



## Pathology & Biology Section – 2004

### G22 Postmortem Analysis of Anastomotic Suture Line Disruption Following Carotid Endarterectomy

Judy Melinek, MD, New York City Office of Chief Medical Examiner, 520 First Avenue, New York, NY 10016; Patrick Lento, MD\*, Mount Sinai Hospital Medical Center, 1190 Fifth Avenue, New York, NY 10029; John Moalli, ScD\*, Exponent Failure Analysis Associates, 149 Commonwealth Drive, Menlo Park, CA 94025

The goal of this presentation is to describe a case report of a suture line disruption following surgery and how proper specimen handling and microscopic analysis allowed us to determine the cause of this therapeutic complication.

This presentation will impact the forensic community and/or humanity by providing this first report of its kind in which a postmortem analysis of suture material from a failed suture line implicated improper surgical technique in the death of a patient. In cases where an anastomotic failure is successfully repaired, a broken suture is often discarded along with any clot and blood-soaked gauze. The failure may be reported in the surgical literature or to the suture manufacturer but, without photography or an ultrastructural evaluation of the filament, it cannot be confirmed whether surgical technique or defective manufacturing was at fault.

In the forensic setting there is a singular opportunity to examine the sutures and resolve these issues. The findings can have both medicolegal and public health implications. In this study it was clear that tissue debris and formalin fixation did not significantly hinder such an analysis and we, therefore, recommend that in future death investigations of this nature, the medical examiner should refrain from handling the suture ends with dissecting implements, and preserve the anastomotic suture line with the surrounding tissue en-bloc so that a more detailed analysis can be performed.

The tensile strength of a surgical suture is essential in maintaining the integrity of vascular anastomoses. In the surgical literature, there have been several reports of suture line disruptions due to apparent fracture of polypropylene suture, including failure of an atrial septal defect repair, a proximal anastomosis of a coronary artery bypass, an aortic closure in a patent ductus arteriosus repair, a femoral-popliteal bypass repair, and a carotid endarterectomy. These previous case reports do not present a detailed analysis of the suture tips and there is no photography to document the findings.

While faulty operative technique and the loading strength of individual sutures have been implicated in spontaneous suture line disruptions, there has, to date, never been a published post-mortem analysis of a suture that has known to have failed. We present the case of suture line disruption leading to fatal exsanguination in a 77-year-old man following carotid endarterectomy with a facial vein patch. As part of the public health role performed by the medical examiner's office and in compliance with the requests of family, hospital and the suture manufacturer, we performed a detailed analysis to address the question of whether the suture or the surgical technique were at fault.

A 77-year-old white man with a history of hypertension, coronary artery disease and remote myocardial infarction underwent a carotid endarterectomy for high-grade stenosis of the right carotid artery. Under general anesthesia, the endarterectomy was performed and a right facial vein patch was placed using a double armed, #6-0 Prolene suture. He expired approximately 18 hours after surgery, following a sudden, fatal exsanguination from the surgical site. At autopsy, there was a 1 cm defect of the sutured anastomotic line. At the defect, two suture tips were identified: a straight cranial end and a tightly coiled caudal end. There was no knot on either side, nor were any loose suture fragments identified. The smooth edges of the vein graft and carotid artery confirmed that the tissue itself didn't fray or tear.

The carotid specimen was preserved en-bloc in 10% formalin and photographed using both dissecting and scanning electron microscopy. Examination of the specimen under a dissecting microscope demonstrated that other suture knots from the specimen, some involving vascular ligatures and others involving a distant line of interrupted sutures, were tied in stacked granny or half-hitch configurations. Several of these interrupted sutures were in various stages of untying, with one that had completely untied but had not yet pulled through the tissues.

For scanning electron microscopy, suture tips from the disrupted anastomotic line and from elsewhere on the specimen were carefully removed and oriented. For controls, several #6-0 Prolene control sutures were removed directly from the manufacturing package and were alternately cut with a scalpel blade, surgical scissors, or were manually broken and "popped off" the suture needle. Ultrastructural photography demonstrated that suture tips cut by a scalpel have a squared-off, straight edge while ones that have been cut by scissors are flattened or wedged-shaped with horizontal linear shear marks along the cut surface.

The microscopic shape and contour of the disrupted suture tips, and the complete absence of a knot or additional suture fragments, indicated that surgical technique (an untied knot) was the cause of the suture line disruption. The removal of a broken or untied suture at surgery or at autopsy should not preclude proper analysis of the failed suture, as the results can have both medico-legal and public health implications.

**Forensic Science, Forensic Pathology, Anastomosis**