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Major Article

Prevalence and predictive factors of urinary tract infection among patients with stroke: A meta-analysis

Tianyuan Yan MS [a,b], Chenxia Liu MS [a,b], Yingxia Li MS [a], Wei Xiao MS [c], Yating Li MS [a,b], Shuhui Wang MD [a,*]

[a] Department of Infection Prevention and Control, Qilu Hospital of Shandong University, Jinan, Shandong Province, China
[b] School of Nursing, Shandong University, Jinan, Shandong Province, China
[c] Jinan Central Hospital Affiliated to Shandong University, Jinan, Shandong Province, China

Key Words:
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Background: Urinary tract infection (UTI) is thought to be a common complication of stroke and is regarded as a potential risk factor for poor stroke outcomes. However, there is a controversy among predictive factors of stroke-associated UTIs. We aim to estimate the prevalence and predisposing factors of UTIs among patients with stroke.

Methods: PubMed, EMBASE, and Elsevier Science Direct were searched by 2 independent researchers. Sixteen studies with a total of 13,513 patients were included to evaluate the prevalence and predictive factors of stroke-associated UTIs published from the earliest records to March 10, 2017. Pooled effect sizes were calculated using the fixed effect model or random effect model according to I^2 and P values.

Results: The pooled prevalence of UTI was 19.0% (95% confidence interval [CI], 15%-22%; $P < .01$). The predisposing factors for UTIs include female sex (odds ratio [OR], 1.93; 95% CI, 1.55-2.41), older age (OR, 1.28; 95% CI, 1.09-1.50), higher modified Rankin Scale score (OR, 1.90; 95% CI, 1.43-2.53), and postvoid residual volume >100 mL (OR, 3.69; 95% CI, 2.09-6.52).

Conclusions: Approximately one-fifth of patients with stroke contracted at least 1 UTI after cerebral apoplexy. Female sex, older age, higher modified Rankin Scale score, and postvoid residual volume >100 mL were associated with higher risk of UTI.

Urinary tract infections (UTIs) are among the most frequent individual infectious complications encountered by poststroke patients,[1] and previous studies have suggested a link between UTI and poor clinical outcome after stroke.[2,3] Heightened awareness of infectious complications among patients with stroke should be underscored to reduce the incidence rate of such complications, and therapeutic regimen involving application of antibiotics to treat poststroke infection is strongly recommended.[4]

However, there has been a highly variable prevalence of UTIs that occurred in patients with stroke; previous studies have quoted the rate as ranging from 3% up to 40%.[1,5-8] Reasons for wide discrepancy in reported incidence of stroke-associated UTI are unclear, but most likely diversity in follow-up period, single- or multicenter study, UTI diagnostic criteria, length of stay, and antimicrobial drug usage may contribute to this widely divergent prevalence of UTI. Factors claimed to predict increased risk for contracting UTI include diabetes mellitus, stroke severity, increased postvoid residual (PVR) volume, and prior stroke.[9-11] However, studies within cerebrovascular disease literature have mixed results regarding prevalence and predictive factors associated with poststroke UTI. Given the aforementioned information, identification of predictive factors associated with common poststroke infections could permit clinicians to provide close infection surveillance and timely medical treatment of patients with stroke at highest risk for infective complications, thereby optimizing clinical outcomes.

Therefore, in this meta-analysis, we collected different studies' primary data about rates and factors implicated in UTIs among patients with stroke to elucidate the prevalence of UTI and identify predictive factors associated with its development.

* Address correspondence to Shuhui Wang, MD, Department of Infection Prevention and Control, Qilu Hospital of Shandong University, Jinan, Shandong Province P.C.250012, China.
E-mail address: wangshqlyy@163.com (S. Wang).

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METHODS

Search strategy and databases

A literature search in PubMed, Elsevier Science Direct, and EMBASE was performed from the databases' earliest records to March 10, 2017. The following key words, Boolean operators and Medical Subject Headings were used combined with article title and abstract-based search strategies in all databases: *urinary tract infection*, *UTIs*, *stroke*, *apoplexy*, *cerebrovascular accident*, *cerebrovascular diseases*, *hemorrhagic stroke*, *ischemic stroke*, *cerebral infarction*, *cerebral hemorrhage*, *intracerebral hemorrhage*, *intracranial hemorrhage*, *subarachnoid hemorrhage*, and *factors*. Non-English language articles were excluded from this analysis. Two reviewers scanned the article titles and abstracts independently for initial screening, and any disagreement was resolved by the third author's review of the articles until consensus was reached. We also searched reference lists of potential articles to include as many relevant studies as possible for the present study.

