# Intraoperative Neuromonitoring in Anterior Cervical Discectomy and Fusion is Protective Against Post-Operative Neurosurgical Complications, But at What Cost?

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INTRODUCTION: Intraoperative neuromonitoring (IONM) is used during anterior cervical discectomy and fusion (ACDF) to limit the risk of neurological damage. While IONM is common, there is a paucity of literature that considers the costs, trends in costs, and long-term outcomes of IONM. This study uses a national cohort to evaluate both the cost and outcomes differences between patients undergoing ACDF with or without IONM.

METHODS: Using the Premier Healthcare database, patients undergoing ACDF between January 2016 and December 2020 with and without IONM were included. Patients who received IONM during ACDF were 1:1 propensity score matched with patients who did not based on demographics, Elixhauser comorbidities, indications for surgery, multilevel surgery, surgery length of stay, and inpatient/outpatient status. Hospital costs were categorized (implants, labor, room/board) and adjusted to 2023 dollars. Yearly average costs over the study period were assessed in IONM and non-IONM groups. Two-year revision rates, 30-day readmissions, two-year post-operative neurological complication, and two-year post-operative hemi/paraplegia were evaluated using Kaplan-Meier and multivariate Cox-Proportional Hazard (CoxPH) models. A subgroup analysis of these outcomes were performed for patients presenting with radiculopathy or myelopathy.

RESULTS: 39,490 patients underwent ACDF performed with IONM in the study period. After 1:1 matching, age, gender, inpatient %, Elixhauser comorbidities, and indications for surgery did not differ significantly. Average surgical encounter costs were 15.9% greater in the IONM group ($23,938.21 vs $20,650.77), driven by $1,018.83 spent on IONM and 20.5% ($1,063.83) more spent on operating room time (Figure 1). Between 2016 and 2020, IONM and non-IONM costs have diverged significantly (Figure 2). In 2016, prices between each group were significantly different, but non-IONM ACDF costs have remained flat while ACDF with IONM costs have risen (Figure 2). In the CoxPH models, IONM usage does not significantly change the hazard of 2-year revision (p = 0.731), 30-day readmission (p=0.487), or 2-year post-operative hemi/paraplegia (p=0.130), but it does protective against 2-year post-operative neurosurgical complications (HR = 0.82 [95% CI: 0.69-0.97], p = 0.017) (Figure 3). In radiculopathy and myelopathy patients, there is also a lack of statistically significant protective effect in 2-year revision and 30-day readmission.

DISCUSSION AND CONCLUSION:

IONM usage in ACDF is associated with greater costs and increasing costs between 2016-2020. Previous studies have found no effect of IONM on post-surgical neurological complications after ACDF which contrasts with findings here. Finally, the growing costs of IONM over time shown in this study is concerning and requires further investigation into the drivers of expense that are not present in ACDF without IONM.

**Figure 1:** Summary of costs between matched IONM and Non-IONM groups

| Cost Category | No IONM | IONM | % Difference |
|---|---|---|---|
| Anesthesia | $608.06 | $629.28 | 3.5% |
| Central Supply | $2,242.29 | $2,619.76 | 16.8% |
| Diagnostic Imaging | $348.79 | $389.02 | 11.5% |
| Implant Bone/Replacement | $880.52 | $816.06 | -7.3% |
| Implant Ortho | $340.24 | $481.20 | 41.4% |
| Implants Spinal Hardware | $3,302.50 | $3,292.22 | -0.3% |
| Pharmacy | $956.93 | $979.50 | 2.4% |
| Physical Medicine /Pt/Ot/Rehab | $257.76 | $307.93 | 19.5% |
| Plate Ortho Hardware | $540.21 | $598.85 | 10.9% |
| Recovery Room | $663.71 | $676.64 | 1.9% |
| Room And Board | $2,826.10 | $2,961.34 | 4.8% |
| Screw Ortho Hardware | $1,236.01 | $1,471.20 | 19.0% |
| Surgery | $5,190.72 | $6,254.55 | 20.5% |
| Electromyographic Testing | $0.00 | $1,018.83 | - |
| Other | $1,256.91 | $1,441.84 | 14.7% |
| Total | $20,650.77 | $23,938.21 | 15.9% |

**Figure 2:** IONM versus matched non-IONM costs over time

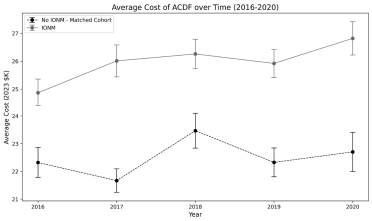


**Figure 3:** Kaplan Meier Curves and Cox Proportionate Hazard models of 2-year revision, 30-day readmission, 2-year post-operative neurological complication, and 2-year hemi/paraplegia