Demographic Trends in Paddle Lead Spinal Cord Stimulator Placement: Private Insurance and Medicare Beneficiaries

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Objective: Although spinal cord stimulators (SCS) continue to gain acceptance as a viable nonpharmacologic option for the treatment of chronic back pain, recent trends are not well established. The aim of this study was to evaluate recent overall demographic and regional trends in paddle lead SCS placement and to determine if differences in trends exist between private-payer and Medicare beneficiaries.

Methods: A retrospective review of Medicare and private-payer insurance records from 2007–2014 was performed to identify patients who underwent a primary paddle lead SCS placement via a laminectomy (CPT-63655). Each study cohort was queried to determine the annual rate of SCS placements and demographic characteristics. Yearly SCS implantation rates within the study cohorts were adjusted per 100,000 beneficiaries. A chi-square analysis was used to compare changes in annual rates.

Results: A total of 31,352 Medicare and 2,935 private-payer patients were identified from 2007 to 2014. Paddle lead SCS placements ranged from 5.9 to 17.5 (p<0.001), 1.9 to 5.9 (p<0.001), and 5.2 to 14.5 (p<0.001) placements per 100,000 Medicare, private-payer, and overall beneficiaries respectively from 2007 to 2014. SCS placements peaked in 2013 with 19.6, 7.1, and 16.8 placements per 100,000 Medicare, private-payer, and overall patients.

Conclusion: There was an overall increase in the annual rate of SCS placements from 2007 to 2014. Paddle lead SCS placements peaked in 2013 for Medicare, private-payer, and overall beneficiaries. The highest incidence of implantation was in the Southern region of the United States and among females. Yearly adjusted rates of SCSs were higher among Medicare patients at all time points.

Keywords: Spinal cord stimulation, Back pain, Demography, Medicare, Laminectomy

INTRODUCTION

Since its introduction by Shealy et al in 1967, spinal cord stimulators (SCS) have gained a wide range of application amongst a number of medical specialties for neuropathic pain alleviation.¹² The recent intersection between the health and economic burden of chronic back pain and the ongoing opioid epidemic has heightened the need for safer alternatives to treat chronic back pain.³⁴ SCSs continue to gain acceptance amongst spine surgeons as a nonpharmacologic treatment option to address chronic back pain from failed back surgery syndrome and other pain pathologies such as complex regional pain syndrome (CRPS), where conservative medical management (CMM) therapies have failed. In a number of randomized controlled trials, SCSs have been shown to be more effective in the treatment of chronic pain in spine patients compared to CMM or
reoperation. With the rising popularity of SCSs, the role of insurance providers' play in utilization has begun to garner attention. Private-payers have shown to have lower overall costs following implantation while simultaneously less likely to receive SCS coverage approval when compared to their public counterparts. However, to date, one has explored what effect these differences in providers have on annual incidence of SCS.

Presently, SCS placement is performed either percutaneously with cylindrical leads or with paddle lead placement via a laminectomy. Although previous studies have reported on the trends of SCS use, most are outdated and there is a lack of consensus amongst these studies. The aim of this study was to evaluate recent overall demographic and regional trends in paddle lead SCS implantation. Additionally, given the disparity of post-SCS cost-effectiveness and coverage among insurance providers, the study will examine if differences in annual trends exist between private-payer and Medicare beneficiaries.

MATERIALS AND METHODS

1. Data Source

A retrospective database review was conducted, utilizing the commercially available PearlDiver Patient Records Database (www.pearldiverinc.com; PearlDiver Inc., Colorado Springs, CO, USA), which contains Medicare (2005–2014) and private-payer insurance (Humana, 2007–2016) patient records, searchable by billable codes. All queried data are de-identified and Health Insurance Portability and Accountability Act compliant. As such, this study was exempt from Institutional Review Board approval.

2. Study Population

Our study includes all Medicare and private-payer patients suffering from neuropathic related pain who underwent a primary paddle lead SCS placement via a laminectomy (CPT-63655) from 2007 to 2014. Only primary paddle lead SCS placements were included in this study. Percutaneous cylindrical lead placements were not included because coding does not differentiate between trial and permanent cylindrical lead placement. Furthermore, International Classification of Diseases, Ninth Revision diagnosis codes were used to exclude patients with a history of spine infection, trauma, or a primary malignancy or metastasis of the spine.

3. Trends in SCS Placement

Each database was queried separately to identify patients in the Medicare and private-payer cohorts. Each cohort was further queried to determine the number of SCS placements and to calculate annual rates. Data were then pooled to provide overall assessment of the population. A breakdown of demographic parameters, including total number of patients, age, region, and gender was also performed. As the private-payer database permits the query of race and physician specialty information, these additional parameters were included in the private-payer cohort.

4. Data Analysis

The frequency of SCS placement amongst different demographic parameters including age range (less than 65, 65–84, and greater than 85 years), female sex, and region was determined in each cohort. Additionally, frequency of SCS placements was determined for race and physician specialty within the private-payer cohort. Annual rates of SCS placements within both study cohorts were adjusted per 100,000 beneficiaries. A chi-square analysis was used to compare changes in annual rates, with significance set at p < 0.05.