Inclusion and exclusion criteria

All cohort, case-control, and observational studies focusing on prevalence and predictive factors of UTIs among patients suffering from acute stroke were searched. Only studies conducted among human subjects were included. Animal experiments, case reports, reviews, comments, and duplicated studies were excluded for this meta-analysis. Study subjects were patients with stroke (aged >18 years) contracting UTIs. The studies provided odds ratios (ORs) and 95% confidence intervals (CIs) or sufficient data to calculate these statistical figures to get the prevalence or risk factors of UTI among target patients. In each report, UTI was diagnosed according to criteria of the U.S. Centers for Disease Control and Prevention, International Classification of Diseases-9th Revision, case report and clinical features, and mainly positive urine culture. All UTI diagnoses were confirmed by patient medical records or doctor office records in relevant medical databases.

Data extraction

Two independent investigators extracted and recorded the following information from selected articles using a predesigned form: first author, publication year, regions, study design, sample size, number of male and female patients, patient age, number of UTI occurrences, and UTI diagnosis approaches. Prevalence of UTI—a common stroke-associated nosocomial infection—was also extracted. Study population characteristics retrieved were type of stroke, regions, sex, age, white race, modified Rankin Scale (mRS) score, modified National Institutes of Health Stroke Scale (mNIHSS) score, PVR, Foley catheter dwelling conditions, medical history, follow-up period, and so forth. OR and 95% CI with the corresponding items can be obtained to compare pooled effect sizes. Begg and Egger tests[12-14] were used to evaluate publication bias in this analysis.

Quality assessment

Assessing the methodologic quality or risk of bias of studies included in meta-analyses is essential as recommended by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement[15] because inclusion of poor quality studies can lead to a distortion of the summary effect estimate. The Cochrane Collaboration recommended the use of the Newcastle-Ottawa scale (NOS)[16] to assess the quality of observational studies in its 2011 handbook.[17] Reliability of this tool has been assessed. Previous existing studies have stated interrater reliability on the NOS (intraclass correlation coefficient, 0.52; 95% CI, 0.14-0.76) was moderate to good[18] and test-retest reliability (intraclass correlation coefficient, 0.85; 95% CI, 0.55-0.95) was fair to excellent.[19] A meta-analysis conducted by Li et al[20] remarked this scale as reliable and valid. This evaluation tool continues to be a frequently used tool in practice. Numerous studies refer to the scale's application in appraising a body of evidence, as conveyed by several recent publications in which it has been used.[21,22] Therefore, considering the moderate to good reliability, high ease of use, clarity of individual items, short scoring time, rating values used for each item, and ease during arbitration or consensus, the NOS has the potential to be an reliable rating instrument for study quality evaluation in meta-analyses of observational studies.

The NOS is a quality rating instrument for use on observational studies, specifically cohort and case-control designs. The quality of each study was evaluated using the assessment criteria of the NOS, which contains 9 items categorized into 3 dimensions, including selection of participants, comparability of study groups, and outcome of interest. These three major aspects are worth 4, 2, and 3 stars, respectively. A star rating system is used to indicate the quality of a study, with a possible maximum evaluation of 9 stars for the least risk of bias. Each assessment item receives a single star if appropriate methods have been reported. Those studies with >7 stars were regarded as high quality. Study quality assessment in this meta-analysis was performed by 2 independent reviewers (T.Y. and C.L.) for each study. Disagreements between 2 observers were resolved by discussion with a third author (S.W.).

Statistical analysis

Stata 14.0 (StataCorp, College Station, TX) was used to calculate pooled prevalence of UTI among patients with stroke, and a subgroup analysis in terms of study regions and follow-up periods was also performed. Predictive factors for stroke-associated UTI were estimated by calculating pooled ORs and 95% CIs using Review Manager 5.2 (Cochrane Collaboration, London, United Kingdom) and Stata 14.0 (StataCorp, College Station, TX) software. The predictive factors were considered significantly associated with UTI when $P < .05$ and 95% CI did not span 1. The I^2 statistic and P value were used to describe heterogeneity size. $I^2 > 50\%$ or $P < .1$ indicated high heterogeneity and a random-effects model was applied for pooled effect size; otherwise, a fixed-effects model was implemented because of a low degree of heterogeneity. Tests for publication bias were routinely performed, both graphically and statistically. A funnel plot was used to test publication bias visually. Additionally, statistical tests for funnel plot asymmetry were also carried out because visual inspection might be subjective, and necessary to quantify the evidence for asymmetry. Hence, Begg and Egger regression asymmetry tests[12-14] were consequently conducted, with $P > .05$ indicating the lack of publication bias.

RESULTS

Literature search

A total of 1,157 records were identified by search procedures in all databases (PubMed: 952, EMBASE: 45, and Elsevier Science Direct: 160). After duplicates removal and initial screening of article titles, 762 records were excluded. Then, 281 articles remained after abstract review, among which 151 primary articles with full-text access were left. Of these, 16 articles were eligible and assessed using the NOS based on inclusion criteria; the excluded studies included 63 studies that did not provide ORs and 95% CIs, 27 articles that were not in English, and 45 studies that did not report UTI predictive factors in the articles. The authors ultimately included 16 articles