Occipitocervical Fusions in Elderly Patients: Mortality and Reoperation Rates From a National Spine Registry

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BACKGROUND: **Several studies have shown excellent fusion rates in occipitocervical (OC) fusions, but very little is reported on mortality and reoperation rates in elderly patients. Our article reports these rates in elderly patients from a national spine registry with a >2-year follow-up period.**

METHODS: **Using data from a spine implant registry developed at a large integrated health care system (Kaiser Permanente), elderly patients (aged ≥65 years) with instrumented OC fusions between January 1, 2009 and September 30, 2013 were identified. Patients' demographics were extracted from the registry. From chart review, the types of hardware and bone graft used, as well as mortality and reoperations rates were noted.**

RESULTS: **Forty-seven patients with OC fusions were identified. Six patients had reoperations related to their fusions. Two occurred in the same patient, which resulted in a 14.9% reoperation rate. There were a total of 13 deaths (27.7%), with 7 occurring within 3 months, but only 4 (8.5%) related to the procedure. Bone morphogenetic protein was used in 29 patients (85.3%, 29/34). All cases used occipital plates with rods and screws. There was 1 nonunion.**

CONCLUSIONS: **Mortality rate was 27.7% and the reoperations rate was 14.9% for patients who underwent OC fusions with age >65 years and were observed for >2 years. These numbers are much higher than in younger patients, but reflect a higher mortality due to their comorbidities and from progression of their disease for cases of metastasis to the spine.**

INTRODUCTION

United States Census Bureau estimates by the year 2050, the number of Americans aged >65 years old will 80.4 million.[1] The need to better understand the medical implications of this increase in our population is important. Spine surgery in the elderly has been reported extensively in the lumbar spine,[2-12] although fewer articles have looked at surgery in the cervical spine.[13-15] We have seen high mortality rates in elderly patients with type II odontoid fracture treated with halo vest immobilization,[16-18] which has modified our treatment (anterior screw fixation, sublaminar wiring, C1-C2 transarticular screw fixation, lateral mass fixation).[19,20] Wang et al[13] found that even with a shift to more aggressive surgically treatments, there still were inherent risks. They found that in cervical spine surgery for degenerative disease that the risks dramatically increase with age, with patients >74 years old having 4.1 times the odds of a complication and 19 times the odds of dying during the same hospitalization, when compared with patients aged 20–34 years old.

There has been only 1 article on occipitocervical (OC) fusions in the elderly in the literature.[21] It described 20 patients >65 years old who underwent OC fusions and showed that with careful medical management and control of perioperative complications, these patients can make significant neurological recoveries. Our article expands on that study with 47 patients

Key words
- Bone morphogenetic protein
- Elderly patients
- Mortality
- Nonunions
- Occipitocervical fusions
- Reoperation

Abbreviations and Acronyms
BMP: Bone morphogenetic protein
CSF: Cerebrospinal fluid
OC: Occipitocervical

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Citation: World Neurosurg. (2016) 86:161-167.
http://dx.doi.org/10.1016/j.wneu.2015.09.077

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

obtained from a spine registry, aged ≥65 years old who underwent OC fusions and were followed for >2 years. We report the mortality and reoperation rates among these elderly patients and analyze the reasons for these high rates, as well as analyzing their fusion data.

METHODS

Spine Registry

A Spine Registry to track instrumented spinal fusions was developed in 2009 at a large integrated U.S. health care system (Kaiser Permanente) with >9 million members serving 8 states and the District of Columbia. The registry tracks procedures that use spinal implants including anterior cervical plates, interbody devices, pedicle and lateral mass screws, total disc replacement devices, and bone morphogenetic protein (BMP). The data collection and validation process have been previously described.[22,23] In brief, using electronic medical record data and a combination of spinal procedural codes from the International Classification of Diseases, Ninth Revision, Clinical Modification codes and manufacturers' implant catalog reference numbers, as well as chart review, patients with instrumented spinal fusion were identified. Electronic screening algorithms were used to determine reoperations and revisions from the index spinal procedure. Adjudication by chart review following Centers for Disease Control and Prevention and Agency for Healthcare Research and Quality guidelines was used to identify complications. Patient's age, gender, body mass index, American Society of Anesthesiologists score, operative time, diagnosis, region of the spine fused, number of spine levels fused, implant characteristics, procedural information, and outcomes (i.e., complications, revisions, and reoperations) were captured in the registry.

