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Review

Management and closure of the open abdomen after damage control laparotomy for trauma. A systematic review and meta-analysis

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ABSTRACT

Introduction: Damage control laparotomy for trauma (DCL) entails immediate control of haemorrhage and contamination, temporary abdominal closure (TAC), a period of physiological stabilisation, then definitive repair of injuries. Although immediate primary fascial closure is desired, fascial retraction and visceral oedema may dictate an alternate approach. Our objectives were to systematically identify and compare methods for restoration of fascial continuity when primary closure is not possible following DCL for trauma, to simplify these into a standardised map, and describe the ideal measures of process and outcome for future studies.

Methods: Cochrane, OVID (Medline, AMED, Embase, HMIC) and PubMed databases were accessed using terms: (traum*, damage control, abbreviated laparotomy, component separation, fascial traction, mesh closure, planned ventral hernia (PVH), and topical negative pressure (TNP)). Randomised Controlled Trials, Case Series and Cohort Studies reporting TAC and early definitive closure methods in trauma patients undergoing DCL were included. Outcomes were mortality, days to fascial closure, hospital length of stay, abdominal complications and delayed ventral herniation.

Results: 26 studies described and compared early definitive closure methods; delayed primary closure (DPC), component separation (CS) and mesh repair (MR), among patients with an open abdomen after DCL for trauma. A three phase map was developed to describe the temporal and sequential attributes of each technique. Significant heterogeneity in nomenclature, terminology, and reporting of outcomes was identified. Estimates for abdominal complications in DPC, MR and CS groups were 17%, 41% and 17% respectively, while estimates for mortality in DPC and MR groups were 6% and 0.5% (data heterogeneity and requirement of fixed and random effects models prevented significance assessment). Estimates for abdominal closure in the MR and DPC groups differed; 6.30 (95% CI = 5.10–7.51), and 15.90 (95% CI = 9.22–22.58) days respectively. Reporting poverty prevented subgroup estimate generation for ventral hernia and hospital length of stay.

Conclusion: Component separation or mesh repair may be valid alternatives to delayed primary closure following a trauma DCL. Comparisons were hampered by the lack of uniform reporting and bias. We propose a new system of standardised nomenclature and reporting for further investigation and management of the post-DCL open abdomen.

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Introduction

Whilst trauma can affect anyone at any age, the demographic of those requiring a laparotomy for trauma is of a younger, fitter, more economically active population compared with those requiring an expedient laparotomy for other disease processes (such as ruptured aortic abdominal aneurysm, intestinal obstruction, perforation or ischaemia) [1,2]. In trauma, the damage control laparotomy is a well-established technique aimed at prioritising the control of haemorrhage and contamination, and the preservation of physiological reserves, over restoration of anatomical congruity. A key part of the damage control laparotomy is deferment of fascial closure until after the visceral injuries have been definitively managed [3]. Delaying closure facilitates abdominal re-exploration and mitigates the development of abdominal compartment syndrome. In the civilian trauma environment between 8.8% and 36.3% [4] of patients undergoing a trauma laparotomy have a damage control, rather than a definitive laparotomy [5], and in only 65% of these patients is delayed primary closure (DPC - apposition of fascia through mass-closure type suture) [6] achievable. The factors which reduce the chance of restoration of abdominal continuity include delay beyond day eight [7,8] (which increases the incidence of significant abdominal complications such as entero-atmospheric fistulae), abdominal wall tissue defects, and retraction or oedema of the abdominal viscera. It may also be possible that failure to utilise alternate closure methods such as acute component separation and the use of a permanent synthetic or biologic mesh or panel alongside DPC may result in fewer successful closures.

In the time between damage control laparotomy and restoration of abdominal continuity, or planned ventral hernia, the abdomen is temporarily closed (temporary abdominal closure (TAC). Recognised methods of temporary abdominal closure (TAC) include topical negative pressure (TNP) or vacuum assisted closure, The Wittman patch or artificial burr, temporary mesh, fascial tension methods (such as fascial traction sutures or sequential tensioning of mesh), Bogota bag and skin tension. In each method, the primary goal is to contain and protect the peritoneal contents and to prevent egress of intestinal loops whilst the patient is cared for and the conditions are set for definitive closure of the abdomen. A recent systematic review of publications reporting on the TAC management of the open abdomen determined that the Wittman patch, dynamic retention sutures (fascial tension methods) and vacuum assisted closure methods to have similar pooled DPC rates of 78% (eight series), 71% (three series) and 61% (38 series) respectively [9]. However, only a fifth of the patients reported in these series were trauma patients, and comparison was hampered by lack of uniform descriptions of technique and definition of outcome. Similarly, studies reporting on definitive closure techniques [10,11] are difficult to extrapolate to trauma patient due to the heterogeneity of their study populations, so are of limited utility when managing the Damage Control trauma patient.

Following temporary abdominal closure, the abdomen is ideally closed; and it is the techniques to achieve this which are of interest. When restoration of abdominal wall continuity cannot be achieved, the solution is a planned ventral hernia (allowing the wound to granulate with or without mesh, combined with split skin grafting, and then reconstruction as required at six to 12 months). Such staged abdominal repairs have been associated with significant physical and psychological morbidity [12,13], but may be an appropriate course of action in those who have considerable abdominal wall loss or fascial retraction.

The lack of clarity surrounding the options for a staged abdominal repair as part of the damage control laparotomy sequence forms the basis of review. This tests the hypothesise that alternate techniques to mass-closure for restoration of abdominal continuity following the DCL sequence exist, and that these have comparable outcomes. The aims of the study were to identify all methods of abdominal closure following DCL, and to simplify this into a 'map' to describe the sequential and temporal attributes of each technique. The secondary aims were to compare the outcomes of alternative techniques to DCL in terms of mortality, significant abdominal complications, residual hernia or significant abdominal laxity at one year, length of hospital stay and time to closure. These were chosen to assess any differences in both short and long term outcomes. Significant abdominal complication was predefined as any complication related to the abdominal closure which required intervention, and included dehiscence, wound infection, haematoma and fistulation. Significant abdominal laxity was defined as 'a bulge without a palpable or radiographically detected defect' [14]. Through summary and reflection of the literature it was envisioned that the outcomes of closure techniques could clarified and standardised nomenclature developed with recommendations for the design of future research.

Methods

A literature review protocol was generated according to relevant Cochrane guidance [15] in order to clarify the objectives and minimise selection bias. The definition of terms and nomenclature was developed and agreed upon by the study team (Table 1).

Eligibility criteria

Randomised controlled trials (RCTs), case series and cohort studies of trauma patients who had undergone an abbreviated,