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ORIGINAL ARTICLE

An obstetric brachial plexus data sheet

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Abstract
Background Several reputed obstetric brachial plexus clinics use their own protocols and indications for surgery. This study is to present and explain the obstetric brachial plexus data sheet used at our institution.
Methods The data sheet is composed of 5 main parts: (1) the basic database which includes the name, age, type and side of palsy, maternal history, birth history and other complications of the traumatic delivery; (2) motor assessment of the limb; (3) preoperative investigations; (4) description of intraoperative brachial plexus findings and type of nerve procedure performed; and (5) secondary surgery to the shoulder, elbow, forearm, wrist and hand.
Results The data sheet was found useful in documenting the assessment and events in infants and older children.
Conclusion An obstetric brachial plexus data sheet is presented and it may be modified and used by other centers.

Keywords Brachial plexus · Data · Obstetric.

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Introduction

Several well known obstetric brachial plexus clinics use their own protocols and indications for surgery [1–4]. The obstetric brachial plexus data sheet used at our institution [5] is presented (see Appendix 1). The data sheet is composed of five main parts as follows:

Part I: The basic database

Data regarding the name, medical record number, and age of the patient are documented. The palsy is usually either right or left sided. Bilateral palsies are rare and seem to be unique for breech deliveries [6]. The pathomechanics to explain this is interesting [7]. In cephalic presentation, the head and one shoulder are delivered first and there is difficulty in delivering the other shoulder (the so-called shoulder dystocia) resulting in palsy of the ipsilateral limb. Breech babies are usually small and delivery of the legs, upper limbs, and trunk occur first. Once the shoulders are delivered, there may be difficulty in delivery of the 'after-coming' head. Pulling the baby out by traction on one or both shoulders may lead to unilateral or bilateral traction injury. We prefer to document the type of palsy as upper Erb's (involving the C5 and C6 roots), extended Erb's (C5, C6 and C7 roots), or total palsy (C5, C6, C7, C8, T1 roots). The latter is subdivided into two depending on the presence of Horner's syndrome which is a significantly bad prognostic sign for spontaneous recovery [8]. The clinical diagnosis is relatively easy to make because C5 injury is translated as lack of shoulder abduction/external rotation, C6 injury as inability to flex the elbow, C7 injury as wrist drop, C8 injury as weak or absent flexion of the digits, and T1 injury as intrinsic minus posture of the hand. The so-called 'waiter's tip posture' is seen in the extended Erb's type. Note should be given that other types of palsy namely: Klumpke's palsy (isolated C8-T1 injury) and intermediate palsy (mainly involving the C7 root) are not seen clinically with mod-

ern obstetric practice [9–11]. The author is frequently involved in the medico-legal assessment of birth palsy cases and I have put a list of the possible causes, other than traumatic delivery of upper limb paralysis in the newborn, which mimics the clinical picture of obstetric palsy. These causes include fracture pseudo-paralysis, congenital aplasia of the roots of the brachial plexus, congenital varicella of the upper limb, cerebral palsy, intra-uterine compression by the umbilical cord, 'deformation syndrome' in Bicornuate uterus, and intra-uterine maladaptation palsy [12–15].

In maternal and birth history, all known risk factors for birth palsy are documented such as maternal short stature, diabetes/gestational diabetes, multiparity, previous children with birth palsy, increased birth weight, assisted (vacuum or forceps) delivery, and difficult delivery (shoulder dystocia and difficult delivery of the after coming head) [13–18]. Note should be given that although delivery by cesarean section has a protective role, it is not a guarantee against the occurrence of birth palsy and about 1% of all reported cases are delivered by cesarean section [19]. Finally, other complications of delivery are documented. Fractures of the clavicle and humerus may be present. The obstetrician may intentionally fracture the clavicle during delivery if there is shoulder dystocia in order to help dislodge the shoulder from the pelvic rim. However, most clavicular fractures seen clinically are unintentional and concurrent fractures have no prognostic value for spontaneous recovery [20]. Concurrent phrenic nerve palsy also has no prognostic value for spontaneous recovery [21], but is considered as a significant injury because most newborns will require plication of the diaphragm soon after birth. As mentioned before, concurrent Horner's syndrome usually indicates lower root avulsion and hence is a poor prognostic sign for spontaneous recovery [8].

