

Injection nerve palsy

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ABSTRACT

Objective: To study the clinical profile and outcome of surgery for injection nerve palsies. **Materials and Methods:** This is a retrospective study of patients with INP who were treated at our institute during May 2000 to May 2009. Clinical, electroneuromyography (ENMG), and operative findings were noted. Intraoperative nerve action potential monitoring was not used in any case. Outcome of patients who were followed was reviewed. **Results:** INP comprised 92 (11%) of 837 nerve injury patients. Seventy one patients were children less than 16 years. The nerves involved were sciatic in 80 patients, radial in 8, and others in four. Fifty seven patients had power, grade 0/5. ENMG studies revealed absent compound muscle action potential in 64 and absent sensory nerve action potential in 67 patients. Thirty nine (42.3%) of 92 patients underwent surgery. The mean duration since injury in these patients was 5.2 months (3 months to 11 months). All underwent neurolysis. Only 18 patients who underwent surgery had a follow up of more than 3 months. Ten (55.5%) patients had good or fair outcome after surgery. Except for grade of motor deficit prior to surgery, none of the variables were found to significantly affect the outcome. **Conclusion:** The outcome of INP is generally good and many patients recover spontaneously. The outcome of surgery is dependent on preoperative motor power.

Key words: Injection, lesion in continuity, nerve injury, paralysis

Introduction

Although considered a basic technique, intramuscular injections (IMI) are far from innocuous. Injury to the peripheral nerves from accidental injection of drugs is known as injection nerve palsy (INP). INP is known from the inception of IMI over 100 years ago.^[1] In developed countries, the incidence of INP following IMI has decreased over the last decade.^[1-7] However, INP appears to be a much greater problem in developing countries because of indiscriminate use of IMI for treating common illnesses.^[4,8-11]

It is estimated that in developing countries each person receives two injections per year, and 50% of these injections are unsafe.^[12] In 68% of visits to private clinics patients were given an IMI.^[13] Data collected in cross sectional

studies in India and Pakistan has found a high frequency of indiscriminate use of injections in these regions. More than 50% of these injections are administered in unregistered health care facilities, non-formal health care systems, and at home by friends and relatives for indications that may include fever, pain, infections, and injuries. The purpose of this study was to evaluate the clinical profile and surgical outcome of patients with nerve injury following IMI managed at our institute.

Materials and Methods

This is a retrospective study of patients with INP who were treated at our institute during May 2000 to May 2009. The study was undertaken following clearance from our Institutional Scientific Ethics Committee. Surgically as well as conservatively management patients were included. The data of all patients with nerve injury are entered in a comprehensive structured "Nerve Injury Proforma" at the time of admission. The details of which are verified by the consultant. From this proforma the demographic data, indication for IMI, the person who administered IMI, preceding systemic symptoms, timing of onset of neurological symptoms, and clinical and electrophysiological findings were reviewed.

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Medical Research Council (MRC) grading was used to quantify motor and sensory deficits. For analysis purpose, quantification of neurological deficits was restricted to key muscle/muscle group supplied by the involved nerve distal to the level of injury and autonomous sensory zone of that nerve; e.g., wrist extensors and anatomical snuffbox respectively for radial nerve. Electroneuromyography (ENMG) findings; compound muscle action potential (CMAP) and sensory nerve action potential (SNAP) were also noted. Outcome of patients who were followed was reviewed. For statistical analysis, only those patients with a follow up of more than 3 months were included. The outcome was graded as good if there was grade 2 or more motor power improvement, fair if grade 1 motor power improvement, and poor if there was no motor improvement. Functional outcome was graded as used by Kline *et al.* as more than 3 MRC grade as good functional recovery. MRC grade 3 as fair functional outcome and MRC grade <3 as poor functional outcome.^[14] All statistical analyses were performed using SPSS software version 17 (SPSS Inc., Chicago, IL, USA. Feature 1200-SPSS Statistics Base 17.0: Local license for version 17.0-Network Expiration: None). Chi-square tests were used to assess the univariate relationship between the variables of interest and the outcome. There are many other variables which could influence the prognosis; however analysis was restricted to few because of less number of patients available for follow up. Multivariate analysis could not be used because of less number of patients.

