WRIST ALGODYSTROPHY COMPLICATING OVERDISTRACTION OF DISTAL RADIAL FRACTURES

PAWEL GRAŁA¹, PAWEL HRYCAJ², ANNA OLEWIK-GAWLIK², KRZYSZTOF SŁOWIŃSKI¹

Department of Trauma, Burns and Plastic Surgery¹
Kierownik: prof. dr hab. K. Słowiński
Department of Rheumatology and Clinical Immunology²
Kierownik: prof. dr hab. P. Hrycaj
K. Marcinkowski Memorial Medical University in Poznań

Many publications list algodystrophy as one of the most common and disabling complications of distal radius fractures. Presented data suggest many possible factors leading to its development, where median nerve injury is an important risk factor.

The aim of the study was to present our experience with such complications after hybrid external fixation of distal radius fractures. The operative procedure, as well as clinical symptoms of algodystrophy are described in details.

Material and methods. Among 14 patients with neglected or after secondarily displaced distal radius fractures treated with hybrid external fixator three developed algodystrophy, in two cases refractory to our management protocol. The operation was performed at three to five weeks after injury. All cases with algodystrophy had a period of overdistraction of bone fragments. These patients had electromyographic studies performed. This examination revealed serious damage to the median nerve in all cases. Additionally all of them presented with serious bone atrophy of the wrist as documented on radiograms.

Results. A year after fracture all have persisting radiographic symptoms of wrist osteoporosis and two have poor functional result despite union of bone fragments in good anatomic alignment.

Conclusions. Prolonged overdistraction of bony fragments in distal radius fractures may produce injury to the median nerve and result in algodystrophy.

Key words: complex regional pain syndrome, reflex sympathetic dystrophy, distal radius fracture, hybrid external fixation, non-bridging external fixation

Algodystrophy (A) is a disease of still unknown origin and varying localization. Usually develops after seemingly benign injuries, mainly to the upper extremities (1-5). The most common inciting event is a distal radius fracture (DRF), irrespective of the treatment chosen (1, 2, 6, 7). Besides soft tissue injuries and fractures, tightness of the plaster cast may increase the risk of A (8). Furthermore, it has been hypothesized that repeated repositions (an indicator for repetitive trauma) and psychological problems are important risk factors (2, 9).

There are various synonyms of A in the medical literature, like Complex Regional Pain Syndrome (CPRS), Reflex or Sudeck’s Sympathetic Dystrophy (1, 2, 4, 5, 6, 10). Burning pain is the most common clinical symptom suggesting this complication. Pain at the injury site, but also over a wide area distally and proximally, disproportionate to the inciting stimuli may appear as allodynia, hyperalgesia or hyperpatia (3, 5, 11, 12). Additionally symptoms of regional vasomotor instability, changes in skin color and temperature, altered su-
domotor activity and joint stiffness suggests dysfunction of the sympathetic system (1-4, 6, 9, 11). Such complication often (about 6-37%) coexists with a fracture of the distal radius (DRF) contributing to poor functional result with significant disability. High rate of DRF in European population (75% of forearm fractures) if complicated by A leads to high social and economic costs (1, 2, 6, 8, 9, 11, 13).

MATERIAL AND METHODS

This study was performed in a prospective fashion. Since 2004 we have treated a homogenous group of 14 extraarticular DRF with the use of hybrid external fixator (HEF). There were nine females age 34-70 and five males age 39-56. In all cases the use of HEF was a secondary choice, after failed attempts of conservative treatment.

Fractures were classified according to the AO classification system (14). All were considered unstable because of marked dorsal or volar comminution, angular deformity exceeding 20°, osteoporosis or redisplacement after previous satisfactory reduction. The operative intervention took place after two to five weeks from injury (mean – 3).

Operations were performed under general anesthesia or brachial plexus block (optional upon patient-anesthesiologist agreement).

Placement of 1.8 mm K-wires into the distal fragment was performed through “safe zones” as suggested by Lindsay (15). No targeting device was used. The two proximal 4.0-mm halfpins (predrilled, self-tapping) were placed through a limited open approach between the brachioradialis and extensor carpi radialis longus muscles at the level of their myocutaneous junction. Our construction consisted of an Ilizarow 3/5 ring forming a base for two Kirschner wires with olives entirely supporting the distal fragment (steel – Master-Med, Cracow, Poland or carbon fiber – Synthes, Solothurn, Switzerland) attached with a self-designed adapter to the unilateral two bar/pin assembly (Stryker Howmedica Osteonics, Kalamazoo, MI, USA) (fig. 1). The procedure was performed under radiographic control with closed reduction after the implant was attached to both main bone fragments (16).

