Opinions of Practicing Surgeons on the Appropriateness of Published Indications for Use of Damage Control Surgery in Trauma Patients: An International Cross-Sectional Survey

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BACKGROUND: Variation in use of damage control (DC) surgery across trauma centers may be partially driven by surgeon uncertainty as to when it is appropriately indicated. We sought to determine opinions of practicing surgeons on the appropriateness of published indications for trauma DC surgery.

STUDY DESIGN: We asked 384 trauma centers in the United States, Canada, and Australasia to nominate 1 to 3 surgeons at their center to participate in a survey about DC surgery. We then asked nominated surgeons their opinions on the appropriateness (benefit-to-harm ratio) of 43 literature-derived indications for use of DC surgery in adult civilian trauma patients.

RESULTS: In total, 232 (64.8%) trauma centers nominated 366 surgeons, of whom 201 (56.0%) responded. Respondents rated 15 (78.9%) preoperative and 23 (95.8%) intraoperative indications to be appropriate. Indications respondents agreed had the greatest expected benefit included a temperature $<34^{\circ}C$, arterial pH <7.2, and laboratory-confirmed (international normalized ratio/prothrombin time and/or partial thromboplastin time >1.5 times normal) or clinically observed coagulopathy in the pre- or intraoperative setting; administration of >10 units of packed red blood cells; requirement for a resuscitative thoracotomy in the emergency department; and identification of a juxtahepatic venous injury or devascularized or destroyed pancreas, duodenum, or pancreaticoduodenal complex during operation. Ratings were consistent across subgroups of surgeons with different training, experience, and practice settings.

CONCLUSIONS: We identified 38 indications that practicing surgeons agreed appropriately justified the use of DC surgery. Until further studies become available, these indications constitute a consensus opinion that can be used to guide practice in the current era of changing trauma resuscitation practices. (J Am Coll Surg 2016;223:515–529. © 2016 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

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Members of the Indications for Trauma Damage Control Surgery International Study Group are listed in the Appendix.

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Abbreviations and Acronyms

BP = blood pressure
DC = damage control
ED = emergency department
INR = international normalized ratio
PRBCs = packed red blood cells
PT = prothrombin time
PTT = partial thromboplastin time
SMA = superior mesenteric artery

Hemorrhage is the leading cause of preventable death after injury.[1] Significant blood loss is often complicated by development of a "vicious cycle" of hypothermia, acidosis, and coagulopathy, which has been linked with a high risk of mortality.[2,3] To prevent the onset of and/or limit the effects of this vicious cycle, surgeons have adopted damage control (DC) surgery to manage severely injured patients.[4] As opposed to definitive (ie single-stage) surgery, DC allows the initial operation to be abbreviated after control of exsanguinating hemorrhage and/or gross contamination to allow for restoration of pre-injury physiology in the ICU before returning to the operating room for additional surgery.[3,4]

Although widely assumed to improve survival among critically injured patients, survivors of DC surgery may suffer a number of complications (eg complicated ventral hernias and enteroatmospheric fistulae), long lengths of hospital and ICU stay, and reduced quality of life.[5-7] Studies have also recently reported data suggesting that a variation in use of DC surgery exists across trauma centers or that the procedure may be overused.[3,4,8] These observations are concerning because overuse of DC surgery has been associated with increased morbidity and mortality.[9,10] Some authors have therefore suggested that clinical outcomes may improve with more selective use of DC surgery, especially given the recent advent of trauma resuscitation practices that focus on rapid hemorrhage control, prevention and immediate correction of coagulopathy, and avoidance of over-resuscitation with crystalloid fluids (ie DC resuscitation).[3]

Variation in rates of use of surgical procedures may occur when surgeons are unsure which treatment is best in varying clinical situations.[11] We hypothesized that variation in use of DC surgery across trauma centers may be due to surgeon uncertainty as to when it is appropriately indicated.[12,13] The purpose of this study was therefore to determine the opinions of practicing surgeons on the appropriateness of a list of literature-derived candidate indications for use of DC surgery in adult civilian trauma patients. We also sought to determine if surgeons' decisions to perform DC surgery were influenced by whether physiologic derangements significantly improve or reverse as a result of rapid surgery and resuscitation (ie DC resuscitation). Finally, we examined whether these opinions/decisions varied across subgroups of surgeons with different training, experience, and practice settings.

METHODS

Design

We conducted a self-administered, electronic, cross-sectional survey of trauma centers and surgeons located in 4 high-income countries with similar emergency medical services.[14] The study was approved by the University of Calgary Conjoint Health Research Ethics Board and was conducted and reported according to recommendations for performing survey research.[15,16]

Study population

The population of interest included surgeons practicing in level 1, 2, or 3 trauma centers in the United States, Canada, Australia, and New Zealand, who perform emergent thoracic, abdominal, and/or peripheral vascular operations on injured adults. To generate a sampling frame of potential respondents, we surveyed the designated trauma program leader (medical director or program manager) of centers in these regions and asked them to provide the names and e-mail addresses of 1 to 3 surgeons who practice the previously mentioned types of surgery in their center and would be qualified to participate in a survey about DC surgery. The sampling frame of American, Canadian, and Australian trauma centers was created using lists of those verified by the American College of Surgeons in 2013,[17] those who contributed data to the Canadian National Trauma Registry Comprehensive Data Set in 2010 to 2011 (with the exception of Quebec),[18] or those who were part of the Australian Trauma Quality Improvement Program as of August 31, 2014,[19] respectively.

Questionnaire development and testing

The trauma program leader questionnaire was developed by modifying a previously validated questionnaire administered to trauma program leaders in countries mentioned previously.[20] In addition to identifying potential surgeon respondents, the modified questionnaire collected information about geographic location, accreditation/verification and academic status, and designated level of care of their center as well as trauma program characteristics, including numbers and characteristics of injured patients assessed per year (see eAppendix 1 for

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