Results

INP comprised 92 (11%) of 837 nerve injury patients treated between May 2000 to May 2009. Their demographic profile is shown in Table 1. Seventy one (77.2%) patients were children less than 16 years age, most of them received injections by unqualified medical practitioners to treat fever. The symptoms are summarized in Table 2. Most patients developed severe pain along the distribution of nerve with neurological deficits immediately after receiving injection however they were referred late after injury. The commonest nerve involved was sciatic nerve due to gluteal injection. Within sciatic nerve, common peroneal division was more often involved.

The MRC grading of key muscles and sensory zones of the involved nerve is summarized in Table 3. All patients had motor deficits and most patients had complete paralysis of involved muscle. Most patients had partial sensory loss in the sensory zone of involved nerve. The ENMG findings are summarized in Table 4.

Treatment

All patients were advised physiotherapy and appropriate orthoses. Seven (7.6%) patients consulted us for purpose of certification for litigation, and did not want any treatment.

Nine patients (9.8%) made some spontaneous recovery and were happy with it. Five (5.4%) patients presented

Table 1: Demographic profile of the patients

Age	2 years to 60 years (mean 8 years)
Sex (%)	75 (81.1) Male, 17 (18.9) Female
Injection administered by (%)	Unqualified medical practitioner 50 (60.4) Medical Doctor 18 (19.8) Alternative medicine practitioner 10 (10.5) Nurse 8 (9.3)
Indication for injection (%)	Fever 58 (65.6) Cough 5 (5.6) Pain 18 (18.9) Infection 6 (6.7) Femoral puncture 2 (2.2) Abscess 2 (2.2) Snake bite 1 (1.1)

Table 2: Neurological symptoms and distribution of nerves involved

Onset of symptoms (%)	83 (90) immediate, 9 (10) delayed
Duration of symptoms	3 months (1 month to 15 months)
Nerves involved (%)	Sciatic 80 (86.9) Common peroneal division 56.6 Common peroneal more than tibial division 24.5 Both common peroneal and tibial division 18.9 Radial 8 (8.7) Femoral 2 (2.2) Median 1 (1.1) Common peroneal 1 (1.1)

Table 3: Number of patients with deficits according to medical research council (MRC) grading of the nerve palsies

MRC Grade	Sensory (%)	Motor (%)
0	13 (14.1)	57 (61.4)
1	5 (5.6)	16 (17.0)
2	16 (16.9)	7 (8.0)
3	24 (25.8)	9 (8.0)
4	10 (11.3)	5 (5.7)
5	24 (25.4)	0 (0)

late (more than one year after injury) and had developed contractures hence were not offered surgery.

Surgery

All patients who did not improve beyond 3 months of sustaining injury were offered surgery. As most of the injuries were of sciatic nerve at the buttock level, the surgical technique of exposure of sciatic nerve deep to the buttock is described [Figure 1]. The patient is positioned prone with knee slightly flexed at the thigh and sand bag placed under the anterior iliac crest on the side of the exposure. A curvilinear skin incision is made, starting cephalad and adjacent to the posterior iliac spine, curving around the lateral aspect of the buttock mass and then medially, to end below the buttock crease in the midline of the posterior upper thigh.

The gluteus maximus muscle is detached along its lateral aspect, 2 to 3 cm from its insertion into the greater trochanter, leaving a cuff of muscle and tendon to attach to bone for closure. The entire muscle mass including some gluteus medius is reflected medially. Blunt followed by sharp dissection is performed in a relatively avascular plane deep to the muscle and medially to expose the sciatic nerve. Sharp dissection is performed on and along the nerve itself. The general principle is to work alternatively from above and below the presumed level of injury, gaining circumferential exposure. The last area to be dissected is the lesion site itself.

External internal and neurolysis (making longitudinal incisions) is done over the lesion till healthy fascicles are seen below and above the lesion. The neurolysis is extended superiorly towards the sciatic notch, with care taken to preserve the hamstring, the posterior femoral cutaneous nerve branches, and gluteal nerves and vessels. Piriformis muscle was often sectioned to facilitate exposure in the region of the sciatic notch.

