Monteggia Lesions and Their Complicating Nerve Damage

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Fracture of the ulnar shaft associated with anterior dislocation of the radial head was first described by Giovanni Battista Monteggia in 1814 (Peltier 1957). Originally, the lesion was assumed to be the result of direct trauma, but in the light of the works of Evans (1949) and Bado (1962) this view was revised to the effect that in most cases the provoking mechanism is a traumatic torsion of the forearm. In children a violent force applied longitudinally to an extended elbow can be the causative factor (Wright 1963, Tompkins 1971). Other more violent and less well-defined traumas may result in Monteggia-fracture-like lesions, all of which have in common dissociation of the proximal ends of the radius and ulna as well as dislocation of the radius in relation to the humerus. Bado (1967) classified these lesions into four types under the term "Monteggia Lesion" so as to give an understanding of the aetiology and a rationale for reduction and bandaging.

The present work is concerned with these 4 types of Monteggia lesion:

Type I: Fracture of the middle or upper third of the shaft of the ulna and forward dislocation of the upper end of the radius.
Type II: Fracture of the middle or upper third of the shaft of the ulna and posterior dislocation of the upper end of the radius.
Type III: Fracture of the upper ulnar metaphysis and lateral dislocation of the upper end of the radius.
Type IV: Same as Type I associated with fracture of the upper third of the shaft of the radius.

Type I is twice as frequent as the Types II and III together, whereas Type IV constitutes only 5 per cent of the cases in large series.

In addition, Bado described different lesions of the elbow and fore-

arm as equivalents to the Types I and II Monteggia lesions; in the following they will be referred to as E-I and E-II.

A Monteggia lesion will often involve the radial nerve which is exposed to injury by this fracture-dislocation on account of the anatomy of the forearm after division of the nerve. After having given off the ramus superficialis with motor and cutaneous sensory fibres, the nerve continues in ramus profundus, giving off motor branches to the extensor carpi radialis brevis and supinator muscles. The ramus profundus enters the supinator proximal to the point where it passes about the neck of the radius. After emerging from the supinator it gives off branches to the extensor digitorum communis, the extensor digiti quinti, the extensor carpi ulnaris, the extensor indices proprius, the abductor pollicis longus, and the extensors pollicis longus and brevis, and terminates in proprioceptive fibres for the carpal joints. In 25 per cent of all individuals the nerve lies in direct contact with the radius during its passage through the supinator, and in 30 per cent a marked fibrous arch has formed in the muscle insertion by which the nerve is held close to the bone. In idiopathic paralysis of the ramus profundus of the radial nerve, exploration often reveals compression of the nerve at this point (Spinner 1972). With both anterior and posterior dislocation of the radius in relation to the humerus the same segment of the nerve is susceptible to injury by traction or compression.

MATERIAL

Over the period 1962–1972 a total of 14 patients with Monteggia lesions were treated, four of whom had received their first treatment elsewhere. Table 1 shows the characteristics of these patients with regard to sex, age and type of lesion.

The three children had sustained the injuries by falling during play. There were two Type I lesions and one Type III. One of the Type I lesions had severe dislocation and was associated with total paralysis of the ramus profundus of the radial nerve. The two Type I lesions were treated with closed reduction, whereas the Type III case required open reduction of the radial head and repair of the ligament. Fixation was in plaster-of-Paris for 6 weeks.

The 11 adults had sustained severe, and in some cases multiple, injuries, many of which were more grave than that of the forearm (cf. Table 1). Five of the six Type I lesions were treated with osteosynthesis of the ulna. One patient had an E-I lesion with volar dislocation of the radial head and fracture of the ulnar shaft as well as posterior dislocation of the olecranon. This patient had been treated elsewhere with reduction, and was not seen in our clinic until 2 months later when he came to have the plaster removed. The radial head proved still to be dislocated, and there was mal-union of the ulnar fracture; resection of the radial head and

Table 1. 14 Monteggia lesions and their management.

Patient number	Age, sex and type of lesion			Complicating nerve damage	Other associated lesions	Treatment of the Monteggia lesion or equivalent	
						The ulna	The radius
1	10	F	I	–	–	closed reduction	closed reduction
2	66	F	E-II	–	commotio cerebri	closed reduction	unsuccessful closed reduction (late excision of radial head)
3	54	M	I	–	–	screw	closed reduction
4	21	M	I	+	fractura cruris complicata	rush-pin	open reduction
5	50	F	II	–	–	closed reduction	closed reduction
6	29	M	I	–	–	rush-pin	open reduction and fascial loop reconstruction
7	58	F	E-II	–	ruptura symphysis luxatio art. sacroiliaca bilat. laesio plexus lumbosacralis	closed reduction (late rush-pin)	closed reduction (late excision of radial head)
8	73	M	E-I	+	–	closed reduction (late rush-pin)	unsuccessful closed reduction (late excision of radial head)
9	52	F	E-II	–	fractura pelvis comminuta	closed reduction (late screw)	closed reduction (late excision of radial head)
10	21	M	I	+	commotio cerebri	rush-pin	closed reduction
11	41	M	I	+	fractura femoris bilat. fracturae costarum fractura pelvis comminuta	closed reduction	closed reduction
12	5	M	III	–	–	closed reduction	open reduction and repair of ligament
13	39	M	I	+	–	rush-pin	closed reduction
14	10	M	I	+	–	closed reduction	closed reduction

osteosynthesis of the ulna (a.m. Rush) were carried out. Postoperatively, partial radial paresis of the ramus profundus occurred.