Part II: Motor assessment

In the first 3 years of life, we use the Toronto scale [22] because it is difficult to assess motion against resistance or measure the actual degrees of motion in a reliable way. After 3 years of age, we have developed our own motor assessment scale (see Appendix) [23]. Most surgeons use the Mallet system to assess the shoulder [24]. We found difficulties applying the Mallet system in many patients because the system associates shoulder abduction and external rotation in each grade. For example, Mallet IV means active shoulder abduction over 90° and external rotation over 20°. Several patients, however, will have active shoulder abduction of over 90° with zero external rotation. Therefore, we assess external rotation and abduction separately. Although some centers include sensory assessment in birth palsy [25] we do not include this in our assessment. Note should be given that our motor assessment is a combination and modifications of the assessment used in other OBBP Clinics. Other scoring systems exist in the literature [26].

Part III: Investigations

Except for X-rays (for fractures) and fluoroscopy (for the diaphragm), not all centers perform EMG/nerve conduction and CT myelogram/MRI. There are problems with interpretation of EMG/nerve conduction in the newborn because of many reasons including the well known massive 'collateral sprouting'. However, with experience, EMG/nerve conduction may reach a high level of accuracy [27]. Despite the false positive and false negative occurrences, CT myelogram/MRI gives an idea regarding root avulsion. However, surgeons who argue against these tests in birth palsy make the point that radiological findings will have no impact on the decision for primary exploration. Furthermore, CT myelogram and MRI require general anesthesia in the newborn. We believe that these tests can give a good idea regarding the preoperative diagnosis of root avulsion but their results should not be used as the sole indication for surgical exploration.

Part IV: Primary surgery

I have previously reviewed the literature regarding the indications of primary exploration of the brachial plexus in birth palsy [14]. Almost all centers (including ours) agree that primary surgery is indicated in total palsy if there is no significant recovery by 3 months of age or if there is an associated persistent Horner's sign. What is controversial is the indication for primary surgery in Erb's palsy. Many centers apply Gilbert's golden rule: 'No elbow flexion by 3 months of age' [28]. In our center, no elbow flexion by 4 months of age is the indication for primary surgery in Erb's palsy [29]. The technique of surgery varies from one surgeon to another and is not the subject of this paper [30, 31]. For Erb's palsy, we use a neck incision with two limbs: one along the border of sternomastoid and one along the clavicular border. In total palsy, the latter limb is extended along the deltopectoral groove. We first identify the supraclavicular nerves and follow them to the C4 root and hence, identify (and stimulate) the phrenic nerve first. The phrenic nerve is protected and the remaining roots of the plexus are explored. Exploration may reveal one of five pathologies in the roots of the brachial plexus [15]: favorable conducting neuroma-in-continuity (neuromas with strong muscle contraction on electrical stimulation are treated with neurolysis), unfavorable conducting neuroma-in-continuity (all these should be resected to provide useful functional recovery [32]), postganglionic root rupture (treatment is

Appendix 1. Obstetric Brachial Plexus Palsy Data Sheet

PART I: ASIC DATABASE

Name : _____

Medical record number : _____

Date (at the time of 1st visit) : _____

Age (at time of 1st visit) : _____

Sex: [ ] Male [ ] Female

Side/type of palsy : Right ☐ ERB's C5, 6 ☐
ERB's C5, 6, 7 ☐
Left ☐ Total with no horner ☐
Total with horner ☐

Maternal history : Maternal Height/Weight at Delivery: _____
Diabetes/Treatment of Diabetes: _____
Gestational Diabetes: _____
Prolonged Labor: _____
Para: _____ Gravida: _____

Previous children

Number	Age	Birth Weight	Place of Birth	Position/Delivery	Birth Palsy

Birth history: Gestational age: _____ Birth weight: _____ Hospital _____
Presentation (vertex/breech): _____
Position at delivery: ☐ LOA ☐ LOT ☐ LOP ☐ ROA ☐ ROT ☐ ROP

Mode of delivery: ☐ Spontaneous vaginal ☐ Vacuum assisted vaginal ☐ Forceps assisted ☐ C – Section