After ensuring decompression of the fascicles, incision is closed in layers; muscle and tendon with non absorbable sutures, and subcutaneous tissue and dermis with absorbable sutures.

Thirty nine (42.3%) of 92 patients underwent surgery. The mean duration to surgery since injury in these

patients was 5.2 months (3 months to 11 months). All underwent exploration of the involved nerve based on preoperative clinical and ENMG findings. All underwent external and internal neurolysis. On exposing the injured nerve all patients were found to have lesion in continuity; 30 (10.3%) had scar, 4 (10.3%) had neuroma, and 5 (12.8%) had thinned out nerve. Intraoperative nerve action potential (NAP) monitoring was not used in any case. None of the patients underwent resection of lesion and nerve grafting. The only complication which occurred was wound infection and it was treated with appropriate antibiotics.

Outcome

Only 18 (46.1%) patients who underwent surgery had a follow up of more than 3 months (mean 5.1 months; range 3-18 months). The outcome of these patients is summarized in Table 5. Except for grade of motor deficits prior to surgery none of the variables significantly affected the outcome [Table 6].

Discussion

Intramuscular injection is an often abused form of medical intervention in developing countries. It is the commonest cause of iatrogenic nerve injuries. The exact incidence of INP is not known. During acute flaccid paralysis (AFP) surveillance in children, it was found that INP comprised 12% to 20% cases of AFP.^[8,15] Injection injury of peripheral nerves constitutes a sizeable burden of all nerve injuries. In our study 11% of the patients with nerve injury were due to injections. This is higher than the rates of around 2% reported in literature.^[7,16] In spite of regulations, injections in developing countries are still administered by untrained personnel. In our study 70% of the patients received IMI from persons other than doctors or nurses. In a study

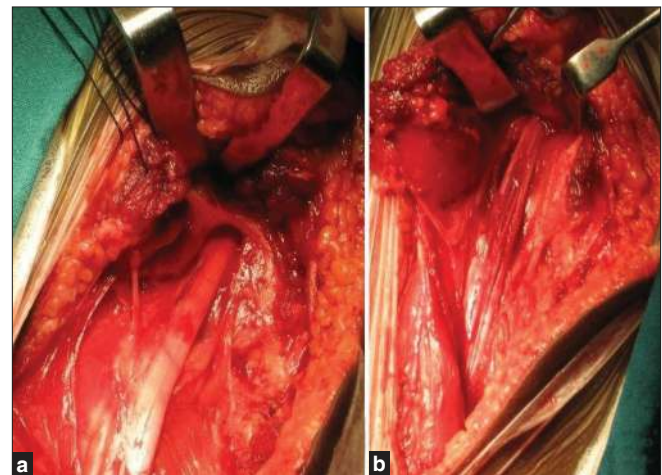


Figure 1: Exposure of sciatic nerve in buttock (a) Sciatic nerve after reflection of gluteus muscle (b) Sciatic nerve after neurolysis

Table 4: Electroneuromyography (ENMG) findings

ENMG parameter	Number (%)
Absent CMAP	64 (70.5)
Reduced CMAP	28 (29.5)
Absent SNAP	67 (72.9)
Reduced SNAP	25 (27.1)

CMAP=Compound muscle action potential, SNAP=Sensory nerve action potential

Table 5: Outcome of patients after surgery

	N=18 (%)
Motor outcome	
Good (>1 grade improvement)	7 (38.89)
Fair (1 grade improvement)	3 (16.67)
Poor (no improvement)	8 (44.44)
Functional outcome	
Good (MRC Grade>3)	5 (27.78)
Sciatic 3	
Radial 1	
Median 1	
Fair (MRC Grade=3)	5 (27.78)
Sciatic 5	
Poor (MRC Grade<3)	8 (44.44)
Sciatic 5	
Radial 3	

done from North India,^[16] It was found that uncertified Medical Practitioners were responsible for 86% of INPs. Though most of our patients received injection for febrile illness, the nature of drug injected was not available. In an African study it was found that the common drugs, given intramuscularly in children, resulting in nerve injury were chloroquine, novalgin, penicillin, and sulfadoxine-pyrimethamine.^[11] Certain drugs are much more damaging than others when injected into a peripheral nerve. The most toxic agents are penicillin, diazepam, chlorpromazine, meperidine, dimenhydrinate, tetanus toxoid, procaine and hydrocortisone.^[17]