There was one Type II lesion, which was treated conservatively.

E-II lesions occurred in three instances, all with dorsal dislocation and avulsion of the radial head together with ulnar fracture; one of these patients also had dorsal dislocation of the olecranon, another had fracture of the olecranon as well as of the distal antebrachium on the same side. The three E-II lesions were treated initially with closed reduction but the radial head was not repositioned in any of the cases. Late extirpation of the radial head was performed in all three, and in two of them osteosynthesis of the ulna as well.

Five of the 11 adult patients had radial nerve involvement, and patient No. 13 had also partial median nerve involvement.

A total of six out of the 14 patients with Monteggia lesions developed radial paresis. These six cases all occurred in association with Type I or E-I lesions and were confined to the ramus profundus of the radial nerve. The diagnosis was based on the clinical examination; only the last two patients underwent neurophysiological examination which confirmed the site of the lesion.

Exploration was done in two cases to localize and, if required, to treat the lesion. Twelve days after early osteosynthesis a small haematoma was noted in patient No. 10 at the point of division of the radial nerve, but there was no interruption of continuity or evidence of peripheral degeneration of the nerve. Thirty days after early osteosynthesis in patient No. 13, discolouration after bleeding was observed at the point where the median nerve gives off the anterior interosseous nerve and at the radial nerve. In this case, too, the changes were located primarily at the point of division of the radial nerve; there was no interruption of continuity and no fibrosity.

RESULTS

All six patients regained full radial function with the regeneration starting at 6–8 weeks. In the 10-year-old boy, however, beginning function was not demonstrable till at 8 weeks.

Follow-up examination

All 14 patients were followed up; the mean time of observation was 6 years 1 month (10 years 8 months to 8 months). The three children had no after-effects, whereas for the 11 adults there were substantial sequelae. Nine patients were satisfied with the results and four were fairly satisfied. The fourteenth patient was unable to give his opinion as he was demented following a subsequently sustained craniocerebral lesion.

Table 2 records the loss in range of movement, and the most important radiological findings. Unexpectedly, we found two cases of pseudoarthrosis of the ulnar fracture. They did not cause much dis-

Table 2. Results at follow-up of 14 Monteggia lesions.

Patient number and type of lesion	Time of observation in years/months	Loss in ranges of motion as compared with undamaged arm				Radiological findings at follow-up
		Flexion	Extension	Pronation	Supination	
1	I	10 years 8 months	none	none	none	none	none
2	E-II	9 years 8 months	40°	5°	none	40°	10° angulation of the ulna (radial head removed)
3	I	8 years 4 months	40°	90°	50°	50°	15° angulation of the ulna, severe osteoarthritis of the elbow joint
4	I	8 years 7 months	none	none	25°	none	10° angulation and non-union of the ulna
5	II	6 years 8 months	none	25°	none	45°	10° angulation of the ulna, severe osteoarthritis of the elbow joint
6	I	7 years 6 months	none	none	none	20°	15° angulation of the ulna
7	E-II	6 years	none	none	25°	60°	severe osteoarthritis of the elbow joint (radial head removed)
8	E-1	5 years 3 months	15°	30°	75°	40°	severe osteoarthritis of the elbow joint (radial head removed)
9	E-II	5 years 6 months	60°	90°	30°	75°	radiogram not taken
10	I	5 years 4 months	5°	10°	none	none	10° angulation and non-union of the ulna
11	I	5 years 3 months	20°	5°	none	20°	radiogram not taken
12	III	4 years 7 months	none	none	none	none	none
13	I	9 months	none	10°	20°	none	none
14	I	8 months	none	none	none	none	none

comfort even though on clinical examination it was possible to produce springing and an audible "click" at the site of the fracture. Both patients refused surgical treatment of the pseudarthrosis; they had in the meantime changed to less physically strenuous work but not because of sequelae from the Monteggia lesion. Cubitus valgus was present in three patients, in two of them following extirpation of the radial head. Patients Nos. 3 and 9 had 90° flexion of the elbow; in No. 3 movement was restricted to a minimum, and No. 9 had arthrodesis.

All patients with radial nerve lesion regained full function without neurological sequelae. In patient No. 13 function of the median nerve was not fully restored but continued to improve.

DISCUSSION

The fact that over a 10-year period no more than 14 cases of Monteggia lesions, and of various types at that, were encountered in a large surgical department receiving casualties indicates that these lesions are relatively rare. It is, therefore, difficult to acquire personal experience in their management.

