A Comparison of the Efficacy and Adverse Effects of Double-Lumen Endobronchial Tubes and Bronchial Blockers in Thoracic Surgery: A Systematic Review and Meta-analysis of Randomized Controlled Trials

Ana Clayton-Smith, Kyle Bennett, Robin Peter Alston, FRCA, MbChB, MD, George Adams, Greg Brown, Timothy Hawthorne, May Hu, Angus Sinclair, and Jay Tan

Objective: **To compare the efficacy and adverse effects of using bronchial blockers (BBs) and double-lumen endobronchial tubes (DLTs).**

Design: **Systematic review and meta-analysis of randomized controlled trials (RCTs) comparing BBs and DLTs.**

Setting: **Hospital units undertaking thoracic surgery**

Participants: **Patients undergoing thoracic surgery requiring lung isolation.**

Interventions: **BBs and DLTs.**

Measurements and Main Results: **A systematic literature search was conducted for RCTs comparing BBs and DLTs using Google Scholar, Ovid Medline, and Cochrane library databases up to October 2013. Inclusion criteria were RCTs comparing BBs and DLTs, intubation carried out by qualified anesthesiologists or trainee specialists, outcome measures relating to either efficacy or adverse effects. Studies that were inaccessible in English were excluded. Mantel-Haenszel fixed-effect meta-analysis of recurring outcome measures was performed using RevMan 5 software. The search produced 39 RCTs published between 1996 and 2013. DLTs were quicker to place (mean difference: 51 seconds, 95% confidence intervals [CI] 8-94 seconds; p = 0.02) and less likely to be incorrectly positioned (odds ratio [OR] 2.70; 95% CI 1.18-6.18, p = 0.02) than BBs. BBs were associated with fewer patients having a postoperative sore throat (OR 0.39, 95% CI: 0.23-0.68, p = 0.0009), less hoarseness (OR: 0.43,95%, CI 0.24-0.75, p = 0.003), and fewer airway injuries (OR 0.40, 95% CI 0.21-0.75, p = 0.005) than DLTs.**

Conclusion: **While BBs are associated with a lower incidence of airway injury and a lower severity of injury, DLTs can be placed quicker and more reliably.**

KEY WORDS: bronchial blocker, double-lumen endobronchial tube, lung isolation, one-lung ventilation, thoracic surgery, efficacy, adverse effects

IN THE EARLIER YEARS of thoracic anesthesia, controlling of secretions during lung surgery was a major problem for anesthesiologists.[1] Today, control of secretions is much less of a problem because the incidences of bronchiectasis, lung abscess, empyema, and tuberculosis in patients now presenting for thoracic surgery are far lower. However, lung isolation remains fundamental to the practice of thoracic anesthesia, because it facilitates surgical access during thoracotomy and, even more so now, for video-imaged thoracoscopic surgery.

Although endobronchial intubation can be undertaken with a single-lumen tube, the 2 main techniques that presently are used for lung isolation are bronchial blockers (BBs) and double-lumen endobronchial tubes (DLTs). The first technique to be introduced into clinical practice was BBs by Magill in 1936.[2] Today, there are a number of commercially manufactured BBs, including Arndt, Cohen, Univent tube, Uniblocker, and EZ-blocker.[3] Arising from tubes designed for differential bronchospirometry, Bjork et al reported the use of a DLT designed by Carlens for lung resection in 1953.[4] DLTs are available from many manufacturers in left and right versions. While there is little discernible difference in the design of left DLT among manufactures, there are significant differences in the design of right DLTs.[5]

Although BBs and DLTs have been in use for more than 6 decades, controversy remains as to which technique is most effective and has fewer adverse effects.[3,5] Indeed, the choice of DLT or BB often relates to the preferences of the institution or anesthesiologist. However, to address this controversy, a number of randomized controlled trials (RCTs) comparing BBs and DLTs have been undertaken in recent years[6–21] Most of the RCTs have had small study populations and so are susceptible to Type-II statistical error and, in particular, for adverse events that may be infrequent but clinically important. For this reason, the aim of this study was to undertake a systematic review and meta-analysis of these RCTs to compare the efficacy and adverse effects associated with the use of BBs and DLTs for lung isolation.

METHODS

A preliminary search using Google Scholar obtained information regarding various BBs and DLTs and was used to form the basis of the inclusion and exclusion criteria of the study. Inclusion criteria were RCTs comparing the use of at least one BB and DLT for lung isolation during thoracic surgery in humans, placed by either qualified anesthetists or trainee specialists, comparing either efficacy and/or the adverse effects, and published in English. No publication date restrictions were imposed. Any of the papers that met the inclusion criteria were included in the systematic review and meta-analysis. Search terms were devised to conduct a literature search on Ovid Medline and the Cochrane library. The search was run from September 26, 2013 to November 26, 2013.The systematic review was written in accordance with the PRISMA 27-step checklist (2009),[22] and literature was critically appraised after the PICO method.[23]

All papers were critically appraised, and citations of other relevant RCTs listed as references were extracted and incorporated into the study. MeSH terms were unavailable due to the

From the College of Medicine and Veterinary Medicine, Academic Administration, The University of Edinburgh, Edinburgh, United Kingdom.

