ORIGINAL ARTICLE

Traumatic Brachial Plexus Injuries: HULS Protocol of Management.

Saeed Ahmad[1], Khalid Masood[2], Hafiz Muhammad Kashif Shafi[3], Khalid Zulfiqar Qureshi[4], Belal Saadat[5], Karam Rasool Basra[6]

[1,3,5,6] Classified Orthopedic Surgeon, Hand and Upper Limb Surgery(HULS) Center CMH Lahore Medical College
[2]Head of Department, HULS Center CMH Lahore Medical College
[4]Hand Surgeon HULS Center CMH Lahore Medical College

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Corresponding author:
Saeed Ahmad
E-mail: saeed.ahmed627@gmail.com

ABSTRACT

Objective: To determine the functional outcome of traumatic brachial plexus injuries managed in our institution with our own designated treatment protocol(Hand and Upper Limb Surgery-HULS).

Methods: This descriptive study was conducted in Hand and Upper Limb Surgery center CMH Lahore Medical College from 12th October 2012 to 12th October 2020.Patients of either gender and all ages with traumatic brachial plexus injuries fulfilling the inclusion criteria were assessed and treated with our own designitated algorithm (HULS protocol). Post treatment functional results were gradded as excellent, good, fair and poor.

Results: The total number of patients in our study were 336.Mean age was 32.72 ± 5.58 years.Male patients were 316(94%) and female 20(5.9%). Right sided brachial plexus injury was noted in 245(72.9%) patients and left in 91(27%).Mean follow up peroid was 18 months(range 12 to 23 months).Post treatment functional results were excellent in 16(4.7%) patients, good in 159(47.3%),fair in 121(36%) and poor in 40(11.9%) patients.

Conclusion: Traumatic brachial plexus injuries managed as per HULS protocol resulted in excellent and good functional outcome in majorityof our patients.We found this protocol relevant, applicable and feasible with improved clinical decision making, patient care and outcomes in traumatic brachial plexus injuries.

Keywords: Brachial Plexus, Functional Outcome, Injury, Muscle transfer, Nerve.

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INTRODUCTION

Brachial plexus is an anatomical divergent network of nerves arising from the upper spinal cord responsible for the motor, sensory and sympathetic innervations of the upper extremity.[1] It can be damaged by trauma, inflammatory disorders and tumors.[2] Incidence of brachial plexus injuries is 1 to 2% worldwide and majority of cases are reported from developing counties.[3,4] Brachial plexus injury is most common in younger males between the ages of 15 and 25 years.[2] Traumatic brachial plexus injury(TBPI) can be complete or partial and majority results from motor vehicle accidents.[3] The complexity and chronicity of untreated brachial plexus injury imposes devastating life-changing effects with permanent disability, mental suffering and financial burden.[4,5] Addition of associated vascular injuries, visceral injuries and fractures further add up to the complexity and challenge of managing brachial plexus injuries.[6]

Brachial plexus injuries most commonly affect supraclavicular zone involving roots and trunks while infraclavicular and retroclavicular zones are less commonly affected.[1]These injuries vary from mild stretch to complete tear or avulsion.[7,8] In axonal injuries spontaneous healing potential is low whereas conservative treatment is of no value in avulsion injuries.[1] Different treatments options are being employed for the management of brachial plexus injury depending upon available resources and surgical expertise. Surgical options include neurolysis, nerve repair with or without nerve graft, nerve transfer, functioning muscle or tendon transfer and

joint arthrodesis.[9] Recent advancements like brachial plexus re-implantation and adjunct use of neuroprotective agents and reparative cell therapies are still under trial.[10,11]