RESULTS

1. Patient Demographics

In total, 34,287 paddle lead SCS placements were identified in the Medicare (n = 31,352) and private-payer (n = 2,935) insurance databases from 2007 to 2014 (Fig. 1). Incidence of overall SCS placement was highest in ages 65–84 years (54.0%) amongst Medicare beneficiaries and all providers (52.9%) while SCS placement rates were highest in patients < 65 years old (56.8%) amongst private-payers. SCSs were placed in greater propor-
Table 1. 2007–2014 paddle lead spinal cord stimulators demographics among insurance providers

| Variable             | Medicare (n = 31,352) | Private-payer (n = 2,935) | All providers (n = 34,287) |
|----------------------|------------------------|---------------------------|---------------------------|
| Age (yr)             |                        |                           |                           |
| < 65                 | 13,402 (42.7)          | 1,667 (56.8)              | 15,069 (43.9)             |
| 65-84                | 16,919 (54)            | 1,217 (41.5)              | 18,136 (52.9)             |
| > 84                 | 908 (2.9)              | 51 (1.7)                  | 959 (2.8)                 |
| Female sex           |                        |                           |                           |
|                      | 18,595 (59.3)          | 1,676 (57.1)              | 20,271 (59.1)             |
| Race                 |                        |                           |                           |
| Black                | -                      | -                         | -                         |
| White                | -                      | 2,337 (79.6)              | -                         |
| Hispanic             | -                      | 23 (0.8)                  | -                         |
| Other                | -                      | 402 (13.7)                | -                         |
| Region               |                        |                           |                           |
| Midwest              | 5,898 (18.8)           | 537 (18.3)                | 6,435 (18.8)              |
| Northeast            | 3,574 (11.4)           | 69 (2.4)                  | 3,643 (10.6)              |
| South                | 17,439 (55.6)          | 1,966 (67)                | 19,405 (56.6)             |
| West                 | 4,441 (14.2)           | 363 (12.4)                | 4,804 (14)                |
| Physician specialty  |                        |                           |                           |
| General acute care   | -                      | 863 (29.4)                | -                         |
| Neurological surgery | -                      | 824 (28.1)                | -                         |
| Orthopaedic surgery  | -                      | 470 (16)                  | -                         |
| Psychiatry & neurology| -                     | 371 (12.6)                | -                         |
| Other                | -                      | 407 (13.9)                | -                         |

Values are presented as number (%).

2. Trends in SCS Placement

SCS placements ranged from 5.9 to 17.5 (p < 0.001), 1.9 to 5.9 (p < 0.001), and 5.2 to 14.5 (p < 0.001) placements per 100,000 Medicare, private-payer, and overall beneficiaries respectively from 2007 to 2014 (Fig. 2). SCS placements peaked in 2013 with 19.6, 7.1, and 16.8 placements per 100,000 Medicare, pri-

DISCUSSION

Current pain literature supports the use of SCSs compared to other treatment options such as CMM; nonetheless, there is a

Fig. 2. Comparison of adjusted total of paddle lead spinal cord stimulators (SCS) per 100,000 beneficiaries from 2007 to 2014.

Fig. 3. Regional breakdown of paddle lead spinal cord stimulators (SCS) among All providers from 2007 to 2014.
Table 2. Paddle lead spinal cord stimulators (SCS) trends by year

