

Kalanithi PA, Arrigo R, Boakye M. Morbid Obesity Increases Cost and Complication Rates in Spinal Arthrodesis. Spine 2012;37:982-988

Design: Cross sectional study of the effect of morbid obesity on costs and complications of spine fusion

Population and setting

- 84,607 hospital admissions for spinal fusion in California from 2003 to 2007
- Cases identified through the California State inpatient Databases (CA-SID), a hospital discharge database with data from more than 90% of California community and non-community hospitals
- Inclusion criteria were 4 types of spine fusion identified from ICD-9-CM codes: anterior cervical, posterior cervical, anterior lumbar, posterior lumbar
- Exclusion criteria were any non-degenerative spine diagnoses: congenital deformity, inflammatory, neoplastic, trauma, pregnancy, postlaminectomy syndrome, as well as thoracic fusions, reoperations, or occipital and C1-C2 procedures

Main outcomes and analysis:

- Morbid obesity was identified by the ICD-9-CM code 278.01
- Absence of morbid obesity was normal weight identified by the absence of ICD-9-M codes for underweight, overweight, or obesity
- Comorbidity was determined by a scoring system which identifies up to 30 comorbid conditions by groups of ICD-9 codes
 - o Examples are cardiac arrhythmias, congestive heart failure, valvular disease, hypertension, paralysis, “other neurological disorders,” chronic pulmonary disease, diabetes (complicated and uncomplicated), renal failure, liver disease peptic ulcer, lymphoma, metastatic cancer, solid cancer without metastases, anemias, alcohol and drug abuse, psychoses, and depression
 - o The system adds one point for each additional comorbid condition for a maximum of 28 points (some conditions are mutually exclusive: e.g. obesity and underweight)
 - o Obesity was excluded from the comorbidity score
- Postoperative complications were ascertained by ICD-9-CM codes, and included renal, cardiac, neurological, deep vein thrombosis, pulmonary embolism, pulmonary complications, wound complications, and infection
- Multiple logistic regression models were fitted for each of the 4 procedure types and for all fusions combined, with morbid obesity in each model, adjusted for age and for comorbidity scores
- 84,607 hospitalizations for spinal fusion were included in the study
 - o 98% were normal weight; 2% (n=1455) were morbidly obese
 - o 75% were under 65 years
 - o Some fusions were more common than others
 - Anterior cervical fusion, n=40,109
 - Posterior cervical fusion, n=3410

- Anterior lumbar fusion, n=5470
 - Posterior lumbar fusion, n=35,618
 - 43% had no comorbidities
- Morbid obesity was associated with increased length of stay: 3.5 days for normal weight versus 4.8 days for morbid obesity
- Higher hospital charges were associated with morbid obesity, with an average increased cost of \$23,473 over normal weight patients
- The overall complication rate was 7.05% for all fusions: 6.94% for normal weight and 13.61% for morbidly obese patients
 - Pulmonary and wound complications were the most common in normal and morbidly obese patients
 - 3.36% of normal weight patients had wound complications, compared to 5.58% of obese patients
 - 1.95% of normal weight patients had pulmonary complications, compared to 5.84% of obese patients
 - For anterior cervical fusion, the odds ratio was 202; for posterior lumbar fusion, the odds ratio was 1.5
 - Mortality was higher (0.8%) in obese patients than in normal weight patients (0.3%)
- A multiple logistic regression model, adjusted for age and comorbidity score, estimated an odds ratio of 1.648 for all complications for all fusion procedures combined

Authors' conclusions:

- Morbid obesity is associated with increased frequency of postoperative complications in patients undergoing anterior cervical and posterior lumbar spinal fusion, and is more predictive of complications than age and medical comorbidities
- Hospital charges, mortality, and length of stay are increased in morbidly obese patients
- The increased risk of complication does not mean that obesity is a contraindication to fusion surgery but reduction of risks is an important goal
- There are limitations in using ICD-9 codes, which do not provide many important details of the fusion procedure and may undercount late complications after initial hospital discharge

Comments:

- Although administrative databases do have the limitations noted by the authors, the large number of cases is useful for estimating many things like length of stay and rates of serious complications
- The authors estimate an increased cost of \$23,743 due to obesity, but the methods section lacks a discussion of how costs were analyzed
 - Billed charges often do not represent the cost of medical services; pricing systems are likely to vary with different forms of reimbursement, and accounting systems may allocate costs in a variety of ways (Diehr 1999)

- Costs are likely to follow distribution curves with very long right tails, and there is no discussion of the model used for cost estimation
 - However, the length of stay data are likely to be robust, and it is reasonable to accept the authors estimate of a 27% cost increase as mirroring the length of stay data
- The comorbidity score was used to adjust the odds ratio for morbid obesity in the logistic regression model
 - These models adjust odds ratios for likely confounders, which are associated with the exposure (obesity) and also independently associated with the outcome (complications), while not being in the causal pathway between exposure and outcome
 - Some of the comorbidities are likely to be in that causal pathway; for example, obesity can cause diabetes which can cause wound complications
 - The inclusion of intermediates in the logistic model is likely to weaken the odds ratio for obesity, and the estimated odds ratio of 1.648 for all complications may be a conservative one
 - The authors did not include posterior cervical and anterior lumbar fusion in their conclusions because the odds ratios were not statistically significant; however, the odds ratios are consistent with the other procedures, and are not statistically significant because of small numbers, not for a lack of association with obesity
- The authors report that obesity is a greater risk factor than age, but this may require some refinement to make its meaning clear
 - The odds ratio for obesity is 1.648 and for age is 1.021
 - The odds ratio for age means that the odds are multiplied by a factor of 1.021 for each year of age
 - If 1.021 is raised to the 24th power, it is approximately 1.648
 - It may be estimated that morbid obesity, compared to normal weight, increases risks of complications in a manner equivalent to 24 years of age
- The authors state that the ICD-9 codes may misclassify morbidly obese patients as normal weight, potentially weakening the observed association of obesity with complications
 - However, there are ICD-9 codes for overweight and obesity as well as for normal weight, underweight, and morbid obesity
 - Overweight and obesity ICD-9 codes were excluded from the analysis
 - It is likely that some morbidly obese patients would be classified as overweight or obese, but unlikely that they would be classified as normal weight
- Despite the limitations of the study and its analytical methods, the results are consistent with other studies of the effects of morbid obesity on health and surgical complications, and the conclusions are probably sound

Assessment: Adequate for evidence that morbid obesity increases hospital length of stay, mortality, and postoperative complications after spinal fusion surgery, with concomitant increases in hospital costs

Reference: Diehr P, Yanez D, et al. Methods for Analyzing Health Care Utilization and Costs. *Annu Rev Public Health* 1999;20:125-144.