Documented: ☐ Shoulder dystocia (Cephalic) ☐ Difficulty of delivery of the after coming head (Breech)

Other complications: Asphxia _____
Fractures/dislocations _____
Phrenic palsy _____
Horner's syndrome _____
Torticollis _____

PART II: MOTOR ASSESSMENT BEFORE 3 YEARS OF AGE (Toronto Scale)

0. Nil
1. Muscle contraction, No motion
2. Joint Motion ≤ ½ Range
3. Joint Motion > ½ Range
4. Full Motion

Gravity eliminated

5. Joint Motion ≤ ½ Range
6. Joint Motion > ½ Range
7. Full Motion

Against gravity

Date of visit										
Age at visit										
Time since surgery (Post-op)										
Shoulder Abduction Adduction Flexion Extension External rotation Internal rotation										
Elbow Flexion Extension										
Forearm Pronation Supination										
Wrist Flexion Extension										
Finger Flexion Extension										
Thumb Flexion Extension										
Special comments noted during any visit (Mark and write below)										

Motor Assessment After 3 years of Age

Shoulder external/internal rotation

0 = flail joint
1 = the hand reaches the abdomen/thorax
2 = reaches the mouth
3 = reaches the ear
4 = reaches the occiput
5 = normal power and range of motion

Shoulder abduction/adduction, shoulder flexion/extension, elbow flexion/extension, wrist flexion/extension

Modified Medical Research Council system
0 = no contraction or flicker of contraction
1 = active movement with gravity eliminated
2 = active movement against gravity only
3 = active movement against resistance with motion reaching ≤1/2 normal range (? degrees)
4 = active movement against resistance with motion reaching >1/2 normal range (? degrees)
5 = normal power and range of motion

Forearm pronation/supination

1 = pronated forearm causing a functional or cosmetic disability
2 = supinated forearm causing a functional or cosmetic disability
3 = functional forearm position (mid-pronation-supination or slight pronation) with no or minimal active motion
4 = same as 3 but with good active pronation and supination
5 = normal power and range of motion

Hand function

0 = useless hand – complete paralysis or slight finger motion of no use, useless thumb
1 = poor function – only very weak grip possible
2 = fair function – there is some active flexion and/or extension of the fingers and some thumb mobility but the hand posture is intrinsic minus
3 = good function – same as 2 but there is no intrinsic minus posture (intrinsic balance)
4 = excellent function – near normal finger flexion/extension and thumb mobility, with some active intrinsic function
5 = normal function

Date of visit								
Age at visit								
Time since surgery								
Shoulder abduction/adduction Flexion Extension External rotation Internal rotation								
Elbow Flexion Extension								
Forearm (pronation/supination)								
Wrist Extension Flexion								
Hand function score								

PART III	
Investigations	☐ X-Rays/Fluroscopy _____ ☐ Nerve Conduction/EMG _____ ☐ CT Myelogram/MRI _____
PART IV	
Primary Surgery: Date _____ Age _____ Documented Preoperative Photos/Video Intraoperative Diagram Intraoperative Nerve Stimulation	
Intraoperative Diagram Post-Nerve Graft/Neurotization/Neurolysis Documented: – Intraoperative photos – Postoperative follow-up photos/video	
PART V	
Secondary Surgery (Date – Type of Procedure – Complications)	
To shoulder	
To Elbow	
To Forearm	
To Wrist	
To Hand	
Other Events: – self mutilation – psychological issues – contact burns – distraction osteogenesis for length discrepancy	

usually by intraplexus neurotization), root avulsion (treatment is usually by a combination of intra- and extraplexus neurotization) and root avulsion *in situ* (usually seen in breech cases and commonly treated by observation [6]). Our center was the first to use Oberlin's nerve transfer in birth palsy cases [33]. We have also done experimental work on end-to-side neurorrhaphy and applied it in birth palsy [6, 34–36]. All these pathologies and reconstructive techniques are explained on two diagrams in the data sheet: a diagram before and another after the reconstruction.