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | p-value |
|------|------|------|------|------|------|------|------|------|---------|
| **Medicare paddle lead spinal cord stimulators trends by year** | | | | | | | | | |
| Region | | | | | | | | | |
| Midwest | 290 (18.7) | 338 (15.8) | 488 (17.0) | 659 (19.2) | 770 (18.3) | 1,003 (19.6) | 1,066 (19.9) | 979 (20.4) &lt; 0.001 |
| Northeast | 159 (10.2) | 231 (10.8) | 344 (12.0) | 353 (10.3) | 452 (10.7) | 580 (11.3) | 612 (11.4) | 653 (13.6) &lt; 0.001 |
| South | 911 (58.6) | 1,262 (59.0) | 1,627 (56.6) | 1,913 (55.6) | 2,365 (56.2) | 2,811 (54.9) | 2,937 (54.9) | 646 (13.5) - |
| West | 194 (12.5) | 310 (14.5) | 417 (14.5) | 515 (15.0) | 622 (14.8) | 723 (14.1) | 738 (13.8) | 646 (13.5) - |
| Female sex | 906 (58.3) | 1,206 (56.3) | 1,650 (57.4) | 2,058 (59.8) | 2,542 (60.4) | 3,095 (60.5) | 3,184 (59.5) | 2,854 (59.5) &lt; 0.001 |
| Total No. of SCS | 1,554 | 2,141 | 2,876 | 3,440 | 4,209 | 5,117 | 5,353 | 4,797 &lt; 0.001 |
| Adjusted total† | 5.9 | 8.2 | 11.2 | 13.2 | 15.9 | 19.0 | 19.6 | 17.5 | |
| **Private-payer paddle lead SCS trends by year** | | | | | | | | | |
| Region | | | | | | | | | |
| Midwest | 23 (19.7) | 33 (18.2) | 48 (18.4) | 60 (18.3) | 79 (19.1) | 94 (18.7) | 99 (17.6) | 101 (17.7) &lt; 0.001 |
| Northeast | 2 (1.7) | 4 (2.2) | 12 (4.6) | 7 (2.1) | 8 (1.9) | 6 (1.2) | 17 (3.0) | 13 (2.3) 0.008 |
| South | 73 (62.4) | 102 (56.4) | 155 (59.4) | 215 (65.7) | 276 (66.7) | 340 (67.7) | 399 (71.1) | 406 (71.0) &lt; 0.001 |
| West | 19 (16.2) | 42 (23.2) | 46 (17.6) | 45 (13.8) | 51 (12.3) | 62 (12.4) | 46 (8.2) | 52 (9.1) 0.880 |
| Female sex | 65 (55.6) | 111 (61.3) | 140 (53.6) | 197 (60.2) | 233 (56.3) | 275 (54.8) | 314 (56.0) | 341 (59.6) &lt; 0.001 |
| Total No. of SCS | 117 | 181 | 261 | 327 | 414 | 502 | 561 | 572 &lt; 0.001 |
| Adjusted total† | 1.9 | 2.6 | 4.1 | 1.2 | 15.9 | 19.0 | 19.6 | 17.5 | |
| **All providers paddle lead SCS trends by year** | | | | | | | | | |
| Region | | | | | | | | | |
| Midwest | 313 (18.7) | 371 (16.0) | 536 (17.1) | 719 (19.1) | 849 (18.4) | 1,097 (19.5) | 1,165 (19.7) | 1,080 (20.1) &lt; 0.001 |
| Northeast | 161 (9.6) | 235 (10.1) | 356 (11.3) | 360 (9.6) | 460 (10.0) | 586 (10.4) | 629 (10.6) | 666 (12.4) 0.001 |
| South | 984 (58.9) | 1,364 (58.7) | 1,782 (56.8) | 2,128 (56.5) | 2,641 (57.1) | 3,151 (56.1) | 3,336 (56.4) | 2,925 (54.5) &lt; 0.001 |
| West | 213 (12.7) | 352 (15.2) | 463 (14.8) | 560 (14.9) | 673 (14.6) | 785 (14.0) | 784 (13.3) | 698 (13.0) 0.012 |
| Female sex | 971 (58.1) | 1,317 (56.7) | 1,790 (57.1) | 2,255 (59.9) | 2,775 (60.0) | 3,370 (60.0) | 3,498 (59.1) | 3,195 (59.5) 0.014 |
| Total No. of SCS | 1,671 | 2,322 | 3,137 | 3,767 | 4,623 | 5,619 | 5,914 | 5,369 &lt; 0.001 |
| Adjusted total† | 5.2 | 7.1 | 9.8 | 11.8 | 14.0 | 16.4 | 16.8 | 14.5 | |

Values are presented as number (%).

“-” indicates incomplete insurance claims data for statistical analysis.

†Adjusted per 100,000 beneficiaries.

lack of data on the recent trends of SCS placements. Using 2 separate insurance databases, our results show that SCS placements increased significantly over an 8-year period, peaking in 2013. The highest incidence of implantation was amongst women and in the Southern region of the US. Adjusted total were lower among private-payers at all time intervals compared to Medicare patients.

SCS trends have been reported in a similar study by Lad et al. Using 2 separate insurance databases, our results show that SCS placements increased significantly over an 8-year period, peaking in 2013. The highest incidence of implantation was amongst women and in the Southern region of the US. Adjusted total were lower among private-payers at all time intervals compared to Medicare patients.

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...showed that SCS... Interestingly, Heyward et al.,... also reported that their SCS placement... reflected the rising popularity and utilization of SCSs. However, the private-payer and Medicare databases leads to a more accurate representation of the general US population undergoing SCS placement. Furthermore, our study addresses the paucity of data on recent trends of SCSs. To our knowledge, the only similar study on SCS trends was published about a decade ago. Nonetheless, our study has a number of limitations. We only included data from paddle lead SCS placement with laminectomy, and not percutaneous cylindrical lead implantation. As such, our findings pertain to paddle lead SCS placement only and cannot be generalized to the full population. Additionally, a retrospective database study, accuracy of our results is affected by inaccuracies in coding. Instances of miscoding and non-coding of diagnoses have been identified previously in national databases and could be potential sources of error.

CONCLUSION

As the popularity of SCSs in the treatment of chronic neuro-pathic pain increases, so is the need for insight on the current trends of its utilization. There was an overall increase in the an-
nual rate of SCS placement from 2007 to 2014. SCS placements peaked in 2013 within Medicare and private-payer beneficiaries. Yearly adjusted rates of SCSs were higher among Medicare patients at all time points. The highest incidence of implantation occurred in the Southern region of US. Among private-payers, the majority of implantations were performed by general acute care hospital specialists, neurological surgeons, orthopaedic spine surgeons, and neurologists.

CONFLICT OF INTEREST

The authors have nothing to disclose.

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