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TECHNICAL ASPECTS, SAFETY, AND EFFICACY OF KYPHOPLASTY IN A MORBIDLY OBESE PATIENT

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Background: Obesity is increasing at an alarming rate worldwide, with some estimates at a 40% rise in prevalence between 2000 and 2018. Recent data indicates that 42.2% of adults in the United States are obese. Obesity can increase morbidity and mortality as a consequence of complex physiologic changes, and as a result, has many consequences for health care delivery and management of these patients. Patients who are obese often need interventional pain procedures; however, perception of higher risk can lead to less opportunity for these often very needed procedures.

Case Report: The present case report reviews technical aspects, safety, and efficacy of successful kyphoplasty in a morbidly obese patient.

Discussion: This case helps expand the current knowledge base of kyphoplasty in the morbidly obese.

Conclusion: Morbidly obese patients, in general, should have access to kyphoplasty similar to normal body mass index patients.

Key words: Kyphoplasty, morbidly obese, obstructive sleep apnea, sedation, super-super obesity, vertebral fractures

BACKGROUND

Obesity has been rapidly increasing over the past 2 past decades and may lead to an increased risk of fractures (1). However, presently there is no clear understanding about a precise connection between obesity and fracture frequency and pathophysiology (1). A cross-sectional study of 13,970 individuals in China demonstrated that nonspine fractures were increased significantly in male and female patients with increased body fat (2). Additionally, a cohort study of 362 postmenopausal women in Italy revealed a positive relationship between body mass index (BMI) and vertebral fractures (3).

Potential risk factors for vertebral fractures include trauma, osteoporosis, bone metastases, and infection. These fractures often cause severe pain adversely affecting an individual's quality of life. There are several treatments for spine fractures. Unstable fractures with or without neurological symptoms may require surgical stabilization and fusion. Stable fractures may be treated with conservative care using analgesics and physical therapy. In osteoporotic compression fractures,

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however, conservative approaches may cause long-term harm (4). When conservative treatment fails to improve debilitating pain symptoms, procedures such as kyphoplasty may be indicated.

Kyphoplasty and/or vertebral augmentation procedures involve percutaneous cement delivery into the vertebroplasty. Through access cannulas, a bone tamp or balloon is inserted for purposes of creating a cavitary void. Thereafter, poly(methyl methacrylate) cement or orthobiologic materials are placed. The cement hardens and stabilizes the fracture. This promotes rapid and durable pain relief (4-6). Kyphoplasty offers many advantages for the treatment of spinal compression fractures and metastases. The procedure is generally safe, with low morbidity and rapid recovery rates. The procedure is performed with conscious sedation or monitored anesthetic care and is completed typically in 30 to 60 minutes. Multiple studies in recent years have demonstrated long-term durable relief.

Obesity possesses significant risk for both open and minimally invasive spine surgery, including lengthened anesthesia and surgical times, more intraoperative blood loss, wound healing, higher infection rate, longer hospital stay, poorer outcomes, and more medical complications including respiratory complications, deep venous thrombosis, and pulmonary embolism. Physicians should recommend weight-loss strategies, including bariatric surgery, before considering elective spine surgery (7). There is limited research on the outcomes of kyphoplasty in morbidly obese patients. In the present case report, therefore, we report the first case to demonstrate the technical aspects, safety, and efficacy of kyphoplasty in a morbidly obese patient.

CASE

A 38-year-old African American man was referred to our interventional pain practice with a history of morbid obesity (BMI: 68.6 kg/m^2), anaplastic large T-cell lymphoma (ALK+) status post CHOP (cyclophosphamide, doxorubicin hydrochloride, vincristine sulfate and prednisone) regimen chemotherapy, and multiple bony lesions. These lesions were located in his ribs, pelvis, and spine. Oncology referred the patient for back pain. He was complaining of sharp mid-back pain. The pain was rated as an 8 of 10 in severity on the numeric rating scale (NRS) for pain and did not radiate. His pain was not controlled with oxycodone 10 mg/acetaminophen 325 mg 4 times a day. He denied any associated symptoms including numbness, weakness, and signs of radiculopathy. Magnetic resonance imaging showed abnormal marrow signal on T2, T4, T5, T9, T12, L1, L2, and L5 compatible with involvement of these vertebral bodies by the T-cell lymphoma. A computed tomography (CT) scan of the thorax demonstrated collapse of the vertebral body of T9. After reviewing the patient's history and physical, a kyphoplasty of T9 vertebrae was indicated for therapeutic intervention. After potential risks, benefits, alternatives were discussed, consent was obtained.