In children treatment should be conservative although accurate reduction of the radial head may require surgery to correct interposition of soft parts. The results obtained in the three children in our material confirm that the prospects of complete restoration of function seem to be favourable in this age group (Bryan 1971).

Accurate reduction of the ulna is a precondition for a stable reduction of the head of the radius. In adults osteosynthesis of the ulna will often be advisable (Naylor 1942, Wenzel & Sander 1969). With regard to the value of suture or plastic reconstruction of the radial annular ligament opinion remains divided (Boyd & Boals 1969, May & Mauck 1961).

In neglected cases, and in equivalent lesions with separation or fracture of the radial head it may be necessary to excise the radial head; this operation should not be done in children, however, until growth of the radius has terminated (Sharrard 1971).

In posterior Monteggia lesion, Pavel et al. (1965) obtained poor results as well as complications by early, and no definite improvement by late extirpation of the radial head. Late extirpation of the radial head was done in four of our patients with subsequent improvement of function and reduction of pain, but still the functional results

achieved were among the poorest. Cubitus valgus will often result from this procedure.

As regards the time of bandaging, 6 weeks for children and 8 weeks for adults will usually be adequate. In order to retain the radial luxation, the arm is best fixed at 90° of flexion at the elbow with the forearm rotated in the opposite direction to the movement which provoked the lesion.

Development of pseudoarthrosis in the ulnar fracture is a potential risk, and the patients should therefore be followed up until sound healing of the fracture has been demonstrated radiologically (Wenzel & Sander 1969). At follow-up two of our patients presented with pseudoarthroses which did not cause much discomfort, however. Both were young men who at the time could not be motivated to accept surgical treatment. Initially they had been treated with osteosynthesis of the ulna (a.m. Rush) and closed reduction of the radius. They had been bandaged for 3 weeks only, as it was considered advisable to treat their ramus profundus lesion early and actively (with myotensor, for one thing). A too short time of bandaging in combination with a less stable fixation of the ulnar fracture accounts for the development of pseudoarthroses in both cases.

Only the children had no sequelae from the lesion. The poorest results were those obtained in the four instances of equivalent lesions and in patient No. 3, but none of the remaining six adults ended up entirely without functional restriction. Admittedly, our material included several severe cases, and some with multiple injuries, but with the rise in traffic and industrial accidents it is to be expected that in future we shall be faced with, for one thing, Monteggia lesions of a more severe nature.

Spinner et al. (1968) described three cases of posterior interosseous paralysis associated with Monteggia fractures in children. In two of them function was fully restored after 2 and 14 days, respectively, whereas in the third it took 7–8 weeks even though regeneration could be demonstrated by electromyography after 5 weeks. There are also other reports of peripheral nerve involvement in Monteggia lesions (Beddow & Corkery 1960, Smith 1947). Bado's 55 cases included four with radial nerve injury, two with ulnar nerve injury and one with ulnar and median nerve injuries. In our material the incidence of ramus profundus affection was particularly high—six cases out of 14; in one of them there was no sign of nerve involvement till after secondary surgery, but in the remaining five it occurred in association

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with genuine Type I lesions, of which there were a total of eight. The diagnosis was made clinically on the basis of characteristic motor manifestations without concomitant sensory loss.

Two of Spinner et al.'s cases were transitory with the lesions being of the neuropraxia type. In our material the lesions can all be classified as being of the axonotmesis type, as judged from the time that passed before function was regained. In no case was there neurotmesis. Nor does the literature report so severe cases in connection with Monteggia lesions. This fact gives grounds for a conservative, expectant treatment of the neurological complications for up to 8 weeks to allow spontaneous regeneration. By electromyographic studies, Spinner et al. were able to demonstrate evidence of regeneration after 5 weeks but such studies will often leave the question of the reversibility of nerve damage to the forearm unanswered (Howard 1972).

Although neurotmesis has not been described previously in connection with this type of lesion operative exploration is well indicated if regeneration has not occurred at the expected time.

By formation of haematoma with subsequent fibrosis the earlier described anatomy of this region may condition the development of a chronic traumatic entrapment neuropathy requiring surgical decompression to restore function of the nerve (Simeone 1972).

SUMMARY

Monteggia lesions and their equivalents are reviewed on the basis of the literature and 14 cases encountered over a 10-year period. Mention is made of aetiology, classification into types and treatment. For the 14 cases in this study the mean follow-up time was 6 years.

Likewise, mention is made of the relationship between anatomy and the neuropathy which is a frequent complication in Monteggia lesions. In particular the ramus profundus of the radial nerve is exposed to injury but other nerves may also be involved.

It is concluded that Monteggia lesions and their equivalents are relatively rare, a fact that may give rise to therapeutic problems. In adults the lesions often lead to permanent restriction of movement. Patients should be followed up for a long time with a view to early recognition and treatment of ulnar pseudoarthrosis.

In case of neurological complications the initial treatment should be conservative and expectant since there is usually no lesion to the nerve in continuity, but if function has failed to return after 8 weeks, surgical exploration is required with decompression in view.

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