Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Sublay versus underlay in open ventral hernia repair

J.L. Holihan, MD,[a,] Ioana Bondre, BS,[a] Erik P. Askenasy, MD,[b] Jacob A. Greenberg, MD,[c] J.N. Keith, MD,[d] Robert G. Martindale, MD, PhD,[e] J. Scott Roth, MD,[f] and Mike K. Liang, MD,[a] Ventral Hernia Outcomes Collaborative (VHOC) Writing Group*

[a] *Department of Surgery, University of Texas Health Science Center, Houston, Texas*
[b] *Department of Surgery, Baylor College of Medicine, Houston, Texas*
[c] *Department of Surgery, University of Wisconsin, Madison, Wisconsin*
[d] *Department of Surgery, University of Iowa, Iowa City, Iowa*
[e] *Department of Surgery, Oregon Health and Science University, Portland, Oregon*
[f] *Department of Surgery, University of Kentucky, Lexington, Kentucky*

ARTICLE INFO

Article history:
Received 24 September 2015
Received in revised form
3 December 2015
Accepted 11 December 2015
Available online 17 December 2015

Keywords:
Ventral hernia
Incisional hernia
Umbilical hernia
Preperitoneal
Intraperitoneal
Retrorectus
Mesh

ABSTRACT

Background: The ideal location for mesh placement in open ventral hernia repair (OVHR) remains under debate. Current trends lean toward underlay or sublay repair. We hypothesize that in patients undergoing OVHR, sublay *versus* underlay placement of mesh results in fewer surgical site infections (SSIs) and recurrences.

Materials and methods: A multi-institution database of all OVHRs performed from 2010 to 2011 was accessed. Patients with mesh placed in the sublay or underlay position and at least 1 mo of follow-up were included. Primary outcome was SSI. Secondary outcome was hernia recurrence. Multivariate analysis was performed using logistic regression for SSI and Cox regression for recurrence. Subgroup analysis of elective, midline ventral incisional hernias was also performed.

Results: Of 447 patients, 139 (31.1%) had a sublay repair. The unadjusted analysis showed no difference in SSI and lower recurrence using sublay compared with underlay. On multivariate analysis, there was no difference in SSI using sublay compared with underlay (odds ratio 1.5, 95% confidence interval [CI] 0.8–2.8). Recurrence was less common with sublay (hazard ratio 0.4, 95% CI 0.2–0.8). On subgroup analysis of elective, midline incisional hernias only ($n = 247$), there were more SSIs with sublay compared with underlay repair (28.0% *versus* 15.1%, $P = 0.018$); however, there was no difference in major SSI (sublay 9.3% *versus* underlay 5.8%, $P = 0.315$). There were fewer recurrences using sublay repair compared with underlay repair (10.7% *versus* 25.0%, $P = 0.010$).

Conclusions: In this multi-center, risk-adjusted study, sublay repair was associated with fewer recurrences than underlay repair and no difference in SSI. Randomized controlled trials are warranted to validate these findings.

* *Corresponding author*. Department of Surgery, University of Texas Health Science Center, 6431 Fannin St, MSB 5.254, Houston, TX 77030. Tel.: +702 321-6559; fax: +713 566-4242.
E-mail addresses: holihanj@gmail.com, Julie.L.Holihan@uth.tmc.edu (J.L. Holihan).
0022-4804/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jss.2015.12.014

1. Introduction

Mesh reinforcement during ventral hernia repair has been demonstrated to improve long-term outcomes compared with suture-only repair [1–3]. However, the ideal location for mesh is unknown. There are multiple options for mesh placement including onlay, inlay, sublay, or underlay positions (Fig. 1). Onlay repair is when mesh is secured to the exposed anterior fascia. Inlay repair is when mesh is placed within a defect and secured circumferentially to the edges of the fascia. Sublay repair is defined as either retrorectus or preperitoneal and is also commonly referred to as Rives–Stoppa. Finally, underlay repair is when the mesh is placed in the intraperitoneal position and secured to the anterior abdominal wall. Current trends lean toward underlay or sublay placement of mesh, with onlay and inlay repairs being used less frequently [4,5].