Clinical features

The mean age of our patients was 8 years, and most were children. In a similar study from North India, the mean age was 28 years.^[16] However western studies have reported higher incidences in the elderly.^[14,18] The reason of increased possibility of INP in children and elderly is thin built and less gluteal covering. The onset of symptoms was immediate in 90% of our cases. The immediate symptoms are due to injection within the nerve causing severe radicular pain and paresthesias along the distribution of nerve, with immediate onset of variable motor and sensory deficit. The cause of delayed symptoms is injection in epineurium or close to nerve, and in tissue plane from which the drug can seep to the nerve resulting in neurotoxicity later.^[19] Other cause of delayed worsening is perineural fibrosis.

Most of our patients presented very late after injury. This delay is due to lack of awareness of IMI as a cause of nerve palsy, the hope of spontaneous recovery, and misattribution of nerve palsy to other disease. In our study the commonest nerves involved were the sciatic and radial, which is similar to other studies.^[8,16] This distribution is due to preference of gluteal and shoulder sites for IMI. However injury to every major nerve has

Table 6: Univariate analysis of the variables affecting outcome

Variable	P value
Age	0.391
Duration of symptoms	0.328
ENMG	0.202
Motor deficit grade prior to surgery	0.004*
Operative findings	0.616
Scar in continuity	
Neuroma in continuity	
Thinned out	

*Significant

been observed following IMI.^[19] In a review of 280 cases of INP; sciatic (84.3%) was the commonest nerve involved followed by radial (5.4%), median (3.6%), sciatic with posterior femoral cutaneous nerve/pudendal/inferior gluteal (1.4%), axillary (1.1%), ulnar (1.1%), posterior femoral cutaneous nerve (1.1%), superior gluteal nerve (0.7%), femoral (0.7%), lateral femoral cutaneous nerve (0.4%) and medial cutaneous nerve of forearm (0.4%).^[11]

Anatomic proximity of the injection is considered the single, most critical factor in determining the degree of damage, with injection directly into the nerve being the most destructive. The large size of sciatic nerve makes it more vulnerable to injury. In accordance with other studies we have also found that common peroneal part of the sciatic nerve is affected more often. The lateral and superficial location of peroneal division makes it more vulnerable to injury.^[14] Sciatic nerve injury can result when the injection is given in outer upper quadrant of the dorsogluteal region, even in patients with normal anatomy. The needles used can be too long for a particular patient or inserted at an angle after entry into the tissue. If the hub of the needle depresses soft tissue, even if the needle is inserted in an outer quadrant, injury can still occur. Positioning is also a predisposing factor, when the patient is placed into a lateral decubitus, upright, or bent forward position instead of prone, probability of nerve injury increases. This changes the relationship of the quadrants to the sciatic nerve.^[18]

Most of our patients had severe motor deficits at presentation (about 60% had motor power grade 0), and had inexcitable nerves (about 70%). This observation is similar to other Indian studies^[16] but significantly higher than western reports.^[14] This may be due to the poor referral system in our country, as most of the patients with partial deficits are not referred.

Management

Evaluation of patients with INP includes proper history and clinical evaluation, with quantification of motor and sensory deficits, supplemented with ENMG studies.

The management of INP is similar to the principles of any other nerve lesions in continuity. The patient should be managed conservatively initially with physiotherapy and appropriate orthoses, with serial clinical and electrophysiological monitoring.

