Robot-assisted laparoscopic surgery versus conventional laparoscopic surgery in randomized controlled trials: a systematic review and meta-analysis

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Abstract

IMPORTANCE: This review provides a comprehensive comparison of treatment outcomes between robot-assisted laparoscopic surgery (RLS) and conventional laparoscopic surgery (CLS) based on randomly-controlled trials (RCTs).

OBJECTIVES: We employed RCTs to provide a systematic review that will enable the relevant community to weigh the effectiveness and efficacy of surgical robotics in controversial fields on surgical procedures both overall and on each individual surgical procedure.

EVIDENCE REVIEW: A search was conducted for RCTs in PubMed, EMBASE, and Cochrane databases from 1981 to 2016. Among a total of 1,517 articles, 27 clinical reports with a mean sample size of 65 patients per report (32.7 patients who underwent RLS and 32.5 who underwent CLS), met the inclusion criteria.

FINDINGS: CLS shows significant advantages in total operative time, net operative time, total complication rate, and operative cost ($p < 0.05$ in all cases), whereas the estimated blood loss was less in RLS ($p < 0.05$). As subgroup analyses, conversion rate on colectomy and length of hospital stay on hysterectomy statistically favors RLS ($p < 0.05$).

CONCLUSIONS: Despite higher operative cost, RLS does not result in statistically better treatment outcomes, with the exception of lower estimated blood loss. Operative time and total complication rate are significantly more favorable with CLS. More RCT evidence is needed to be accumulated in order to enable full subgroup analyses on each surgical procedure.

Protocol

Performing a pilot study (PilotStudy.xlsx)
Step 1.

It is necessary to perform pilot studies using the previous meta-analysis. In our previous pilot study, we found how difficult it is to combine these large-scale datasets. Initially, we designed to integrate all the RCT, prospective, and retrospective studies. To ensure correctness during our information gathering process, we had a well-organized dataset with highlighted errors suspected to have

occurred in earlier meta-analyses. This approach proved to be beneficial, since we could benchmark meta-analyses of each surgical domain and cross-check our analysis results against the published analyses of previous meta-analyses. Although we later chose to narrow our scope only to RCT, the previous meta-analyses were excerpted in this study, hoping that this may save other researchers' time and efforts when approaching this topic. In addition, although the first two authors independently performed the search, it is essential to share the protocol before the actual data gathering procedure, based on the pilot study.

Step 2.

(1) Pubmed

(((((robot[Title/Abstract] OR robotic[Title/Abstract] OR robotics[Title/Abstract] OR robotically[Title/Abstract] OR robot-assisted[Title/Abstract] OR robotic-assisted[Title/Abstract])) AND (laparoscopic[Title/Abstract] OR laparoscopy[Title/Abstract] OR laparoscope[Title/Abstract])) AND (randomized[Title/Abstract] OR randomised[Title/Abstract] OR random[Title/Abstract] OR RCT[Title/Abstract])) AND ('1981/01/01'[Date - Publication] : '2016/12/31'[Date - Publication])

(2) EMBASE

robot:ab,ti OR **robotic**:ab,ti OR **robotics**:ab,ti OR **robotically**:ab,ti OR **'robot assisted'**:ab,ti OR **'robotic assisted'**:ab,ti AND (**laparoscopic**:ab,ti OR **laparoscopy**:ab,ti OR **laparoscope**:ab,ti) AND (**randomized**:ab,ti OR **randomised**:ab,ti OR **random**:ab,ti OR **rct**:ab,ti) AND [1981-2016]/py

(3) Cochrane

[Title,Abstract,Keywords] robot or robotic or robotics or robotically or robot-assisted or robotic-assisted AND [Title,Abstract,Keywords] laparoscopic or laparoscopy or laparoscope AND [Title,Abstract,Keywords] randomized OR randomised OR random OR RCT
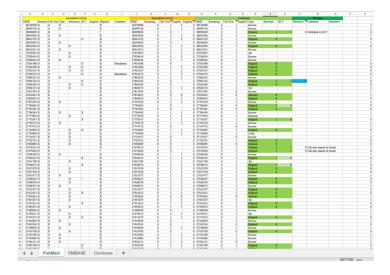
Publication Year from 1981 to 2016:

