of this can sometimes be misdiagnosed as a severe median mononeuropathy at the wrist/carpal tunnel syndrome (CTS).

We describe two cases that were referred for evaluation of CTS and were found to have incidental RCA.

Results: Electrophysiological studies showed typical findings consistent with RCA and coexistent mild CTS. Patients in whom median sensory and motor latency prolongations suggest CTS, the presence of an anastomosis should be suspected if the median motor amplitudes are worse than the median sensory amplitudes.

Conclusion: The electrophysiological study should be extended to avoid erroneous interpretation of low median motor amplitudes as severe CTS and to prevent unnecessary surgical intervention.

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1. Introduction

Anomalous anastomoses between the Median (MN) and Ulnar (UN) nerves in the upper extremity are well documented. There are four commonly described anomalous connections between the MN and UN.

The connection from MN to UN in the forearm is known as the Martin Gruber anastomosis (MGA) (Amoiridis, 1992). The Marinacci anastomosis, is opposite to MGA, with interneural connections from UN to MN in the distal forearm (Sarikcioglu and Sindel, 2002). An interneural connection between common digital nerves of UN and MN nerves in the palmar surface of the hand is called the Barrettiinni anastomosis (Dogan et al., 2009; Zolin et al., 2014). Finally, an anomalous connection from the UN to the MN in the hand is known as the Riche–Cannieu anastomosis (RCA) (Fig. 1). The latter was described in 1897 by Riche and Cannieu and is a cross over in the palm, between the deep branch of the UN and the recurrent branch of the MN (Cannieu, 1897; Riche, 1897).

The RCA is described in cadaveric dissections with a variable frequency of 3.12–77% (Harness and Sekeles, 1971; Sarikcioglu and Sindel, 2002). Normally, all intrinsic hand muscles are innervated by the UN except the lumbricals I–II, opponens pollicis, abductor pollicis brevis (APB), and flexor pollicis brevis (LOAF) muscles. (Blumenfeld, 2010) In the rare RCA, three patterns can be seen which include both sensory and all intrinsic hand muscles innervated exclusively by the ulnar nerve (referred to as the all ulnar hand) or only complete hand motor innervation by the UN or lastly, some median innervated muscles supplied by the UN (Kim et al., 2004).

We present two interesting cases diagnosed with RCA based on nerve conduction studies (NCS) and electromyogram (EMG). These electrodagnostic findings can be missed or misdiagnosed as severe carpal tunnel syndrome (CTS) or motor neuron disease (Saperstein and King, 2000).

2. Case reports

A 44-years-old lady and 66-years-old lady presented to our neurophysiology department with a 7 years and 3 months history respectively of numbness and pain in both hands. Their neurological examination was within normal limits including normal strength of the APB muscles in both patients. They were referred for evaluation of suspected median mononeuropathy at or distal to the wrists/CTS.
3. Results

NCS and EMG were performed according to international protocols using a Viking Nicolet/C210 machine. Skin temperature was maintained at 32°C. Sensory responses were recorded antidromically from the 2nd and 5th digit for MN and UN respectively using a distance of 14 cm between the stimulating sites at the wrist and recording electrode. For median motor studies, stimulation was done at the wrist (7 cm from the recording site) and anterior cubital fossa with recording from the APB muscle.

The median sensory nerve responses were abnormal showing bilaterally prolonged peak latencies in both patients with borderline normal amplitudes (Table 1). UN studies, both motor and sensory, were within the normal range, bilaterally.

Median motor studies revealed prolonged distal latencies with low motor amplitudes in both patients (Table 1). These findings were suggestive of a possible median nerve compression across the wrist, in view of prolonged median sensory and motor latencies with normal ulnar studies. However very low median motor amplitudes, which remained unchanged with higher stimulation strengths, in the presence of normal sensory amplitudes made us suspect the presence of an anomalous innervation.

Further studies were conducted recording from the APB muscle while stimulating the ulnar nerve at the wrist and below the elbow as shown in Fig. 2. There was normalization of bilateral median motor amplitudes in both patients (Table 2) with an initial negative deflection. EMG examination of the upper extremities was normal in both patients. There was no evidence of an underlying cervical radiculopathy or axon loss changes especially in the APB muscles.

4. Discussion

In both the cases, normal median sensory amplitudes recorded from Digit 2 by stimulating the MNs indicated normal sensory distribution of the MNs. The RCA was manifested by: (1) very low median motor amplitudes in the presence of normal sensory amplitudes (2) normalization of these motor amplitudes when stimulating the UN at the wrist and the elbow. The presence of an initial negative deflection further supported this phenomenon (3) normal EMG. All technical errors were excluded. This localizes the anomalous innervation in the palm. Both our cases were complicated by co-existent CTS in view of prolonged median sensory and motor latencies with stimulation at the wrist, consistent with moderate CTS (Sucher, 2013).

