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The Spine Journal 15 (2015) 1118–1132

THE SPINE JOURNAL

Review Article

Anterior lumbar spine surgery: a systematic review and meta-analysis of associated complications

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Received 26 May 2014; revised 22 December 2014; accepted 18 February 2015

Abstract

BACKGROUND CONTEXT: The anterior approach to the lumbar spine is increasingly used to accomplish various surgical procedures. However, the incidence and risk factors for complications associated with anterior lumbar spine surgery (ALS) have not been fully elucidated.

PURPOSE: To identify and document types of complications and complication rates associated with ALS, determine risk factors for these events, and evaluate the effect of measures used to decrease complication rates.

STUDY DESIGN: Systematic review and meta-analysis.

METHODS: A systematic review of the English-language literature was conducted for articles published between January 1992 and December 2013. A MEDLINE search was conducted to identify articles reporting complications associated with ALS. For each complication, the data were combined using a generalized linear mixed model with a binomial probability distribution and a random effect based on the study. Predictors used were the type of procedure (open, minimally invasive, or laparoscopic), the approach used (transperitoneal vs. retroperitoneal), use of recombinant bone morphogenetic protein-2, use of preoperative computed tomography angiography (CTA), and the utilization of an access surgeon. Open surgery was used as a reference category.

RESULTS: Seventy-six articles met final inclusion criteria and reported complication rates in 11,410 patients who underwent arthrodesis and/or arthroplasty via laparoscopic, mini-open, and open techniques. The overall complication rate was 14.1%, with intraoperative and postoperative complication rates of 9.1% and 5.2%, respectively. Only 3% of patients required reoperation or revision procedures. The most common complications reported were venous injury (3.2%), retrograde ejaculation (2.7%), neurologic injury (2%), prosthesis related (2%), postoperative ileus (1.4%), superficial infection (1%), and others (1.3%). Laparoscopic and transperitoneal procedures were associated with higher complication rates, whereas lower complication rates were observed in patients

FDA device/drug status: Not applicable.

Author disclosures: ***DKB:*** Nothing to disclose. ***PWM:*** Stock Ownership: Globus Medical ($0). ***NS:*** Nothing to disclose. ***ABK:*** Nothing to disclose. ***MGM:*** Nothing to disclose. ***JDK:*** Nothing to disclose. ***ARV:*** Royalties: DePuy (C), Medtronic (H), Stryker Spine (G), Biomet Spine (C), Globus Medical (F), NuVasive (B), Aesculap (B); Stock Ownership: Replication Medica (15,000 shares, value B), Globus Medical (123,398 shares, value I), K-2 Medical, Paradigm Spine (975,000 shares, value F), Stout Medical (1% company, value E), Spine Medica (25,000 stock options, unknown value), Computational Biodynamics (50% ownership, unknown value), Progressive Spinal Technologies (30% ownership, unknown value), Spinology (8,125 shares, unknown value), Small Bone Innovations (15,000 shares, unknown value), Cross Current (62,500 shares, paid 50,000), Syndicom 2,750 shares, value 5,032), In Vivo (123,935 shares, unknown value), Flagship Surgical (Invested 50,000, value D), Advanced Spinal Intellectual Properties (30% ownership, unknown value), Cytonics (25,000 shares, unknown value), Bonovo Orthopedics (100,000 shares, paid 116,500), Electrocore (50,000 shares, unknown value), Gamma Spine (15% ownership, unknown value), Location Based Intelligence (20% ownership, unknown value), Flow Pharma (2,000,000 nonqualified stock options, unknown value), R.S.I (50% ownership, unknown value), Rothman Institute and Related Properties (practice, unknown value), Innovative Surgical (30% ownership, unknown value), Design (Unknown), Spinicity (53,000 shared, 3.4% ownership); Consulting: Gerson Lehrman Group (B), Guidepoint Global (B), Medacorp (B), Stout Medical (B), Innovative Surgical Design (B), Orthobullets (A); Board of Directors: AO Spine, Innovative Surgical Design, Association of Collaborative Spine Research, Spinicity; Grants: Stryker Spine, Cerapedics, NuVasive (C).

The disclosure key can be found on the Table of Contents and at www.TheSpineJournalOnline.com.

Disclosures: This work had no outside funding, and the authors present no conflicts of interest in relation to this study.

