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Review

Laparoscopy versus laparotomy for the management of penetrating abdominal trauma: A systematic review and meta-analysis

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HIGHLIGHTS

- Laparoscopic evaluation of haemodynamically stable patients with PAT is safe and can reduce post-operative complications.
- It is associated with a very low missed injury rate as reflected by its high sensitivity.
- The most important advantage of laparoscopy is avoidance of non-therapeutic laparotomies.
- The best available evidence comes mainly from heterogeneous observational studies.
- High level evidence from well-designed RCTs are indeed required to facilitate more reliable meta-analysis.

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ABSTRACT

Background: Controversy exists regarding the role of laparoscopy in the evaluation of patients with penetrating abdominal trauma (PAT). Our objective was to perform a comprehensive review of the literature and conduct a meta-analysis to compare outcomes of laparoscopy and laparotomy in PAT.

Methods: In accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement standards, we conducted a systematic search of electronic information sources, including MEDLINE; EMBASE; CINAHL; the Cochrane Central Register of Controlled Trials (CENTRAL); the World Health Organization International Clinical Trials Registry; ClinicalTrials.gov; ISRCTN Register, and bibliographic reference lists. We applied a combination of free text and controlled vocabulary search adapted to thesaurus headings, search operators and limits in each of the above databases. Missed injury, mortality, and complications were defined as the primary outcome parameters. Procedure time, length of hospital stay, sensitivity and specificity of the procedure were the secondary outcomes. Combined overall effect sizes were calculated using fixed-effect or random-effects models.

Results: We identified one randomised controlled trial (RCT) and 8 observational studies comparing outcomes of laparoscopy with laparotomy in PAT. Laparoscopy was associated with a significantly lower risk of wound infection (Odd ratio (OR): 0.55; 95% Confidence interval (CI), 0.37–0.81, P = 0.003) and pneumonia (OR: 0.22; 95% CI, 0.13–0.37, P < 0.00001), and a significantly shorter length of hospital stay (Mean difference (MD): −3.05; 95% CI, −4.68 to −1.42, P = 0.0002) and procedure time (MD: −27.99; 95% CI, −43.17 to −12.80, P = 0.0003) compared with laparotomy. Laparoscopy was 100% sensitive in most of the included studies and avoided non-therapeutic laparotomies in 45.6% of patients.

Conclusions: Our analysis of best available evidence mainly from heterogeneous observational studies has demonstrated that laparoscopic evaluation of haemodynamically stable patients with PAT may be safe and can reduce post-operative complications and length of hospital stay. The most important advantage of laparoscopy is avoidance of non-therapeutic laparotomies which are associated with

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considerable morbidity. However, no definitive conclusion can be made regarding the therapeutic role of laparoscopy in PAT based on the available evidence and future research is indeed required.

1. Introduction

Exploratory laparotomy has traditionally been the most popular procedure for a definite evaluation of patients with penetrating abdominal trauma (PAT) [1]. Mandatory surgical intervention for PAT has been associated with a non-therapeutic laparotomy rate of up to 61% [2–5] due to the absence of peritoneal penetration or the presence of peritoneal penetration with no visceral injuries. However, the morbidity of non-therapeutic laparotomy can be as high as 33.3% and is related to pulmonary problems, wound infections, postoperative ileus, and ventral hernia [3,6].

The ability of various diagnostic modalities, including local wound exploration, diagnostic peritoneal lavage (DPL), abdominal sonography, and computed tomography (CT) to determine the presence and severity of intra-abdominal injuries caused by PAT is controversial [7,8]. Diagnostic laparoscopy, which offers simultaneous therapeutic interventions, has been increasingly used in the evaluation of patients with PAT [9]. A successful diagnostic laparoscopy must identify all trauma induced injuries as effectively as other diagnostic modalities, and a successful therapeutic laparoscopy must allow complete repair of all the identified injuries [9]. The use of diagnostic laparoscopy in trauma initially led to a high rate of missed injuries (41–77%), particularly small bowel injuries [10].

A recent systematic review and meta-analysis compared the outcomes of laparoscopy and laparotomy for the management of abdominal trauma [11]. However, serious concerns on the methodology of this study have been raised [12]. The authors included studies investigating the outcomes of both blunt and penetrating abdominal trauma; however, no sub-group analysis was conducted. Moreover, data from some of the included studies has not been extracted accurately. Most importantly, a large number of their included studies were not indexed in the well-recognised electronic databases and their full texts are not available; therefore, the methodological quality of those studies cannot be assessed. Finally, the authors missed some important studies indexed in the well-recognised databases.

To our knowledge, a review and meta-analysis focusing specifically on comparison of outcomes of laparoscopy and laparotomy in patients with PAT has not been previously undertaken. Our objective was to perform a comprehensive review of the literature and conduct a meta-analysis to compare outcomes of laparoscopy and laparotomy for the management of PAT.

2. Methods

2.1. Design and study selection

The criteria for study selection, methods of analysis, and investigated outcomes were pre-specified and documented in a review protocol. The review conformed to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement standards [13].

We planned to select randomised controlled trials (RCT) and observational studies comparing the outcomes of laparoscopy and laparotomy in patients with PAT. A PAT was defined as any penetrating injury to the abdomen or flank caused by gun pallet, knife, fractured ribs, or any other sharp weapon. Patients aged 16 years or older and of any gender undergoing diagnostic or therapeutic laparoscopy and laparotomy for PAT were considered.

The intervention of interest was diagnostic or therapeutic laparoscopy. Laparoscopy was defined as a surgical procedure in which a laparoscope is used through the abdominal wall with the aim of visualising the pelvic and abdominal cavities to diagnose or treat an underlying trauma induced visceral injury. The primary intervention was compared with laparotomy.

Primary outcome parameters were defined as missed injury, perioperative mortality, and perioperative complications including wound infection, abscess formation, small bowel obstruction or ileus, pneumonia, and thromboembolism. Procedure time, length of hospital stay, re-exploration, readmission, and sensitivity and specificity of the procedure were defined as the secondary outcome parameters.

2.2. Literature search strategy

Two authors (SH and AG) independently searched the following electronic databases: MEDLINE, EMBASE, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL). The last search was run on 16 April 2016. The search strategy, which was adapted according to thesaurus headings, search operators and limits in each of the above databases, is outlined in Appendix 1. In addition, the following trial databases were searched for ongoing and unpublished studies: World Health Organization International Clinical Trials Registry http://apps.who.int/trialsearch/, ClinicalTrials.gov http://clinicaltrials.gov/, and ISRCTN Register http://www.isrctn.com/. We searched the bibliographic lists of relevant articles and reviews for further potentially eligible trials.

2.3. Selection of studies

Two authors (SH and CSW) independently assessed the title and abstract of articles identified through literature searches. The full-texts of relevant reports were retrieved and those articles that met the eligibility criteria of our review were selected. We resolved discrepancies in study selection by discussion between the review authors. An independent third review author (SH) was consulted in the event of disagreement.

2.4. Data extraction and management

We created an electronic data extraction spreadsheet in line with the Cochrane's data collection form for intervention reviews. We pilot-tested the spreadsheet in randomly selected articles and adjusted it accordingly. Our data extraction spreadsheet included the following information:

- Study-related data (first author, year of publication, country of origin of the corresponding author, journal in which the study was published, study design, study size, clinical condition of the study participants, and type of intervention)