

Insurance Status in Vestibular Schwannoma Surgery: Associations with Post-Operative Outcomes

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BACKGROUND

Vestibular schwannomas (VS) are rare, benign tumors of the eighth cranial nerve that can have a significant impact on a patient's senses and quality of life. Surgery remains one of the mainstays of treatment for this condition. Various retrospective studies using large, national cancer databases have found insurance status to influence surgical outcomes in malignant tumors.¹⁻⁴ However, the association between insurance status and benign tumors, like VS, remains relatively unexplored.

Our study aims to evaluate associations of insurance status on a wide range of post-operative outcomes in patients undergoing VS surgery using a national database.

METHODS

Retrospective Study Design

- Data Source: Vizient Clinical Database
- Patient inclusion criteria: Using specific ICD-10 diagnosis and procedure codes, adult patients (18 or older) treated with surgery for vestibular schwannoma between the years 2018 and 2022
- Any patient with Medicare, Medicaid, State, Military, County, or Title V insurance was labeled as having public insurance. Patients with commercial/private insurance were labeled as having private insurance, and those listed as self-pay were labeled as having no insurance
- Outcomes of interest included length of stay (LOS), LOS index (ratio of observed to expected LOS), complication rate, intensive care unit (ICU) LOS, complication rate, direct cost, direct cost index (ratio of observed to expected cost), 7-day readmission rate, 14-day readmission rate, and 30-day readmission rate
- Mortality rate was also collected but ultimately excluded from the final analyses given how rare the outcome is

Statistical Analysis

- Chi-square tests were performed to compare categorical variables; Kruskal-Wallis tests were used to compare continuous variables without a normal distribution
- Multivariable linear regression was performed to evaluate the relationship of insurance status on peri-operative surgical outcomes for vestibular schwannomas. The models were adjusted for sex, race, age, hospital operative volume, case mix index, and geographic location.

RESULTS

| Demographics of Cases | Private Insurance | Public Insurance | No Insurance | P-value* |
|-----------------------|-------------------|------------------|--------------|-----------|
| | No. (%) | No. (%) | No. (%) | |
| Total Cases | 3643 (100%) | 1652 (100%) | 70 (100%) | |
| Sex | | | | |
| Female | 2022 (55.5%) | 945 (57.2%) | 38 (54.3%) | 0.49 |
| Male | 1621 (44.5%) | 707 (42.8%) | 32 (45.7%) | |
| Age | | | | |
| 18-30 | 293 (8.0%) | 105 (6.4%) | 10 (14.3%) | 0.01* |
| 31-50 | 1564 (42.9%) | 318 (19.2%) | 40 (57.1%) | <0.001*** |
| 51-64 | 1633 (44.8%) | 349 (21.1%) | 17 (24.3%) | <0.001*** |
| 65-74 | 141 (3.9%) | 701 (42.4%) | 3 (4.4%) | <0.001*** |
| 75-84 | 12 (0.4%) | 174 (10.5%) | 0 (0.0%) | <0.001*** |
| 85+ | 0 (0.0%) | 5 (0.3%) | 0 (0.0%) | 0.003** |
| Race | | | | |
| White | 3020 (82.9%) | 1313 (79.5%) | 35 (50.0%) | <0.001*** |
| Black | 133 (3.7%) | 82 (5.0%) | 5 (7.1%) | 0.035* |
| Asian | 184 (5.1%) | 62 (3.8%) | 7 (10.0%) | 0.013* |
| Other | 218 (6.0%) | 154 (9.3%) | 16 (22.9%) | <0.001*** |
| Unavailable/Unknown | 52 (1.4%) | 26 (1.6%) | 6 (8.5%) | <0.001*** |
| Declined | 36 (1.0%) | 15 (0.9%) | 1 (1.4%) | 0.89 |
| Case Mix Index | 3.06 (1.77) | 3.32 (1.88) | 4.11 (1.98) | <0.001*** |

Table 1. Patients with surgery for vestibular schwannoma - demographics by insurance status. (a) P-value obtained from Chi-square test of proportions.

| Outcome Measures | Median (IQR) | Median (IQR) | Median (IQR) | P-value* |
|-----------------------------------|-------------------|-------------------|-----------------|-----------|
| LOS² | 3.67 (2.0) | 4.0 (3.0) | 4.0 (4.0) | <0.001*** |
| LOS ² Index | 0.794 (0.39) | 0.782 (0.45) | 0.750 (0.37) | 0.52 |
| LOS ² ICU ¹ | 1.0 (1.0) | 1.0 (1.0) | 1.0 (1.0) | 0.47 |
| Direct Cost | 20573.0 (11314.0) | 21515.0 (13799.0) | 20133 (13316.0) | 0.019* |
| Direct Cost Index | 0.969 (0.51) | 0.990 (0.56) | 0.843 (0.51) | 0.19 |
| Complication Rate | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.15 |
| 7-day Readmission Rate | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.008* |
| 14-day Readmission Rate | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.037* |
| 30-day Readmission Rate | 0.0 (0.0) | 0.0 (0.0) | 0.0 (0.0) | 0.11 |

