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Advanced age does not affect abdominal wall reconstruction outcomes using acellular dermal matrix: A comparative study using propensity score analysis

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ABSTRACT

Background: We hypothesized that elderly patients (≥65 years) experience worse outcomes following abdominal wall reconstruction (AWR) for hernia or oncologic resection.

Methods: We included all consecutive patients who underwent complex AWR using acellular dermal matrix (ADM) between 2005 and 2015. Propensity score analysis was performed for risk adjustment in multivariable analysis and for one-to-one matching. The primary outcome was hernia recurrence; the secondary outcomes included surgical site occurrence (SSO) and bulging.

Results: Mean follow-up for the 511 patients was 31.4 months; 184 (36%) patients were elderly. The elderly and non-elderly groups had similar rates of hernia recurrence (7.6% vs 10.1%, respectively; $p = 0.43$) and SSO (24.5% vs 23.5%, respectively; $p = 0.82$). Bulging occurred significantly more often in elderly patients (6.5% vs 2.8%, respectively; $p = 0.04$).

After adjustment through the propensity score, which included 130 pairs, these results persisted.

Conclusions: Contrary to our hypothesis, elderly patients did not have worse outcomes in AWR with ADM. Surgeons should not deny elderly patients AWR solely because of their age.

1. Introduction

Life expectancy continues to increase globally, regardless of gender or ethnic background.[1] This increase, combined with declining fertility rates, particularly among industrialized nations, has resulted in a shift in the population age distribution towards older age groups, with the number of people aged 65 years or older estimated to increase to up to 86 million by 2060 in the United States.[2] Moreover, the proportion of the population aged 65 and above is expected to grow from 14% in 2011 to 20.3% in 2050.[2] Consequently, the number of elderly patients requiring surgical intervention is anticipated to increase. At present, more than half of the operations in the US are performed on elderly patients.[3]

Despite decades of advancement in surgery and anesthesia, surgical and medical care remain more challenging in elderly patients because of their higher rates of medical comorbidities, malnutrition, cognitive impairment, and inadequate social support.[5] Indeed, many studies have demonstrated that elderly patients undergoing surgery have a higher risk of both mortality and postoperative complications,[6,7] with a mortality rate of up to 5% and a complication rate of up to 20% for elective, major surgeries in patients aged 65 years and above.[8,9] Elderly individuals generally have at least one chronic medical comorbidity, with 80% having three or more chronic comorbidities.[8,10] The presence of these chronic conditions, their severity, and their cumulative influence may considerably affect intra- and postoperative complications and outcomes. In addition, these patients are at higher risk of developing concomitant clinical events during the hospital stay beyond those related to the surgical procedure.[10]

The incidence of abdominal wall reconstruction (AWR), including ventral hernia repair, is increasing annually, with over

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350,000 such surgeries performed in the United States in 2006 alone.[4] To date, the effect of advanced age on AWR outcomes has not been specifically analyzed. Quantifying the risk factors among elderly patients can help to optimize the outcomes and to minimize both complication rates and recurrence associated with AWR. In this way, surgeons can properly screen and counsel elderly patients preoperatively about AWR procedures. Comparing elderly and younger AWR patients in randomized controlled trials is difficult owing to the challenges of forming comparable groups among patients with large differences in rates of comorbidities as well as in abdominal wall defect/hernia size. In order to overcome this issue, we retrospectively analyzed our long-term results of AWR using ADM in elderly and non-elderly patients by adjusting the differences between the two groups through propensity score analysis. We hypothesized that advanced age would negatively affect outcomes following AWR.

2. Material and methods

We performed a retrospective cohort study evaluating all consecutive patients who underwent ventral AWR with underlay biologic mesh, for an abdominal wall hernia or oncologic defect, for which the fascia could or could not be primarily closed without undue tension, performed at The University of Texas MD Anderson Cancer Center between March 2005 and October 2015. The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational cohort studies were followed.[11] The clinical investigation for the present study was conducted in accordance with the ethical principles of the World Medical Association Declaration of Helsinki and the laws of the United States of America. The Institutional Review Board approved this study, and individual informed consent was waived because the source data were de-identified.

For the purpose of this study, we compared outcomes between elderly and non-elderly patients who underwent AWR with acellular dermal matrix (ADM). Elderly was defined as 65 years of age or older.[8,9] We excluded patients with defects that did not involve the midline (lateral defects), primary closure of abdominal wall fascia without mesh, reconstructions using synthetic mesh, reconstruction using onlay synthetic mesh or onlay ADM, defects reconstructed or bridged with tissue from free or local musculocutaneous/fasciocutaneous flaps or fascial grafts. We did not include synthetic mesh reconstructions because the number of cases was too small for a meaningful statistical comparison.

