11-1-2020

What have we learned from C5 palsy - A short communication

Sharath Kumar Anand

Mohamed Macki

Journal of Clinical Neuroscience 81 (2020) 111–112

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Short communication

What have we learned from C5 palsy – A short communication

Sharath Kumar Anand [a], Mohamed Macki [b,*]

[a] Wayne State University School of Medicine, 540 East Canfield, Detroit, MI 48201 USA
[b] Department of Neurosurgery, Henry Ford Hospital, 2799 West Grand Boulevard, Royal Oak, MI 48202, USA

ARTICLE INFO

Article history:
Received 27 March 2020
Accepted 14 September 2020

Keywords:
C5
Cervical
Palsy
Spine

ABSTRACT

A study group on C5 palsy retrospectively reviewed 1001 cervical operations at their institutions in order to understand the incidence, prognosticators, pathogenesis, and outcome of C5 palsy after cervical operations. Three studies are summarized. C5 palsy was higher after posterior versus anterior operations. C4-C5 foraminotomy and age were the strongest predictors of C5 palsy after posterior surgeries and anterior cervical decompression-fusion, respectively. Among patients undergoing C4-C5 posterior laminoforaminotomy with instrumented fusion, cord shift on postoperative imaging was thought to be implicated in the pathogenesis of C5 palsy. Among affected patients, 81.4% recovered. Median time to resolution of C5 palsy was between 6 months to 1 year.

In 2013, the Spine Center at Johns Hopkins Hospital set forth a massive undertaking to retrospectively review all C4-C5 decompressions and fusions for one primary outcome measure: the evaluation of postoperative C5 palsy. The monumental effort produced three landmark publications that calculated the incidence, determined the perioperative predictors, and estimated the recovery time of C5 palsy [1]. C5 palsy is a common complication from cervical spine surgery that causes patients significant distress and disability in the postoperative period. In this manuscript, we hope to provide clinicians with a summary of information to help communicate with patients who incur C5 palsy after spine surgery. In a review of 1001 operations, Bydon et al investigated both anterior (anterior cervical discectomy and fusions - ACDF or corpectomy) and posterior (laminectomy and fusion) approaches, reporting a 1.6% and 8.6% C5 palsy incidence, respectively. Within the anterior approach cohort, they found the palsy incidence of 1.0% following ACDF increased to 4.0% following corpectomies and trended upward with increasing corpectomy levels. Despite these statistically significant findings comparing ACDF and anterior corpectomies to C5 palsy incidence, age proved to be the strongest predictor of C5 palsy in the anterior cohort. One hypothesis is that with age, neural elements become more sensitive to manipulation, resulting in an increased incidence of C5 palsy in the elderly population following these operations. Bydon et al. also found posterior C4-5 foraminotomy to have a statistically significantly higher incidence of C5 palsy compared to the anterior C5 foraminotomy cohort. In addition, with an odds ratio of 2.03, posterior C5 foraminotomy was the strongest predictor of C5 palsy within the posterior cohort, overshadowing both age and number of levels decompressed. These findings from this monumental study set the stage for further investigations.

After finding higher rates of C5 palsy in the posterior approach group and identifying C4-5 foraminotomies as the leading culprit in these approaches, the C5 Palsy Study Group sought to explore causes and potential prognostic factors of C5 palsy. To accomplish this, they studied 41 patients, 9 patients with C5 palsy and 32 without C5 palsy, all of whom underwent C4-5 posterior laminoforaminotomy with instrumented fusion and had both preoperative and postoperative imaging [2]. They hypothesized that posterior cord shift, likely caused by dural expansion following laminoforaminotomies, led to increased tension and/or direct damage to the nerve roots, ultimately increasing the C5 palsy rate. Commensurate with their hypothesis and the literature, Bydon et al. found the C5 palsy cohort had a statistically greater widening of the C5 foramen, dural expansion and posterior cord shift compared to the non-C5 palsy cohort. Furthermore, widening of the C5 foramen was significantly correlated with increased cord displacement and both of these factors statistically predicted C5 palsy. These findings led the authors to suggest wider posterior decompressions at C4-C5 resulted in greater fallback of the spinal cord, placing increased tension on the nerve roots and increasing the risk of C5 palsy. While this hypothesis may explain the mechanisms underlying C5 palsy, it provides little insight into prognosis and recovery time.

