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Review

Intraurethral lidocaine use during urodynamics in female patients: A systematic review and meta-analysis

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ABSTRACT

Pain and discomfort may occur in catheterization during a urodynamic examination. A lidocaine gel combined with a water-based lubricant is sometimes used to reduce pain during catheterization. Several studies claimed that intraurethral lidocaine administration could cause inaccurate urodynamic parameters results. However, its definite effects in urodynamics testing on humans are still not clear. We aimed to evaluate the effects of intraurethral lidocaine on pain and urodynamic study parameters in patients undergoing an invasive urodynamic examination. A systematic search adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol was performed in the MEDLINE, PubMed, and ScienceDirect databases for randomized controlled trials (RCTs). The bias of the studies is evaluated using the Cochrane risk of bias tool by two independent reviewers. The analyses of continuous outcomes were displayed as mean difference (MD), whereas odds ratio is used to analyze dichotomous data. Heterogeneity between studies is determined using the I^2 value. A total of three RCTs out of 622 discovered that articles were eligible for analysis. Forest plot analysis of the mean visual analogue scale difference of the studies indicated an insignificant difference between the lidocaine and placebo group (MD –7.68; 95% CI –34.04 to –18.68, $P = .57$). All urodynamic parameter results were also similar between the two groups ($P > .05$). Routine intraurethral lidocaine injection prior to a urodynamic study does not affect pain intensity and urodynamic parameters.

Keywords: Intraurethral lidocaine; lidocaine; urodynamics; urodynamic study.

Introduction

Urodynamics or urodynamic study is a term that covers a variety of tests to measure physiological parameters of the lower urinary tract by assessing its function.[1] The testing includes both invasive and noninvasive evaluations. Invasive examinations include catheter insertion into the bladder.[2] Catheterization during an urodynamic study could induce pain and discomfort in patients. In performing the examination, external factors that could affect the results should be minimalized to gain accurate results representative of the patient's condition. Several studies reported a relatively higher intensity of pain and discomfort during catheterization in urodynamics examination among female patients with a history of chronic pain.[3,4] A lidocaine gel combined with a water-based lubricant is sometimes used to ease catheter insertion and reduce pain.[5] However, several studies claimed that intraurethral lidocaine administration could disrupt the sensory nerve response, which could interfere with bladder emptying. During urinary passage through the urethra, the afferent nerves of pudendal nerve would be activated and cause bladder contraction to ensure normal efficient micturition.[6] The disruption of the mechanism could lead to ineffective voiding and urinary retention, thus resulting in inaccurate urodynamic parameters results.[7] There is a dilemma whether intraurethral lidocaine could be necessarily given for patients undergoing a catheterization during an urodynamic study. Therefore, we aimed to evaluate

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Table 1. Search Strategy

Database	Keywords	Articles
PubMed/ MEDLINE	(((urodynamical[All Fields] OR urodynamically[All Fields] OR urodynamics[MeSH Terms] OR urodynamics[All Fields] OR urodynamic[All Fields]) AND (lidocain[All Fields] OR lidocaine[MeSH Terms] OR lidocaine[All Fields] OR lignocaine[All Fields] OR lidocaine s[All Fields] OR lignocain[All Fields] OR (lidocain[All Fields] OR lidocaine[MeSH Terms] OR lidocaine[All Fields] OR lignocaine[All Fields] OR lidocaine s[All Fields] OR lignocain[All Fields]))) OR (analgetic[All Fields] OR analgetics[All Fields])) AND (controling[All Fields] OR controllability[All Fields] OR controllable[All Fields] OR controllably[All Fields] OR controller[All Fields] OR controller s[All Fields] OR controllers[All Fields] OR controlling[All Fields] OR controls[All Fields] OR prevention and control[MeSH Terms] OR (prevention[All Fields] AND control[All Fields]) OR prevention and control[All Fields] OR control[All Fields] OR control groups[MeSH Terms] OR (control[All Fields] AND groups[All Fields]) OR control groups[All Fields])	342
	Limited to: "Randomize controlled trials", "Controlled trials	
Science Direct	(Urodynamic) AND (Placebo OR Sham Procedure) AND (Lidocaine)	280
	Limited to: *Clinical Trial, RCT*	
	Total	622

MeSH, medical subject headings; RCT, randomized controlled trial.

the effects of intraurethral lidocaine on pain and urodynamic study parameters.

Methods

Systematic Search Strategy

The protocol for this review has been registered in the PROSPERO database (a systematic search was performed in MEDLINE and ScienceDirect in January 2021 adhering to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guideline).[8] The detailed search strategy and keywords used are listed in Table 1. The systematic search was performed by three investigators.

Eligibility Criteria

Studies were considered eligible based on the following criteria: randomized controlled trial (RCT) study design, evaluating adult patients undergoing urodynamics examination with intraurethral lidocaine injection compared to adults given placebo in the form of a water-based lubricant, comparing at least two arms, and evaluating outcomes based on pain and urodynamics parameters. Studies were excluded based on the following exclusion criteria: non-English articles, animal model studies, unpublished articles, inaccessible full paper, and observational or review studies. Three reviewers performed independent reviews for the search results. Each eligibility of the studies was decided by all reviewers. Any disagreements were discussed between the reviewers until a decision was met. There were not any inter-rater disagreements between the reviewers. The risk of bias analysis was performed using the Cochrane risk of bias (RoB) tool.