OC Fusion Database

Using our spine implant registry database, we identified all instrumented OC fusions between January 2009 and September 2013. Patients' age, gender, smoking history, body mass index, history of diabetes, years of follow-up, operative time, length of hospital stay, operative date, and any subsequent spinal operative dates from the index spinal procedure were extracted from the registry. Admitting diagnosis was categorized based on the etiologies of the patients' OC disease (with some overlap) from chart review: basilar invagination, degenerative disease (degenerative cervical instability, spondylosis, articular facet arthropathy), pathological (primary bone neoplastic disease, metastasis to the spine), rheumatoid arthritis, and trauma. From chart review also, the types of occipital hardware, C1 screws, C2 screws, and types of autograft (allograft and BMP) used were noted. Exclusion criteria only included age <65 years.

Reoperations were defined as all subsequent spine surgeries to the index spinal fusion. Chart reviews were completed on all the reoperation cases. The reason for the reoperation—infections, hematomas/seromas, nonunions, adjacent segment disease, and hardware failure—were identified in the operative or preoperative notes as recorded by the operating surgeon. We did not record the criteria for determining the nonunion, such as radiographic findings or symptoms, but relied on the individual operating surgeon to determine whether the nonunion warranted operative intervention. Of the 110 surgeons (orthopedic and neurosurgeons) who contributed to the spine registry, 6 surgeons performed most of the cases during this study period.

RESULTS

Patient Characteristics

We identified patients with 120 OC fusion between January 1, 2009 and September 30, 2013. When the exclusion/inclusion criteria were applied with age ≥65 years old, >2 years follow-up from index spine procedure, and loss to follow-up within 2 years (only 1 patient who changed insurance), 47 patients were identified (Table 1). The mean age was 78.6 years old (range, 65–95 years), with American Society of Anesthesiologists score of ≤3 in 41 patients with most patients with a diagnosis of trauma (20/47), followed by basilar invagination (10/47). One diagnosis of a C2 meningioma was classified as pathological. Operative times were highest between 100 and 199 minutes (22/47 patients) and length of hospital stay peaked in 2 ranges: 4–6 days in 14 of 47 patients and ≥10 days with 21 of 47 patients.

Mortality. There were a total of 13 deaths among the 47 patients (Table 2) resulting in a mortality rate was 27.7% (13/47). Although 7 patients died in <3 months, we considered only 4 deaths (8.5%) related to the procedure. Of these 4 patients, 2 died (4.3%) due to pulmonary embolisms (<30 days). The other 2 were due to aspiration pneumonia (patient 9) and another due to a pulmonary embolism after 2.9 months (patient 13). Of the other 3 patients with deaths <3 months 2 were due to progression of their disease, and another due to a stroke (patient 11).

Six patents died >6 months of which 4 survived >1 year. Two were due to progression of their disease, whereas the others died from other systemic disease processes. The average age at death among the 13 patients was 83 years old (range, 72–92 years).

Reoperations. Of the 47 patients, we found 6 patients (12.8%) with 7 reoperations (14.9%). One patient had 2 reoperations related to the OC fusion (Table 3). Four patients (patients 1, 2, 4, 6) had reoperations in <3 months. Patient 6 had a cerebrospinal fluid (CSF) leak with multiple reintubations during her intensive care unit stay and had a persistent CSF leak that required the placement of a ventriculostomy on postoperative day 14. This was due to continuous CSF leak after a failed dural repair after an odontoidectomy for removal of a ventral C2 meningioma. There were 2 hardware failures—loosen caps (patient 1) and pullout of caudal screws (patient 4)—in <3 months. Patient 2 had a deep wound infection. The 2 long-term reoperations (patients 3 and 5) occurred >1 year and were caused by a nonunion (loosen screws) and adjacent segment disease with junctional stenosis caudal to the fusion. It should be noted that of the 6 patients with reoperations only 1 (patient 6) died, and this was unrelated to her OC fusion.

Fusion Data. Because 13 patients died before reaching the 2-year follow-up period, we excluded them when looking at the fusion data. A cohort of 34 patients (Table 4) was identified with >2 years of follow-up. All 34 patients had instrumented fusions that consisted of rods and screws with occipital plates. No wiring was used. Most common level fused was O–C4 in 12 patients (35.3%),