Address reprint requests to Ana Clayton-Smith, College of Medicine and Veterinary Medicine, Academic Administration, The University of Edinburgh, 2nd Floor, The Chancellor's Building, 49 Little France Crescent, Edinburgh, EH16 4SB, United Kingdom. E-mail: s1202024@sms.ed.ac.uk

1053-0770/2601-0001$36.00/0

http://dx.doi.org/10.1053/j.jvca.2014.11.017

specificity of the search. Therefore, a search strategy was created using key terms gathered from various publications (Fig 1). Attempts were made to contact authors of those papers that were not written in English to obtain translations. However, these attempts were unsuccessful. Titles of papers retrieved from searches were reviewed by 8 of the investigators and those papers that did not fit the criteria were excluded.

A data extraction table was created to detail key aspects of RCTs and ease comparison. These included title, author, year of publication, type(s) of BB and DLT, study population, study design, the individual responsible for tube placement, measures of efficacy, measures of safety, summarized results, validity, conclusion, number of citations, and number of times cited. Each author critically appraised a minimum of 2 RCTs, and the

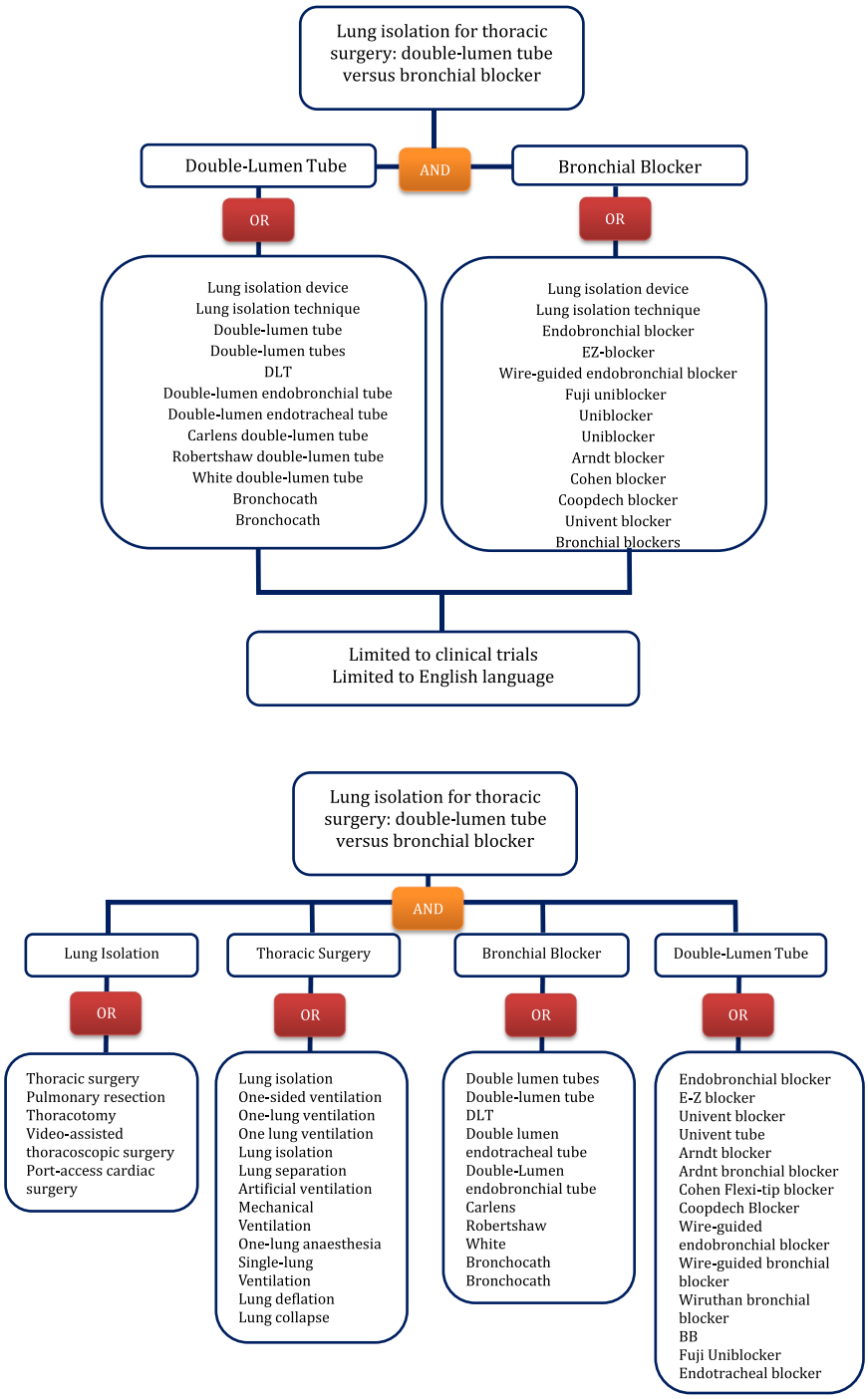

Fig 1. Medical subject headings (MeSH) search terms: Combinations of medical subject headings used when conducting literature search of Cochrane and Ovid Medline databases.