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http://dx.doi.org/10.1016/j.spinee.2015.02.040

receiving mini-open techniques. Our analysis indicated that the use of recombinant bone morphogenetic protein-2 was associated with increased rates of retrograde ejaculation; however, there may be limitations in interpreting these data. Data regarding the use of preoperative CTA and an access surgeon were limited and demonstrated mixed benefit.

CONCLUSIONS: Overall complication rates with ALS are relatively low, with the most common complications occurring at a rate of 1% to 3%. Complication rates are related to surgical technique, approach, and implant characteristics. Further randomized controlled trials are needed to validate the use of preventative measures including CTA and the use of an access surgeon.

Keywords: Anterior approach; Lumbar spine surgery; Complications; Systematic review; Bone morphogenetic protein; Retrograde ejaculation

Introduction

The rate of lumbar arthrodesis has steadily increased over the past couple of decades and can be readily accomplished via anterior, posterior, or combined approaches [1]. Originally developed for the treatment of tuberculous lesions in the early 20th century, anterior approaches are now used for a wide array of degenerative, deformity, tumor, trauma, and infection-related spinal pathologies [2]. Proponents of the anterior approach cite direct access to the anterior vertebral column, allowing more extensive decompression of the interbody space and better end plate preparation for arthrodesis as a critical advantage [3]. Moreover, the ability for improved deformity correction without posterior approach–related morbidity, such as neurologic injury and paraspinal muscle trauma, is often reported as a major advantage [4].

Despite its appeal as a surgical option for access to the intervertebral space, however, anterior lumbar spine surgery (ALS) is associated with various intraoperative and postoperative complications. Considerable anatomic variations exist in the neurovascular structures anterior to the lumbar vertebral column. Reported complications are myriad, including intraoperative vascular, neurologic, and visceral injury, as well as postoperative complications, such as thromboembolism, infection, retrograde ejaculation (RE), and implant-related complications. In an effort to reduce these risks, access surgeons are often used to facilitate safe visualization of the vertebral space while protecting at-risk vascular and neurologic structures. Additionally, preoperative imaging, including computed tomography angiography (CTA), is used to fully define the vascular anatomy and identify anatomic aberrations.

Currently, diverse literature exists regarding the incidence and impact of various complications associated with ALS. Additionally, given the variety of surgical approaches and procedures, guidelines for effective complication management are numerous and inconsistent. In this study, we intend to present a systematic literature review of the incidence and risk factors for complications after anterior lumbar procedures. Additionally, we aim to specifically answer the following questions: What is the incidence of intraoperative and postoperative complications associated with ALS?; what risk factors contribute to an increased rate of complications?; and what measures decrease the incidence of intraoperative and postoperative complications?

Materials and methods

Search strategy

A systematic MEDLINE search via PubMed was performed using various combinations of the following search terms: ‘‘anterior lumbar,’’ ‘‘surgery,’’ ‘‘procedure,’’ ‘‘operation,’’ ‘‘lumbar fusion,’’ ‘‘lumbar arthroplasty,’’ and ‘‘complications.’’ Peer-reviewed articles published between 1992 and 2013 reporting the incidence of complications during ALS were included. Case reports, editorials, reviews without quantitative data, and articles not written in the English language were excluded. Studies including trauma, tumor, or infection as primary surgical indications for greater than 5% of the study population were excluded. If multiple articles from the same author(s) clearly reported the same cohort of patients, only the most recently published articles with the largest sample size were included. To expand the search results, reference lists of key articles were also examined for eligible articles.

Data extraction

Data were extracted by two authors (PWM, NS) and independently reviewed by a third author (DKB). All articles were reviewed and analyzed to extract the following data: study design, type of surgical procedure and approach, number of patients and demographic information, participation of an access surgeon, utilization of preoperative CTA, use of recombinant bone morphogenetic protein-2 (rhBMP-2), and reported complications. The type of surgical procedure was classified as described by the original study author (eg, ‘‘minimally invasive’’ or ‘‘mini-open’’ vs. open). An access surgeon was defined as ‘‘a vascular, urological, or general surgeon who conducts the surgical exposure instead of solely the orthopedic surgeon’’ [5]. Complications were stratified into two categories: intraoperative or approach related (hereinafter referred to as intraoperative) and postoperative. If a study