There are several theoretical benefits to both sublay and underlay repair. Proponents of sublay mesh placement argue that it is associated with fewer recurrences and surgical site infections (SSIs) because the mesh is covered by native tissue on both sides: fascia and muscle anteriorly and fascia posteriorly [6]. This is theorized to protect the mesh from exposure to superficial SSIs and intraperitoneal infections, prevent mesh infection by placement adjacent to well-vascularized tissue, and reduce hernia recurrence through tissue ingrowth to two load-bearing myofascial surfaces [6]. In contrast, advocates of underlay mesh placement argue that it is associated with fewer recurrences due to the wide mesh overlap that can be achieved and is associated with less SSI compared with other techniques due to the limited tissue dissection required [7].

Although both approaches have theoretical risks and benefits, there is a paucity of data comparing outcomes of open underlay and sublay mesh ventral hernia repair. Studies suggest that there is a reduced risk of recurrence and reoperation with sublay repair [6,8]. However, these studies

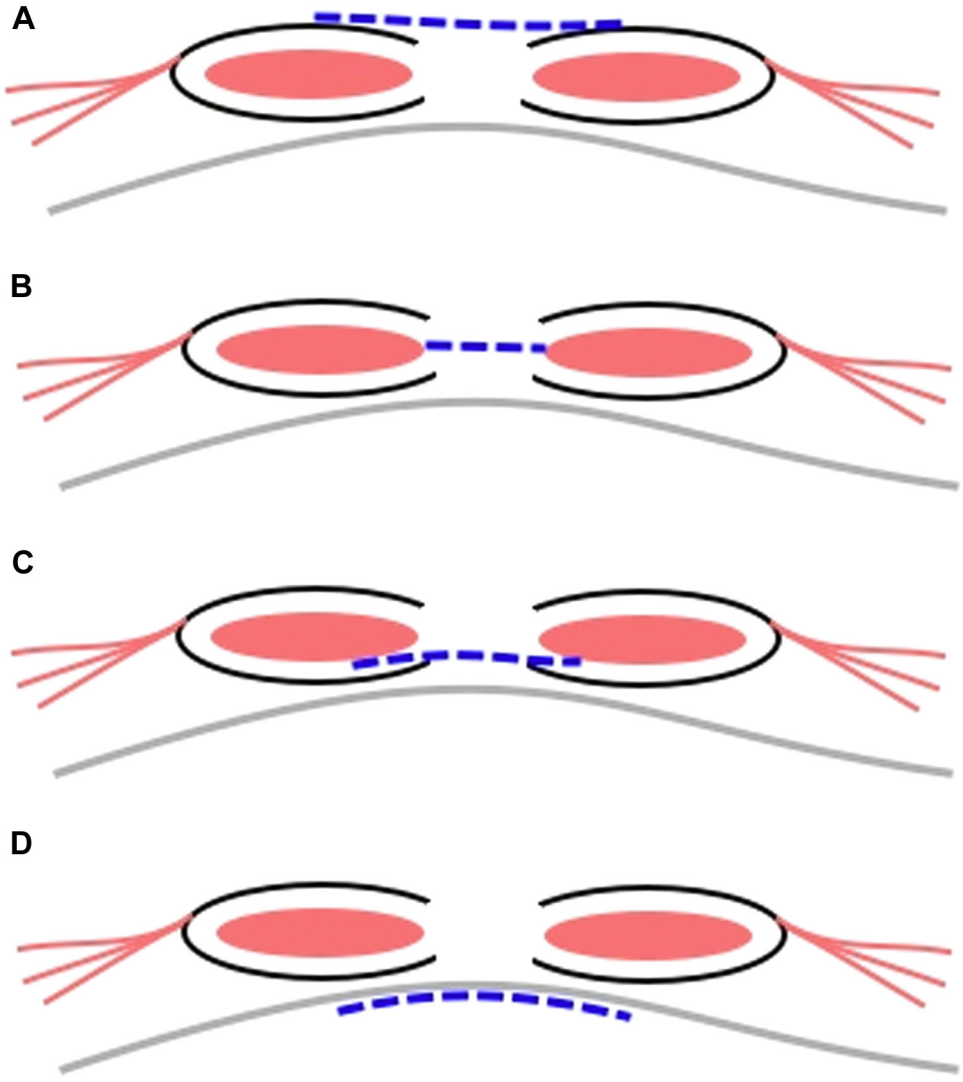

Fig. 1 – Mesh locations. (A) onlay repair, (B) inlay repair, (C) sublay repair, (D) underlay repair; key: blue = mesh; red = muscle; black = fascia; gray = hernia sac. (Color version of figure is available online.)