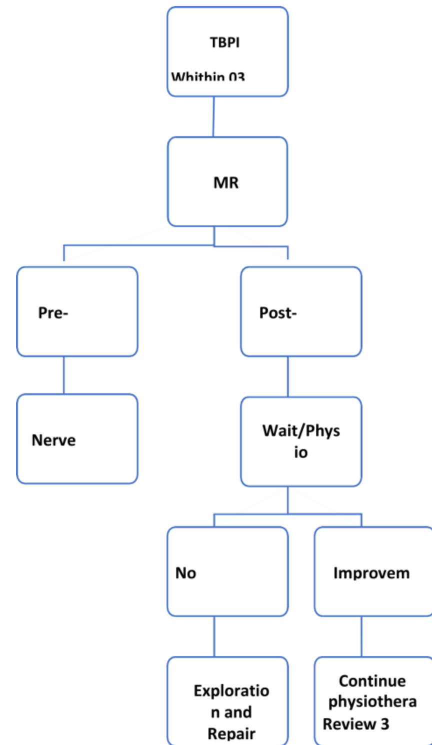
In this study we shared our experience of managing brachial plexus injuries in our institution. We formulated our own protocol (HUL Protocol) of managing brachial plexus injuries based on chronicity and severity. The objective of our study was to determine the functional outcome of traumatic brachial plexus injuries managed in our institution with our own designated treatment protocol Hand and Upper Limb Surgery protocol (HULS).

METHODS

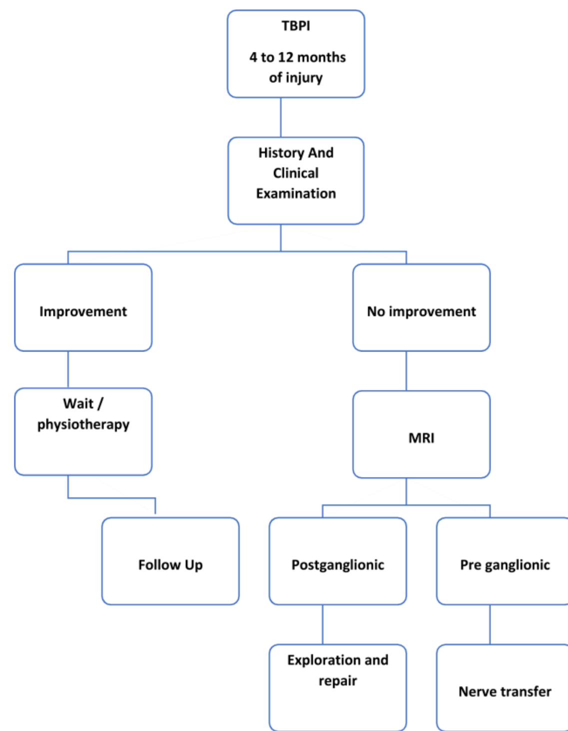
We conducted this descriptive study in Hand and Upper Limb Surgery center CMH Lahore Medical College from 12th October 2012 to 12th October 2020. Patients of either gender and all ages with traumatic brachial plexus injuries presented to the emergency department or OPD were enrolled in our study.Obstetric brachial plexus injuries,acute open TBPI and patients treated surgically in other centres were excluded.The study protocols were approved by the ethical Committee of our hospital and informed written consent was taken from all participants of our study.In the included subjects complete history, physical examinations and relevant investigations were completed. Life-threatening or other major injuries were identified and treated on priority. Our management protocol (**The HULS protocol**) was based upon time since injury and patients were divided into three categories as follows:

Category I: Patients who were presented within 3 months of injury were sreened with MRI brachial plexus to identify the site of injury whether pre ganglionic or post ganglionic. Pre ganglionic injuries were planned for early nerve transfers. Patients of post ganglionic nerve injuries were advised supervised physiotherapy for 3 months and re assessment was done after 3 months. If there was functional recovery then conservative management was continued. If no recovery after 3 months was observed, brachial plexus was explored and repaired (Algorithm A).

Category II: Patients who were presented in 4 to 12 months of sustaining brachial plexus injuries were examined and assessed for functional recovery. If there was improvement physiotherapy was initiated and patient was followed up at regular intervals. In patients with no functional recovery MRI was advised to confirm preganglion or post ganglionic injury. In preganglionic injuries nerve transfers were done while post ganglionic injuries were explored and repaired (Algorithm B)