In the early postoperative period (two days), daily dressing changes at the implant-skin interface were performed and flexion-extension wrist motion was encouraged as tolerated from the second postoperative day. Patients were dissuaded from rotational exercises. Routine clinical and radiographic evaluations were performed postoperatively on the second or third day (discharge from hospital), then after 2, 8 and 14 weeks (more often if needed).

Wrist A was diagnosed based on clinical and radiologic findings. We applied Atkins diagnostic criteria (1). None of our patients had any signs of A prior to operative intervention. Postoperatively, suspicion aroused if pain located in an area unrelated to trauma exacerbated with passive motion and finger oedema and stiffness, sudomotor abnormalities or vasomotor instability (skin color and temperature) ensued. The presence of patchy, severe bone loss of the carpal bones was proven on control radiograms (1, 17).

Those diagnosed with A had electromyographic studies of the forearm performed and additional radiographic examination after 12 months.

RESULTS

Three out of four cases with radiographic features of overdistraction in the initial postoperative period developed full scale symptoms of A and all were proved to have median nerve injury, without other identifiable causes for such injury (fig. 2).

Their symptoms followed those suggested by Atkins and after eight weeks there were obvious signs of patchy bone lost at the wrist level (fig. 3). In all three cases severe bony atrophy was still visible during the last follow up X-ray examination after one year. At that time, only one was satisfied with the function of his hand.

In the early postoperative period (two days), daily dressing changes at the implant-skin interface were performed and flexion-extension wrist motion was encouraged as tolerated from the second postoperative day. Patients were dissuaded from rotational exercises. Routine clinical and radiographic evaluations were performed postoperatively on the second or third day (discharge from hospital), then after 2, 8 and 14 weeks (more often if needed).

Wrist A was diagnosed based on clinical and radiologic findings. We applied Atkins diagnostic criteria (1). None of our patients had any signs of A prior to operative intervention. Postoperatively, suspicion aroused if pain located in an area unrelated to trauma exacerbated with passive motion and finger oedema and stiffness, sudomotor abnormalities or vasomotor instability (skin color and temperature) ensued. The presence of patchy, severe bone loss of the carpal bones was proven on control radiograms (1, 17).

Those diagnosed with A had electromyographic studies of the forearm performed and additional radiographic examination after 12 months.

RESULTS

Three out of four cases with radiographic features of overdistraction in the initial postoperative period developed full scale symptoms of A and all were proved to have median nerve injury, without other identifiable causes for such injury (fig. 2).

Their symptoms followed those suggested by Atkins and after eight weeks there were obvious signs of patchy bone lost at the wrist level (fig. 3). In all three cases severe bony atrophy was still visible during the last follow up X-ray examination after one year. At that time, only one was satisfied with the function of his hand.

Fig. 1. Hybrid external fixation of a distal radius fracture
Wrist algodystrophy complicating overdistraction of distal radial fractures

DISCUSSION

All cases of A reported above had an antecedent overdistraction event and electromiographic studies revealed some form of injury to the median nerve (fig. 4). Hardware placement into the safe zones of the distal forearm had no association with the injury (15, 16).

In many other studies, injury to the median nerve is considered a common trigger event. Such an insult may be caused by overcompres-

sion of the nerve inside the carpal tunnel due to excessive volume of the fracture haematoma (exacerbated by large volume local anesthesia) or to extreme palmar flexion of the radio-carpal joint if immobilized in the mostly abandoned Cotton-Loder position (10, 11, 18, 19). We could not exclude such situation in our three cases because they were all referred to us from other institutions. This forms a significant bias, thus requires cautious interpretation of the results, blaming median nerve overdistraction as caus-
ative factor. Median nerve injury, as diagnosed on EMG studies of all our three cases reflects the CRPS type II according to the second edition of Classification of Chronic Pain Syndromes IASP in 1994, 20, 21). It is widely accepted that A might be caused by local disorder of the sympathetic system, ignited by peripheral nerve injury or oversensitivity of communicating cells in the spinal cord, (20, 22).

On the other hand, EMG studies of the upper extremities with A did not reveal symptoms of major nerve damage according to Oyen and Zyluk (20, 23).

Bone loss is a late (and long lasting) but severe aftermath of A (12, 17). Masson stated that the amount of bone loss in A in a few weeks or months is what might be expected over 10 years during the natural history of uncomplicated osteoporosis (12). A year after injury osteoporosis of the wrist was evident in all three cases of this study, even in the sole with good functional outcome.