Part V: Secondary surgery and other events

Secondary shoulder deformities [37] are common in birth palsy. Our approach to correction of the internal rotation contracture is as follows. Children with congruent joint undergo subscapularis release and latissimus dorsi muscle transfer [38]. If there is joint subluxation, an external rotation osteotomy of the humerus is done [39]. Another significant problem in birth palsy is lack of (or weak) elbow flexion. If the child has a strong wrist-extension and finger flexion, we perform a Steindler procedure [40]. If not, reconstruction of elbow flexion is either by a bipolar latissimus dorsi pedicle muscle transfer or a functional gracilis muscle free flap. A pronated forearm is common in Erb's palsy but usually requires no surgery. A supinated forearm is common in total palsy and we call it the 'beggar's' hand. If there is good passive forearm pronation, strong biceps and no radial head dislocation, we treat this deformity with biceps rerouting. Otherwise, we treat it with rotational osteotomy of the radius [41]. Lack of wrist extension is usually treated with flexor carpi ulnaris or radialis transfer [42] while tendon transfer in the hand is done according to the deformity using standard techniques [41]. Finally, other events such as self-mutilation and contact burns [43, 44] and their treatment is documented in the data sheet. These events also indicate significant sensory impairment. However, we do not do sensory assessment because it is difficult to perform in infants and young children.

References

1. Terzis JK, Papakonstantinou KC (2002) Outcome of scapula statilization in obstetric brachial plexus palsy. A novel dynamic procedure for correction of the winged scapula. Plast Reconstr Surg 109:548–561
2. Clarke HM, Al-Qattan MM, Curtis CG, Zuker RM (1996) Obstetric brachial plexus palsy. Results following neurolysis of conducting neuroma-in-continuity. Plast Reconstr Surg 97:974–982
3. Gilbert A (1995) Long term evaluation of brachial plexus surgery in obstetrical palsy. Hand Clin 11:583–594
4. Birch R, Bonney G, Wynn Parry CB (1998) Birth lesions of the brachial plexus. In Birch R, Bonney G, Wynn Parry CB (eds) Surgical disorders of the peripheral nerves. Edinburgh, Churchill Livingstone pp 209–234
5. Al-Qattan MM (1996) The first multi-disciplinary obstetrical brachial plexus clinic in Saudi Arabia. J Hand Surg 21B:124–125
6. Al-Qattan MM (2003) Obstetric brachial plexus palsy associated with breech delivery. Ann Plast Surg 51:257–264
7. Sandmire HF, DeMott RK (2008) Newborn brachial plexus palsy. J Obstet Gynaecol 6:567–572
8. Al-Qattan MM, Clarke HM, Curtis CG (2000) The prognostic value of concurrent Horner's syndrome in total obstetric brachial plexus injury. J Hand Surg 25B:166–167
9. Al-Qattan MM, Clarke HM, Curtis CG (1995) Klumpke's birth palsy. Does it really exist? J Hand Surg 20B:19–23
10. El-Sayed AAF et al (1996) Incidence of Klumpke's birth palsy: comparison between two decades. Can J Plast Surg 4:111–113
11. Al-Qattan MM, Clarke HM (1994) Re: a fourth type of brachial plexus lesion. J Hand Surg 19B:673
12. Al-Qattan MM, Thomson HG (1995) Congenital varicella of the upper limb: a preventable disaster. J Hand Surg 20B:115–117
13. Al-Qattan MM (1999) Obstetric brachial plexus palsy. J SOGC 21:964–967
14. Al-Qattan MM (2003) Obstetric brachial plexus injuries. J Am Soc Surg Hand 3:41–54
15. Al-Qattan MM (2004) Obstetric brachial plexus palsy. An experience from Saudi Arabia. Semin Plast Surg 18:265–274
16. Al-Qattan MM (1986) Height as a risk factor in Saudi Arabian obstetrical practice. Saudi Med J 7:37–40
17. Al-Qattan MM, Al-Kharfy TM (1996) Obstetric brachial plexus injury in subsequent deliveries. Ann Plast Surg 37:545–548
18. Al-Qattan MM et al (1996) Obstetric brachial plexus injury in subsequent deliveries. Can J Plast Surg 4:203–204
19. Al-Qattan MM et al (1996) Obstetrical brachial plexus injury in newborn babies delivered by caesarean section. J Hand Surg 21:263–265
20. Al-Qattan MM, Clarke HM, Curtis CG (1994) The prognostic value of concurrent clavicular fractures in newborns with obstetric brachial plexus palsy. J Hand Surg 19B:729–730
21. Al-Qattan MM, Clarke HM, Curtis CG (1998) The prognostic value of concurrent phrenic nerve paralysis in newborn children with Erb's palsy. J Hand Surg 23B:225
22. Clarke HM, Curtis CG (1995) An approach to obstetrical brachial plexus injuries. Hand Clin 11:563–580
23. Al-Qattan MM (2003) Assessment of the motor power in older children with obstetric brachial plexus palsy. J Hand Surg 28B:46–49
24. Mallet J (1972) Paralysie obstetrical du plexus brachial traitement des sequelles. Primaute du traitment de l' epaule-methode d' expression des resultats. Rev Chir Orthop Repar Appar Mot 58(Suppl):166–170
25. Narakas AO (1987) Obstetric brachial plexus injuries. In The paralysed hand. In Lamb D W (ed.) The Hand and Upper Limb, vol 2, Edinburgh: Churchill Livingstone, p 116