Search	Search Manager	Medical Terms (MeSH)	Browse

	Title, Abstract, Keywords	robot or robotic or robotics or robotically or robot-assisted or robotic-assisted	Go	Save
⊖	AND	Title, Abstract, Keywords	laparoscopic or laparoscopy or laparoscope	Add to Search Manager
⊖ ⊕	AND	Title, Abstract, Keywords	randomized or randomised or random or RCT	

Search Limits   Search Help   Publication Year from 1981 to 2016 (Word variations have been searched)

Clear limits

Clear

All Results (356)

● Cochrane Reviews (7)
  ● All
  ○ Review
  ○ Protocol

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There are **7** results from **10040** records for your search on '**robot or robotic or robotics or robotically or robot-assisted or robotic-assisted** in Title, Abstract, Keywords and **laparoscopic or laparoscopy or laparoscope** in Title, Abstract, Keywords and **randomized or randomised or random or RCT** in Title, Abstract, Keywords , Publication Year from 1981 to 2016 in Cochrane Reviews'

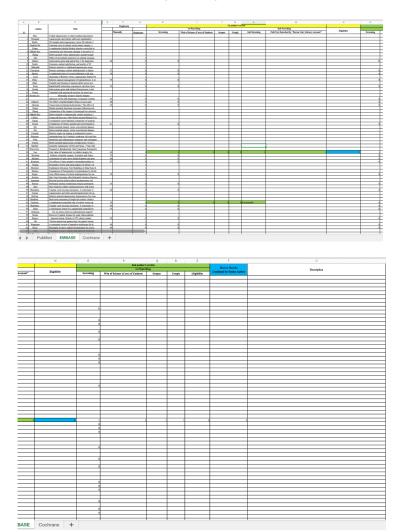**[Screening, Eligibility, and Inclusion] Using the uploaded Worksheet.xlsx**
Step 3.

(1) The study used the uploaded worksheet to indicate the duplicates identified by the Python script (CountingDuplicates.py) or later manually to double-check. All the studies in Cochrane were also found in PubMed or EMBASE. (Please change its extension from pdf to py: CountingDuplicates.pdf => CountingDuplicates.py)

```python
################################################################################
# CountingDuplicates v0.3 (2017)
#
# A script to count duplicates across database for the PRISMA table
# of Meta-Analysis
#
# Author: Hyunsuk Frank Roh (Frank@nGene.org)
# Hanyang University, School of Medicine
# Software Architect of www.nGene.org
################################################################################

from difflib import SequenceMatcher
import re
import codecs

data_pubmed = []
data_EMBASS = []

def similar(a, b):
    a = a.lower()
    b = b.lower()
    return SequenceMatcher(None, a.lower(), b.lower()).ratio()

def iterating_list(data, verbose=False):
    num_counter = 1
    for tmp in data:
        first_author   = tmp[0]
        title          = tmp[1]
        if verbose:
            print("%3s %10s   %s" %(num_counter, first_author, title))
        num_counter = num_counter + 1

def read_EMBASS(file, data):
    f = codecs.open(file, "r",  encoding='utf-8')
    lines = f.readlines()
    i = 0

    while(i < len(lines)):
        tmps = lines[i].split(' ')
        title = ''
        no_title = False
        no_author = False

        if tmps[0] == 'RECORD':
            num_counter = int(tmps[1])
```

(2) The first two authors screened the PubMed data based on the name and abstract. Whenever a suspicion arose, full-texts were examined. In the worksheet, the first two authors indicated whether the full-text was available, whether the study was RCT; the language, relevance, and other comments were also specified.

Similarly, the first two authors screened the EMBASE data based on the name and abstract. In the case of doubt, full-texts were examined using Web of Science (Core) and SCOPUS to find the full text. In the worksheet, what database had the full text was indicated in order for the other author to later double-check whether, in fact, the full text could be found.

The senior author later decided whether to include/exclude the study for any discrepancies between the first two authors. As indicated by the worksheet, we double-checked the worksheet as well.