Thorough clinical observation provides earlier diagnosis and thus might render the treatment more effective (11, 12). It is not always easy. Initial features are similar to typical postoperative pain and oedema, in our cases it appeared that exaggerated symptoms may result from late intervention in the already unyielding tissues. Field diagnosed 24% of A after Colles fractures and all typical features were present after nine weeks. Similar results were presented by Bickerstaff and Kanis – 2). Zyluk and Puchalski reported that obvious clinical features of A were present three weeks after upper extremity trauma in 72% of patients (20).

In case of diagnosed A we applied a standard treatment protocol: during the initial stage of the disease (acute) non-steroid anti-inflammatory (NSAID) medications with subcutaneous injections of Calcitonin, in later stages (atrophic) NSAIDs with vasoactive drugs were used. Additionally all patients afflicted with A were instructed to elevate the extremity and exercise only in the painless range of motion (2, 16, 21).

Poor functional results in two of our A patients are contradictory to optimistic results of some authors who report on good and often spontaneous recovery in the majority of their patients (Sandroni -75%) (5, 20). Since management varies significantly among authors it is impossible to draw any conclusions as to its effectiveness.

Bone loss was always visible on the 8 week follow up radiograms. We did not perform bone scintigraphy, which according to others gives earlier evidence of A (17, 20).

Our study is based on a very specific group of patients with DRF. Firstly, they all had repetitive attempts for reduction (at least two). Secondly, all had a history of prolonged overdistraction of bone fragments (and adjacent soft tissues) lasting one to three days.

At present, patients with neglected DRF managed with HEF are subjected to an X-ray examination one hour after termination of the procedure. If overdistraction is suspected, the fixator is dynamized with loosening of the bar/pin device.

CONCLUSIONS

1. Prolonged overdistraction of bony fragments in DRF may produce injury to the median nerve.
2. Median nerve overdistraction may result in algodystrophic complications.
3. In cases of neglected DRF, hybrid external fixation allows achievement of good anatomic reduction and its maintenance even weeks after fracture, but distractive forces applied through the fracture site should be avoided as soon as possible.

REFERENCES

5. Sandroni P, Benrud-Larson LM, McClelland RL et al.: Complex regional pain syndrome type I: incidence and prevalence in Olmsted county, a pop-
Wrist algodystrophy complicating overdistraction of distal radial fractures


Received: 9.06.2009 r.
Adress correspondence: 61-285 Poznań, ul. Szwajcarska 3

COMMENTARY

Typical radius fractures are one of the most common injuries of the locomotor system. In Poland, in locations where departments of trauma orthopedic surgery are unavailable, such fractures are treated by surgeons. Various methods of immobilization are used after reduction of bone fragments, such as: plaster cast splint on the forearm, plaster cast on the arm, circular plaster cast on the forearm with thumb inclusion. The most effective method to prevent secondary translocation of the bone fragments in unstable fractures is percutaneous fixation of the bone fragments with Kirschner wires and additional immobilization with circular plaster cast with the thumb inclusion. The reduced fracture should always be subjected to both clinical and X-ray monitoring on the next day and then every 7 days for 3 weeks. Translocation detected during this time can be easily corrected.

Lack of care results in suboptimal results of treatment. Limitation of the wrist and finger mobility, pains, carpal tunnel syndrome and hand deformation are observed most commonly. The most unfavorable complication is Sudeck’s acute bone atrophy (algodyostrophy).

The clinical material presented in the commented paper is relatively limited (14 patients). It documents that acute bone atrophy occurred in three cases as a consequence of excessive bone fragment distraction. These patients experienced injury of the median nerve, confirmed by EMG. The paper does not specify whether it
was a one-stage distraction or slow correction. One-stage correction under anesthesia is not controlled by pain which is an important indicator of the fact that the distraction should be discontinued or slowed.

There are many risk factors of algodystrophy. These include: women at the age of 50–60 years, white collar workers, fractures with repeated reductions without anesthesia or incompletely reduced or incorrectly immobilized. These factors are associated with pain as a predominant symptom, especially in subjects with low pain threshold.

The method of treatment of persistent translocation of radius fragments with an external fixator, proposed by the authors, is believed to be a method worth recommendation. Treatment methods presented in the paper involve predominantly pain alleviation, active exercise, drugs improving perfusion, are correct. The literature mentions also calcium supplements and vitamin D₃ supplementation. However, calcitonin treatment using its analgesic effect is effective, but cheaper drugs can provide the same end effect.

In summary, hand exercise, possible with external fixation, limited by pain, plays a significant role in the therapeutic process.

Three final conclusions provide information that excessive distraction may result in the injury of the median nerve, which can lead to algodystrophic complications accompanying treatment of the typical radius fracture.

Prof. dr hab. Kazimierz Rapala
Klinika Ortopedii CMKP w Otwocku