The patient was brought to the interventional radiology procedure suite and placed in the prone position. The T9 vertebral body was identified and marked with an indelible marker. After routine sterile preparation, antibiotic administration (1 gm cefazolin), and commencement of moderate sedation, the procedure was initiated under fluoroscopic guidance. Local anesthetic was administered to the skin overlying the right and left T9 pedicles. Introducer cannulas were advanced using an extrapedicular approach into the T9 vertebral body, bilaterally. The cannulas were further advanced in the ventral one-third of the vertebral body. Thereafter, a hand-operated drill was advanced through the cannula, and the outer cannula was pulled back. The same procedure was repeated on the right side as well. A balloon was inserted through both cannulas and insufflated. Each balloon reached a volume of 2 mL and was pressurized to about 200 to 250 psi. Poly(methyl methacrylate) cement was then mixed and then 1.5 mL of cement was delivered on each respective side, after the balloons were removed. There was some cement spread ventral to the anterior vertebral body cortex. The patient did not develop any intraoperative or postoperative complications; specifically, there was no chest pain nor any cardiopulmonary event sequelae. The cannulas were then removed, and sterile strips were applied. The patient was rotated onto his back and brought to the recovery room. He tolerated the procedure well and was discharged the same day. The radiation dose applied during the procedure was 0.45 Gray (Gy) for the anteroposterior and 0.86 Gy for the lateral plane. The cumulative dose area product was 93,966 mGy x cm^2. The total fluoroscopy time for the procedure was 3.6 minutes. The patient was followed up in the clinic one week after the procedure and his pain improved quite significantly in terms of severity, with his VAS score decreasing to 3 of 10 and his oxycodone usage dropping from 4 to one time per day. His pain relief continued at this level during postoperative visits at one and 4 months.

DISCUSSION

Obese patients with osteoporosis are at higher risk of compression fractures as compared to patients with normal BMI with osteoporosis (10,11). Vertebral fractures produce enormous socioeconomic costs secondary to pain, impairment of function, increased stress, higher morbidity and mortality, and loss of function (3,12). The cost of care for osteoporotic bone fractures in 2005 was more than $19 billion; 6% of that cost was from vertebral fractures. This cost is estimated to increase 50% by 2025 (14).

The terms super obesity and super-super obesity are sometimes used for BMI ≥ 50 and BMI ≥ 60, respectively. Open spine surgery in obese patients is often complicated by urinary tract infections, venous thromboembolism, pneumonia, and poor wound healing (15). Kyphoplasty can be an effective and safe alternative for the management of painful vertebral fractures. Although safer than surgery, kyphoplasty can lead to certain complications. A meta-analysis has reported complications of kyphoplasty with new vertebral fractures in 11.4% of patients. Cement leakage was another common side effect at 8.1%. Only 10% of the cement leakages were symptomatic (7). Pulmonary embolism, radiculopathy, and infection have also been reported in less than 1% of kyphoplasty patients (8). Hence, informed consent should discuss these options. Similarly, conservative care and analgesic therapy can cause complications. Patients should be informed of potential risks of all treatment options: surgical, kyphoplasty, or conservative care. Furthermore, opioid exposure for acute pain greater than 7 days could lead to long-term opioid use. In addition to pain relief, kyphoplasty provides correction of anatomy of the vertebral body, in terms of both height and angulation, while also improving mobility (16).

In obese patients undergoing kyphoplasty, several technical issues must be addressed. The procedure table may have a weight limit. Depending on the manufacturer, the maximum may be 300 or 350 lbs to avoid damage to the table and motor control system. Additionally, the standard aperture diameter of a conventional C-arm is 45 cm. Hence, a patient who meets the weight threshold may still exceed the bore diameter to the girth (17). Finally, image quality during fluoroscopy may be poor in the morbidly obese patient. The kilovoltage constant potential (kV[cp]) and tube current of an x-ray tube measured in milliamperes (mA) determine tissue penetrability, and resultant image quality.

Our institution uses a GE™ OEC 9800 Plus fluoroscopic C-arm (Soma Tech Intl., Bloomfield, CT). This unit can produce 40 to 120 kilovoltage peak (kV[p]), which is relatively low for a morbidly obese patient (18). A lower kV(p) produces increased noise and motion artifact, resulting in low image quality. The image quality can be improved by increasing the kV(p) and reducing mAs, without exposing the interventional pain physician or surgeon to excess radiation (19). The interventional radiology (IR) suite offers biplanar fluoroscopy. Typical weight capacity of an IR suite is about 500 lbs. Also, an IR suite machine has a capacity to produce 125 kV(p) and automatically adjusts the mAs to provide better image quality with a relatively low radiation dose. These factors provide better image quality and safety.

Boszczyk et al (20) studied fluoroscopic radiation exposure on 60 patients during a single-level kyphoplasty. This group reported an estimated radiation dose of 0.32 Gy (range, 0.05-0.88 Gy) in the anteroposterior plane and 0.68 Gy (range, 0.1-1.43 Gy) in the lateral plane. Our patient received a dose of 0.45 Gy and 0.86 Gy in the AP and lateral planes, respectively (20). Our total fluoroscopy time was 3.6 minutes, which was also comparable to this study's measures. CT-guided kyphoplasty is an option; however, cement delivery cannot be monitored in a live fashion. Furthermore, access to CT is often limited inside and outside of the hospital. Overall, fluoroscopy is feasible, but the interventionalist must check the parameters of the imaging unit. If not feasible, the procedure should be scheduled in an IR suite with biplanar imaging.

CONCLUSION

Our case report provides an example of a safe and effective way to perform kyphoplasty using biplanar fluoroscopy in an interventional radiology suite in a super-super obese patient with BMI of 64.67 kg/m^2. We suggest that biplanar fluoroscopy of the IR suite provides an efficient use of the resource at your hospital or surgical center to perform a technically difficult kyphoplasty in an obese patient. This case will also help expand the current knowledge base of kyphoplasty in the morbidly obese. The goal is to educate physicians that the morbidly obese can have access to kyphoplasty similar to normal BMI patients.

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