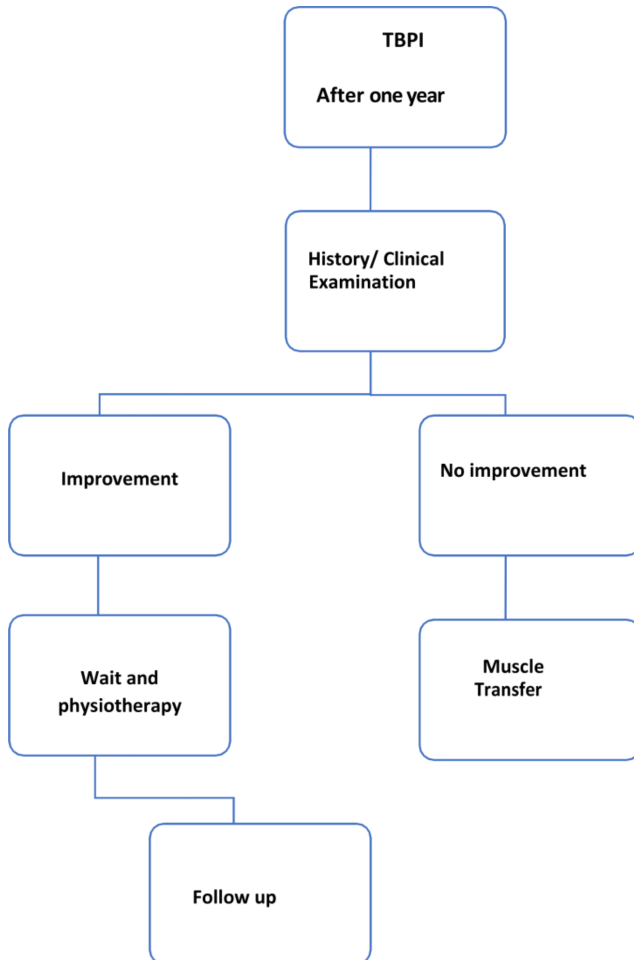


Algorithm A: Management of TBPI presented within three months.



Algorithm B: Management of TBPI presented in between 4 to 12 months of injury.

Category III: Patients who were presented after one year of sustaining brachial plexus injuries were assessed for functional recovery.If signs of improvement were present then physiotherapy and conservative management were continued. If no signs of improvement were noticed muscle or tendon transfers were done. (Algorithm C)



Algorithm C: Management of TBPI presented after one year of injury.

All patients were followed up at 2 weekly interval for intial 2 months, monthly for six months and then six monthly onwards.All cases followed postoperative supervised physiotherapy emphasizing on target muscle strengthening and joint motion.At final follow up visit at 18 months functional outcome was assessed by documenting whether the patient could perform routine work (eating, drinking, cleaning, brushing teeth, combing, change clothes, washing face) and skilled task (writing, painting, driving, use cell phone/laptop).This assessment was done by a qualified hand and upper limb surgeon who was not part of this study team. Post treatment functional results were gradded as excellent(performed routine daily tasks and maximum skilled tasks), good (routine daily tasks and some skilled task), fair (routine daily tasks only and no skilled tasks) and poor(no function).

Data were entered and analyzed with SPSS version 20. Mean and standard deviation was calculated for age. Categorical data was presented as frequencies and percentages.

RESULTS

We included 336 patients.The mean age was 32.72 ± 5.58 years.Majority(94%,n=316) of our patients were male while female were 20(5.9%). The aetiology of TBPI was motor vehicle accidents in 244(72.5%) patients,gunshot injury in 44(13%),fall in 36(11%) and lacerations in 12(3.5%) patients. Right sided brachial plexus injury was noted in 245(72.9%) patients and left in 91(27%).Nerve repair(end to end/autologous sural nerve grating) was performed in 43(12.7%) patients. Nerve transfers were done in 168(50%) patients and included spinal accessory nerve to supra scapular nerve,nerve to long head of triceps to anterior branch of axillary nerve,ulnar nerve to musculocutaneous nerve and intercostal nerve to musculocutaneous nerve. Pedicle muscle transfer was performed in 80(23.8%) and the common transfers were latissimus dorsi to bicep, pectoralis major to bicep,pectoralis major to flexor digitorum profundus and trapezius to bicep or proximal humerus, depending upon target and available muscles.Tendon transfers were performed in 20(5.9%) patients,free muscle transfer in 4(1.1%) cases while 21(6.2%) cases were treated conservatively. Mean follow up peroid was 18 months(range 12 to 23 months).Post treatment functional results at final follow up visit was excellent in 16(4.7%) patients, good in 159(47.3%),fair in 121(36%) and poor in 40(11.9%) patients.