Table 2. Patients with surgery for vestibular schwannoma - outcomes by insurance status. (a) P-values obtained from Kruskal-Wallis test. ¹ICU= Intensive Care Unit ²LOS= Length of Stay

| Effect | LOS ¹ | | LOS ¹ Index | | LOS ICU ² | | Complication Rate | | Direct Cost | |
|-------------------------|------------------|-----------|------------------------|-----------|----------------------|-----------|-------------------|-----------|-------------------|-----------|
| | Coeff (SE) | P-value | Coeff (SE) | P-value | Coeff (SE) | P-value | Coeff (SE) | P-value | Coeff (SE) | P-value |
| Public insurance | 1.0 (0.19) | <0.001*** | 0.01 (0.02) | 0.66 | 0.31 (0.12) | 0.01* | 0.01 (0.01) | 0.12 | 1667.0 (513.6) | 0.001** |
| No insurance | 1.6 (0.55) | 0.005** | 0.01 (0.07) | 0.94 | 0.12 (0.35) | 0.74 | -0.01 (0.03) | 0.67 | -847.6 (1495.1) | 0.57 |
| Age 31-50 | -0.10 (0.29) | 0.72 | 0.02 (0.04) | 0.51 | -0.07 (0.18) | 0.71 | 0.01 (0.01) | 0.62 | -1922.7 (780.5) | 0.01 |
| Age 51-64 | -0.06 (0.29) | 0.83 | 0.001 (0.04) | 0.98 | -0.03 (0.18) | 0.87 | 0.02 (0.01) | 0.26 | -2625.4 (781.0) | <0.001*** |
| Age 65-74 | -0.40 (0.33) | 0.23 | -0.008 (0.04) | 0.84 | -0.17 (0.21) | 0.42 | 0.02 (0.02) | 0.30 | -3498.5 (896.1) | <0.001*** |
| Age 75-84 | 0.57 (0.46) | 0.22 | -0.009 (0.06) | 0.87 | -0.12 (0.29) | 0.69 | 0.03 (0.02) | 0.16 | -3655.7 (1241.4) | 0.003** |
| Age 85-100 | -1.9 (1.9) | 0.33 | -0.34 (0.24) | 0.17 | -1.8 (1.2) | 0.15 | 0.09 (0.09) | 0.28 | -11943.2 (5127.0) | 0.02* |
| Female sex | -0.17 (0.17) | 0.31 | -0.003 (0.02) | 0.89 | 0.03 (0.11) | 0.77 | -0.03 (0.01) | <0.001*** | -600.8 (451.0) | 0.19 |
| Case Mix Index | 1.0 (0.05) | <0.001*** | 0.08 (0.01) | <0.001*** | 1.0 (0.03) | <0.001*** | 0.05 (0.003) | <0.001*** | 4844.1 (145.5) | <0.001*** |
| Black | 0.01 (0.33) | 0.97 | 0.02 (0.04) | 0.66 | -0.15 (0.21) | 0.47 | 0.02 (0.02) | 0.13 | 730.3 (893.9) | 0.42 |
| Asian | 0.51 (0.33) | 0.13 | -0.04 (0.04) | 0.67 | 0.22 (0.21) | 0.29 | 0.03 (0.02) | 0.03* | 2576.5 (903.1) | 0.004** |
| Other | 0.13 (0.27) | 0.68 | 0.03 (0.03) | 0.40 | -0.25 (0.17) | 0.15 | 0.01 (0.01) | 0.26 | 1018.3 (742.8) | 0.18 |
| Unknown | 0.36 (0.58) | 0.53 | 0.005 (0.07) | 0.94 | 0.96 (0.41) | 0.01* | 0.04 (0.03) | 0.16 | -204.1 (1564.1) | 0.90 |
| Declined | 0.48 (0.63) | 0.45 | 0.04 (0.08) | 0.59 | 0.32 (0.39) | 0.42 | 0.02 (0.03) | 0.55 | 2804.1 (1696.6) | 0.10 |
| Low volume | 1.49 (0.48) | 0.002** | 0.27 (0.06) | <0.001*** | 0.83 (0.31) | 0.007** | 0.01 (0.02) | 0.64 | 2365.4 (1322.4) | 0.07 |
| Medium volume | 1.0 (0.21) | <0.001*** | 0.16 (0.03) | <0.001*** | 0.69 (0.14) | <0.001*** | 0.02 (0.01) | 0.09 | 2094.4 (576.1) | <0.001*** |
| Midwest | 0.23 (0.24) | 0.33 | 0.09 (0.03) | 0.006** | 0.05 (0.16) | 0.73 | 0.01 (0.01) | 0.43 | 691.6 (655.8) | 0.29 |
| South | 0.27 (0.24) | 0.25 | 0.09 (0.03) | 0.003** | 0.18 (0.15) | 0.24 | 0.01 (0.01) | 0.26 | -621.0 (655.4) | 0.34 |
| West | -0.06 (0.26) | 0.82 | -0.05 (0.03) | 0.09 | -0.11 (0.16) | 0.52 | 0.01 (0.01) | 0.23 | 4348.7 (694.5) | <0.001*** |

Table 3. Multivariable model results for vestibular schwannoma surgical outcomes. ¹ICU = Intensive Care Unit ²LOS = Length of Stay

Discussion

Overall, patients with private insurance were more likely to be between the ages of 31-64 while patients with public insurance were more likely to be between the ages of 65+. Patients with private insurance were also more likely to be White.

Most importantly, this study demonstrated that public insurance status was associated with a significantly longer length of stay (LOS) and direct costs of care.

Possible explanations for these findings are:

- 1) Increased tumor size at presentation which leads to more extensive surgery: There are disproportional barriers to care amongst those with public insurance including lack of transportation and limited provider networks^{5,6}
- 2) Difficult discharge planning: There are increased frequencies of non-home discharges (e.g., rehabilitation centers, skilled nursing facilities, shelters/temporary housing units) among those with public insurance^{7,8}

CONCLUSION

Insurance status warrants consideration as a social determinant of health that may be related to LOS after VS surgery, dictating overall costs of care. Insurance status may act as a heuristic to find those who require more extensive surgery or need additional attention to ensure timely discharge.

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