Patients with partial deficits uncomplicated by severe pain, with significant spontaneous recovery or late referral can be managed without surgery. Surgical exploration is not indicated in as many as 50% of injuries.^[14] Most of these patients achieve partial but good spontaneous recovery. However conservative management should not be prolonged in patients who do not exhibit recovery at the expected time following injury.^[14]

If intraoperative nerve action potential (NAP) facility is available then these injuries can be explored at 3 months. The timing of exploration is influenced by whether a sensory or motor deficit exists. If a motor deficit exists, some proximal muscle recovery is anticipated, either clinically or electrophysiologically within 3 months. If only a sensory deficit exists; a longer period of observation is appropriate, as successful reinnervation of sensory receptors is not as time dependent as are motor targets. Only exception to this is severe pain; not responding to neuropathic analgesics; which can be relieved with neurolysis. Controversy exists regarding the role of immediate surgical intervention in the treatment of nerve injection injuries. Experimental studies have shown good outcome of immediate exploration for neurolysis or irrigation of the involved nerve with normal saline.^[20] This approach is not practical for human beings. Most of these cases are seen by specialist much later for non improvement. The timing of surgery in our series was 5.2 months since surgery. The surgical treatment for INP is neurolysis. After neurolysis if NAP is not elicitable across the lesion in a particular division of nerve, only that portion needs to be excised and repaired using nerve graft. Most of these lesions are within 1 to 2 cms of sciatic notch hence it is difficult to get good length of proximal stump after resection for anastomosis. In a study of sciatic nerve injection palsy, less than 15% of patients required either suture or graft repair of the nerve. Rest could be managed with neurolysis only based on NAP monitoring.^[18] We do not have facility for intraoperative NAP monitoring and hence only neurolysis was done.

Outcome

Some patients recover function spontaneously, but others do not. Results are generally good because many injuries are focal. As with other injuries, the prognosis depends on the part or divisions involved, level of injury, timing of surgery, and the patient's overall medical

status.^[18] Outcome of tibial division is better than peroneal division of sciatic nerve. In a study of 64 INPs of sciatic nerve, 84% of patients with tibial division had good functional outcome after neurolysis, as opposed to only 68% of patients with peroneal division injury.^[18] However improvement in inversion (peroneal nerve function) leads to better functional outcome as patient is able to put the foot flat on the ground for taking steps. Outcome is not so good after resection of lesion and graft repair. In the same study only 57% of patients with tibial division had good outcome after graft repair. Outcome of surgery for INP is better than that for other iatrogenic injuries like total hip arthroplasty. Only 75% patients with tibial division and 25% with peroneal division injuries after hip arthroplasty had good outcome. Patients with nerve injuries improve over several months following surgery and if they are followed up for longer duration many will show good outcome eventually. Of 164 INPs of sciatic nerve, 57% and 78% in the early and late stage, respectively had excellent to good nerve recovery.^[21] The functional outcome was good or fair in 55% of our cases. The reason of less number of good outcomes in our study was short duration of follow up. The only significant factor which affected outcome was motor power grade before surgery.

Prevention

The need to discourage indiscriminate use of intramuscular injections and choice of a proper site of injection should be stressed. Only trained staff should be allowed to administer intramuscular injections. The choice of site for injection must be based on good clinical judgment, using the best evidence available and individualized assessment of the patient. There is wide agreement in the literature that the ventrogluteal site is preferable site for intramuscular injections in the gluteal region. According to royal college of nursing recommendation, the anterolateral thigh should be used in infants and the deltoid in older children. The buttock is not recommended. The size of the needle should also be according to age and built of children.^[22] Physicians and nurses should be educated about INP. When they suspect INP they should refer patients early to the specialist. If motor deficits occur, physiotherapy should be started and appropriated orthoses should be prescribed for prevention of contractures. INP from erroneous injection causes discomfort, morbidity, lasting disability, and also provides the basis for negligence suits.^[17]

Conclusion

INP still constitutes a public health hazard in developing countries and shares a significant burden of all nerve

injuries. The outcome of INP is generally good and many patients recover spontaneously. The outcome of surgery is good if performed within reasonable time after injury. Outcome is influenced by motor power after injury. However prevention of nerve injuries due to intramuscular injections cannot be under emphasized.

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