Data were collected both from a prospectively maintained departmental database and from the electronic medical records (Tables 1–3). Patient, treatment, and defect characteristics were analyzed, and surgical outcomes were directly compared between the two groups.

Medical comorbidity was defined as having one or more of the following: coronary artery disease, diabetes mellitus, hypertension, pulmonary disease, or renal disease. Wounds were considered contaminated if they met the American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) definition of contaminated or infected (class 3–4).[12] Obesity was defined as a body mass index (BMI) $\geq$30 kg/m^2.[13] Patients who smoked tobacco within 1 month of surgery were considered active smokers.

The primary outcome measure was hernia recurrence. Recurrent hernia was defined as a contour abnormality associated with a fascial defect. Myofascial laxity or bulging was defined as a contour abnormality without a fascial defect. Hernia and bulge were considered mutually exclusive conditions. We determined the presence of a recurrent hernia or bulge by reviewing records of physical examinations and computed tomographic (CT) imaging (88.8% of cases had a postoperative CT scan at follow-up, typically for oncologic surveillance).

Secondary outcome measures included surgical site occurrences (SSO), defined as the presence of one or more of the following postoperative complications: bulging of the abdominal wall, wound healing complications (wound dehiscence, skin necrosis, fat necrosis, cellulitis, abscess, hematoma, or seroma), and mortality at 30 days. Wound dehiscence was defined as a skin breakdown with full-thickness skin separation extending over 2-cm with or without infection, while skin necrosis involved clearly demarcated necrotic skin edges over 1-cm in width. Fat necrosis was a palpable firmness 1-cm or greater in diameter that persisted beyond 3 months postoperatively. Cellulitis/abscess was an infectious process requiring treatment with intravenous or oral antibiotics with or without surgery. Hematoma and seroma were subcutaneous collections of blood or serous fluid, respectively, requiring percutaneous or operative drainage.

Other outcomes included overall complications (SSO including medical complications), necessity of intensive care treatment (ICU), length of hospitalization, rate of hospital re-admission at 30 days, and rate of recurrent hernia repair.

2.1. Surgical technique

ADM, which is typically used to reduce the risk of mesh-related infection, adhesions, enterocutaneous fistulae, and inadvertent enterotomy at subsequent reoperation, had been used in all cases.[14] The indications for use of ADM included bacterial contamination, unavoidable direct placement of mesh over viscera, high-risk patients with multiple comorbidities, and compromised soft tissue coverage over the AWR with an increased risk of wound complications.[14] The choice of the type of mesh had been left to the surgeons' discretion.

All patients had undergone AWR using a multidisciplinary approach and a standardized surgical technique. The surgical oncologist performed the laparotomy, adhesiolysis, and tumor resection (if required).[15] The reconstructive surgeon defined the defect, including excision of the hernia sac and debridement of devitalized tissue and fascia, and decided whether external oblique fascial release (component separation [CS]) was necessary in order to facilitate the medialization of the rectus muscle complex. When deemed necessary, anterior open or minimally invasive CS,[16,17] involving release of the external oblique aponeurosis from the pubis to above the costal margin, was performed to provide lateral release and to reduce tension from the midline fascial closure.[17] The indication for CS in AWR was an inability to approximate the fascial edges without excessive tension that might place the repair at risk of failure.

We employed an underlay, retrorectus or properitoneal, ADM to reinforce the midline fascial repair. The ADM was fixed circumferentially with interrupted #1 polypropylene sutures, followed by midline primary fascial closure over the mesh with interrupted #1 polypropylene sutures.[18] When the fascial defect could not be completely primarily approximated over the mesh, the ADM was left in place as a bridge at the point of maximal tension to span the residual defect using an underlay technique secured with circumferential sutures[16,17] and a dual circumferential inlay technique.[19] The decision of whether to perform a mesh-reinforced primary fascial closure or bridged repair was at the discretion of the reconstructive surgeon and based on the clinical circumstances. When the defect could not be reinforced and necessitated bridging, CS was still generally performed in order to reduce the size of the bridged portion of the closure. Scarred, non-viable, and/or redundant skin was resected, and subcutaneous drains were placed to reduce the risk of seroma formation.[16,17]