In early literature, Kimura et al. found 57 subjects (17%) with anomalous innervations from the MN to the UN while none showed innervation from the UN to the MN (RCA) in a study of 303 patients (Kimura et al., 1976). Since then there has been further description of this latter anomaly. The inheritance of RCA is believed to be autosomal dominant (Boland et al., 2007) and a recent meta-analysis has revealed the overall electrophysiological incidence of this anomalous innervation at 55.5% (Roy et al., 2016). Amongst the 3 types of RCA mentioned above, a pure motor anastomosis between the deep branch of the UN and the recurrent branch of the MN is most common while the all ulnar hand is rare (Kim et al., 2004).

Low median motor amplitudes in isolation may be considered as severe CTS if anomalous innervations are not sought after (Sucher, 2013). Additionally, this could also be interpreted as an intra-spinal canal lesion/anterior horn cell disorder in the absence of EMG (Saperstein and King, 2000). Severe CTS is excluded by normalization of motor amplitudes when stimulating the UN and a normal EMG of the APB muscle. Obviously above conclusions could be made only when there were no sensory abnormalities. Our two cases are interesting in that both were symptomatic and had sensory abnormalities. They were recognized as having incidental anomalous innervation with isolated crossover of ulnar motor fibers to the MN in the palm.

If an RCA is not recognized, a misdiagnosed case of severe CTS can subsequently undergo inappropriate surgical intervention. Indeed these patients may just have mild to moderate CTS.

Table 1

| Sensory findings Recording Digit 2 | Motor findings stimulating median nerve, recording APB |
|------------------------------------|------------------------------------------------------|
| PL (ms) Amplitudes (uV)            | DL (ms) Amplitudes (mV)                              |
| PL* (ms) Amplitudes* (uV)          | PL* (ms) Amplitudes* (uV)                            |
| PL* (ms) Amplitudes* (uV)          | PL* (ms) Amplitudes* (uV)                            |
| Patient 1. R 5.10 10               | 5.6 2.1                                              |
| Patient 1. L 6.10 11               | 4.8 0.3                                              |
| Patient 2. R 5.0 15                | 5.2 0.5                                              |
| Patient 2. L 5.2 14                | 6.5 2.7                                              |

*Normal peak latency (PL) = <3.5 ms; normal amplitude = >10 uV.
*Normal distal latency (DL) = <4.4 ms; normal amplitude = >4 mV.
(The values are as per department normative data).
also highlights the importance of thorough examination of the hand muscles as the diagnosis of severe CTS with very low median CMAP should usually corroborate with atrophy or weakness of the thenar muscles especially the APB. On the other hand, incidental RCA with normal thenar muscles, in symptomatic patients of CTS has been reported (Refaeian et al., 2001). Moreover, surgical procedures carried out for other reasons in the hand may cause inadvertent injuries to this anastomosis if the possibility of its existence is overlooked. The presence of RCA can also create confusing results in the electrodiagnosis of polyneuropathy or focal mononeuropathies other than median mononeuropathy, as can be seen in Diabetes mellitus or certain autoimmune diseases.

We want to highlight the importance of interpretation of NCS. Identification of anomalous innervations should be part of routine NCS protocols wherever applicable. NCS findings should always be combined with EMG findings for final electrodiagnosis. The latter aspect is especially important as in some laboratories CTS is diagnosed on the basis of NCS alone, either due to non-availability of EMG expertise, doctors time restrictions, cost restraint for the patient and the latter’s preference to avoid painful needle examination.

Table 2
Motor findings with comparison between stimulation sites, recording APB.

| Patient 1. | Median N* stim. wrist (mV) | Ulnar N stim.wrist (mV) |
|-----------|--------------------------|------------------------|
| Right     | 2.1                      | 7.1                    |
| Left      | 0.3                      | 11.3                   |

| Patient 2. | Median N* stim. wrist (mV) | Ulnar N stim.wrist (mV) |
|-----------|--------------------------|------------------------|
| Right     | 0.5                      | 10.0                   |
| Left      | 2.7                      | 11.9                   |

* Normal amplitude = >4 mV.

5. Conclusion

Lately the recognition of anomalous innervation of Riche–Cannieu anastomosis is not uncommon, this includes our two cases.

1. There is a need to understand its existence in patients especially those with mild degree of CTS. Misdiagnosis as severe CTS can lead to unnecessary surgical intervention.
2. In case of other surgical procedures in the hand, the possibility of RCA should be ruled out in order to avoid iatrogenic damage.
3. If only NCS is performed as in some laboratories, it is crucial to understand this anomalous innervation and to extend the study by performing EMG.

Conflict of interest

We have nothing to disclose.
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