Recovery time, although not the primary focus in the aforementioned publications, still merited discussion. In "Incidence and

* Corresponding author at: Department of Neurosurgery, Henry Ford Hospital, 2799 West Grand Boulevard, Detroit, MI 48202, USA.
E-mail address: mmacki22@gmail.com (M. Macki).

https://doi.org/10.1016/j.jocn.2020.09.044
0967-5868/

Prognostic Factors of C5 Palsy: A Clinical Study of 1001 Cases and Review of the Literature," Bydon et al reports improvement in C5 palsy within 3–6 months in 75% of patients in the anterior cohort and 88.6% in the posterior cohort after a mean follow-up of 14.4 and 27.6 months, respectively [1]. However, nuances between improvement and recovery of C5 palsy, and prognosticators thereof, required further investigation. In the publication "Manual muscle test at C5 palsy onset predicts the likelihood of and time to C5 palsy resolution," the C5 Palsy Study Group utilized the manual muscle test (MMT) and studied a cohort of 43 patients who experienced C5 palsy following a posterior decompression and instrumented fusion surgery, of which 81.4% (n = 35) achieved full resolution of symptoms [3]. These 35 patients had a median MMT score of 3- at the onset of C5 palsy symptoms compared to a median MMT score of 2 for those whose C5 palsy symptoms did not resolve. Furthermore, for every one-grade increase in MMT score at symptom onset, the hazards of C5 palsy resolution increased by 19%. Following the discovery of this remarkable yet predictable correlation between MMT score and C5 palsy incidence, surgeons are left with, arguably, the most common patient question: *When will my weakness resolve?* The C5 Palsy studies utilized a discrete-time proportional hazards model to report a median time to resolution between 6 months to 1 year. The variability in duration of recovery is due to a variety of prognostic factors, but interestingly, multiple linear regression revealed lower MMT scores at the onset of C5 palsy predicted a longer time to resolution. These findings as well as the aforementioned radiographic studies suggest the potential utility of both MMT scores and postoperative imaging (Computerized tomographic - CT myelogram/ Magnetic Resonance Imaging - MRI) in understanding C5 palsy.

In summary, these monumental efforts from the Spine Center at Johns Hopkins Hospital elucidated a number of important findings regarding the incidence, perioperative predictors and recovery time of C5 palsy; however, these studies certainly had their shortcomings. Most obviously, these retrospective studies, although great for identifying correlations and associations are simply incapable of establishing causation between the factors illustrated above and C5 palsy. While these contributions to the literature reflect a tremendous feat, further prospective studies to determine causation with various population demographics and surgical expertise are likely necessary before these findings are accepted as paradigm. Different ethnicities have significantly different spinal canal dimensions, and the techniques individual surgeons use to decompress the cervical nerve roots may play a role in the incidence of C5 palsy. Therefore, prospective studies that have the potential to elicit these nuances in both surgeon preferences and patient populations will likely build on the findings from these studies and increase the generalizability to larger populations.

Declaration of Competing Interest

The authors, Sharath Kumar Anand and Mohamed Macki, report no conflicts of interest or disclosures.

References

[1] Bydon M, Macki M, Kaloostian P, Sciubba DM, Wolinsky JP, Gokaslan ZL, et al. Incidence and prognostic factors of c5 palsy: a clinical study of 1001 cases and review of the literature. Neurosurgery 2014;74:595–604. discussion -5.
[2] Bydon M, Macki M, Aygun N, Sciubba DM, Wolinsky JP, Witham TF, et al. Development of postoperative C5 palsy is associated with wider posterior decompressions: an analysis of 41 patients. Spine J 2014;14:2861–7.
[3] Macki M, Alam R, Kerezoudis P, Gokaslan Z, Bydon A, Bydon M. Manual muscle test at C5 palsy onset predicts the likelihood of and time to C5 palsy resolution. J Clin Neurosci 2016;24:112–6.