26. Basheer H, Zelic V, Rabia F (2000) Functional scoring system for obstetric brachial plexus palsy. J Hand Surg 25B:41–45
27. Smith SJM (1996) The role of neurophysiological investigation in traumatic brachial plexus injuries in adults and children. J Hand Surg 21:145–148
28. Gilbert A, Razabon R, Amar-Khodja S (1988) Indications and results of brachial plexus surgery in obstetric palsy. Orthop Clin North Am 19:91–105
29. Al-Qattan MM (2000) The outcome of Erb's palsy when the decision to operate is made at 4 months of age. Plast Reconstr Surg 106:1461–1465
30. Al-Qattan MM (2004) Identification of the phrenic nerve in surgical exploration of the brachial plexus in obstetrical palsy. J Hand Surg 29A:391–392
31. Al-Qattan MM, El-Shayeb A (2005) Identification of the spinal accessory nerve within the operative field during primary exploration of the brachial plexus in infants with obstetrical palsy. J Hand Surg 30A:808–811
32. Clarke HM et al (1996) Obstetrical brachial plexus palsy. Results following neurolysis of conducting neuroma-in-continuity. Plast Reconstr Surg 97:974–982
33. Al-Qattan MM (2002) Oberlin's ulnar nerve transfer to the biceps nerve in Erb's birth palsy. Plast Reconstr Surg 109:405–406
34. Al-Qattan MM, Al-Thunyan A (1998) Variables affecting axonal regeneration following end-to-side neurorrhaphy. Br J Plast Surg 51:238–242
35. Al-Qattan MM (2000) Prevention and treatment of painful neuromas of the superficial radial nerve by the end-to-side nerve repair concept: an experimental study and preliminary clinical experience. Microsurgery 20:99–104
36. Al-Qattan MM (2001) Terminolateral neurorrhaphy: review of experimental and clinical studies. J Reconstr Microsurg 17:99–108
37. Al-Qattan MM (2003) Classification of secondary shoulder deformities in obstetric brachial plexus palsy. J Hand Surg 28B:483–486
38. Al-Qattan MM (2003) Latissimus dorsi transfer for external rotation weakness of the shoulder in obstetric brachial plexus palsy. J Hand Surg 28B:487–490
39. Al-Qattan MM (2002) Rotation osteotomy of the humerus for Erb's palsy in children with humeral head deformity. J Hand Surg 27A:479–483
40. Al-Qattan MM (2005) Elbow flexion reconstruction by Steindler flexorplasty in obstetric brachial plexus palsy. J Hand Surg 30B:424–427
41. Al-Qattan MM, Al-Khwashki H (2002) The beggar's hand and the unshakable hand in children with total obstetric brachial plexus palsy. Plast Reconstr Surg 109:1947–1952
42. Al-Qattan MM (2003) Tendon transfer to reconstruct wrist extension in children with obstetric brachial plexus palsy. J Hand Surg 28B:153–157
43. Al-Qattan MM (1999) Accidental contact burns of the upper limb in children with obstetric brachial plexus injury. Burns 25:669–672
44. Al-Qattan MM (1999) Self-mutilation in children with obstetric brachial plexus palsy. J Hand Surg 24:547–549