DISCUSSION

Our protocol of TBPI management(HULS protocol) had three categories based upon time since injury.In category I patients were presented within 3 months of injury and if diagnosed to had pre ganglionic injury confirmed on MRI, got nerve transfer surgery without any delay. Veronesi[12] is of the opinion that MRI is a promising diagnostic tool in preoperative assessment of brachial plexus injuries with a descriptive correlation between MRI results and surgical findings.Martin[13] in his systemic review on timing of

surgery in brachial plexus injuries had shown better results of surgery within 6 months of injury. He suggested an optimal delay of 3 months for spontaneous recovery.Shelley[14] advocated immediate repair of brachial plexus nerves in clean incised wounds and 3 to 4 weeks delay in cases of blunt open nerve injuries whereas closed TBPI should routinely be explored in between 3 to 6 months after injury.Many authors [15,16] were however of the opinion that surgery should not be delayed more than 6 months because chronic denervation caused muscle atrophy,joint stiffness and fibrosis leading to impaired functional outcome.[17,18]

The outcome of HULS protocol was based upon functional status of the patient to perform routine daily tasks and skilled tasks.This outcome criteria although not validated yet simple to apply and document. We believed that although clinicians can evaluate the post operative sensory and motor performance of patients but quality of life and functional status can only be judged best by the patient himself.[19,20] Many authors[6,21] utilized variable treatment protocols and outcome measures for treating brachial plexus injuries but all were focused on short term outcomes and lacked focus on patient quality of life and return to work. Kachramanoglou[22] utilized VAS, DASH score,Short Form-36(SF-36) and Michigan Hand Outcome Questionnaire to assess outcome of TBPI while Ahmed-Labib[23] used DASH questionnaire and Short Form-36 to evaluate post operative outcome of TBPI in his study.

Our post treatment functional results at final follow up visit were very good in 16(4.7%) patients, good in 159(47.3%), satisfactory in 121(36%) and poor in 40(11.9%) patients. Ahmed-Labib and collegues[23] treated 31 TBPI patients with mean time since injury of 7.5 months. Nerve transfers alone were done in 19 patients,nerve transfer plus graft in 7,only graft in 3 and primary nerve anastomosis in 2 patients.Patients opertated within 6 months had better score on Disability of the Arm,Shoulder and Hand (DASH) questionnaire (*P* value 0.03) and Short Form-36. Patients with root avulsion had more pain (*P* value 0.04) and lower DASH score (*P* value 0.05). These authors concluded that TBPI involving avulsion of roots and delayed repair were associated with poor functional outcome. Choi[24] stressed the importance of subjective outcome following surgical management of TBPI.He treated 32 patients of TBPI and noted moderate satisfaction in 25(78.1%) patients while quality of life was greatly affected in 10(31,2%) patients. Extreme dissatification was however not reported by any patient.

Our study had few limitations.We were not able to document pre surgery functional status of our study participants.The effects of associated injuries and healing potential of supraclavicular and infraclavicular nervers repair was not compared nor results of individual techniques were compared.Although root avulsion injuries had been shown to had sever pain than other nerve injuries,[25,26] but were not able to document post operative pain sensations in our patients.We recommend further studies taking into account all such limitations so that reliability and validity of HULS protocol is further verified.

CONCLUSION

Traumatic brachial plexus injuries managed as per HULS protocol resulted in excellent and good functional outcome in majorityof our patients.We found this protocol relevant, applicable and feasible with improved clinical decision making, patient care and outcomes in traumatic brachial plexus injuries.Although the clinical outcome in different cases is variable but adoption of a sensible protocol and valid techniques will definitely improve the outcome. The centers with adequate facilities and surgical expertise can employ HULS protocol for desired clinical outcomes.Early diagnosis of TBPI and subsequent referral to an appropriate treatment centre by the primary physician is however mandatory.

Conflict of Interest: None
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