Main Points

- Some practitioners administer intraurethral lidocaine gel for patients undergoing an urodynamics study to reduce pain.
- Several findings from animal studies suggested that local anesthetic could affect urodynamics parameters, resulting in misrepresentative findings.
- Current published trials showed that there is no significant difference of pain intensity between an intraurethral lidocaine injection and a water-based lubricant.

Data Collection and Statistical Analysis

Studies were included based on the eligibility criteria and assessed for duplication using Mendeley and manually. The included studies' quality assessment was examined using the Cochrane' risk of bias (RoB) tool. The dichotomous outcomes were presented as an odds ratio (OR), whereas the continuous outcomes were presented as mean difference (MD). To determine the analysis for variables from the studies, the outcomes were tabulated in a table and compared between each group based on the intervention given. Before the analysis, all outcomes were evaluated for missing essential statistical data. Missing standard deviation may be obtained from converting the median, minimum, and maximum data. Heterogeneity of the studies was evaluated by I^2 value. The studies were

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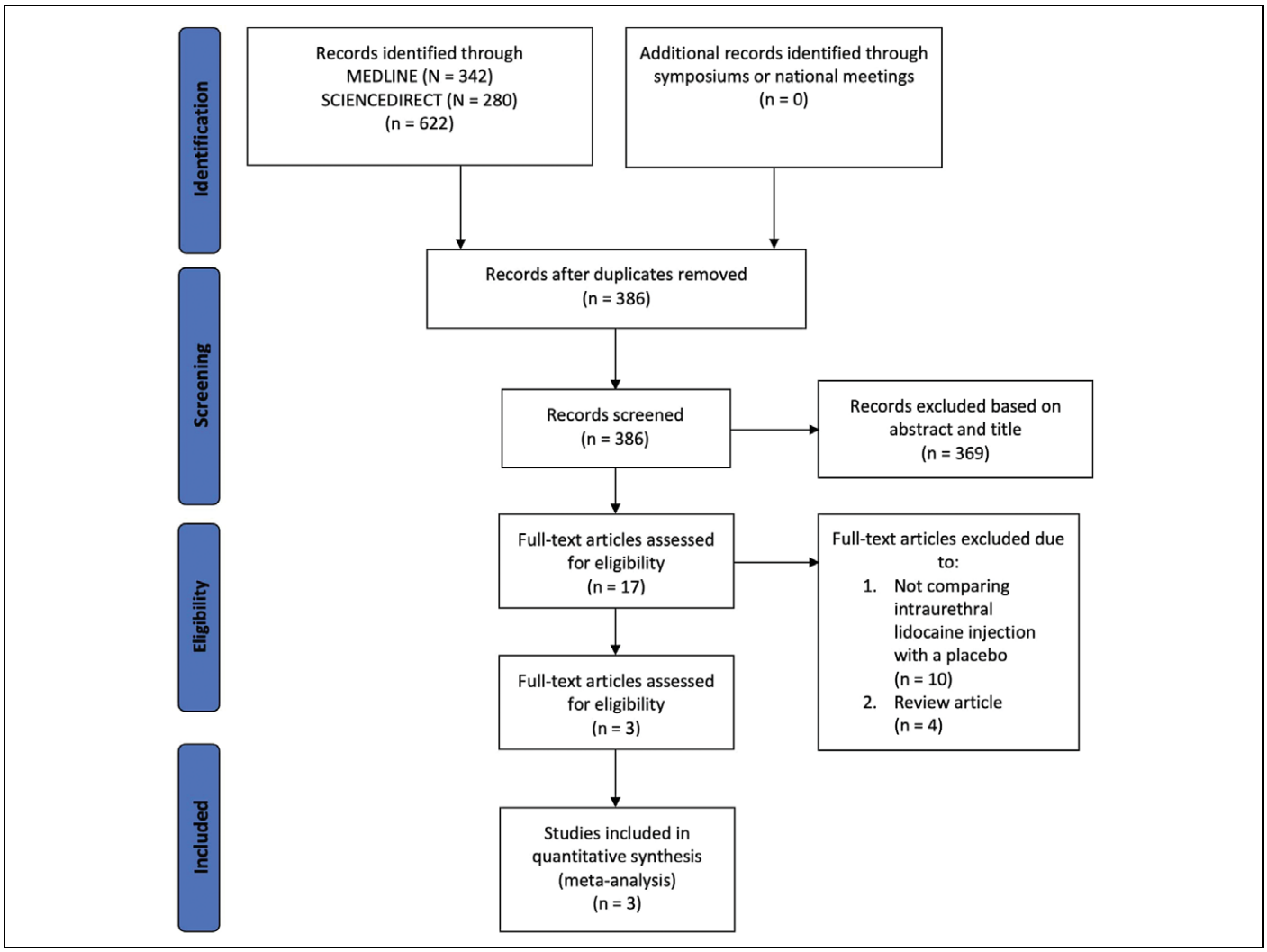

Figure 1. PRISMA flowchart explaining systematic search and screening process.

considered homogenous if the I^2 value was less than 50%, in which a fixed-effect model was selected for the analysis. Otherwise, a random-effects model was selected. We considered the difference of studies as statistically significant based on the *P*-value (<.05). All forest plot analyses were performed using Review Manager (Revman) 5.4.

Outcomes

The evaluated outcomes in this study included visual analogue scale (VAS) to measure pain during catheterization and urodynamics parameters, consisting of voiding efficiency, intermittent flow pattern, postvoid residual (PVR) volume, Detrusor pressure at maximum flow (Pdet@Qmax), Pabdominal (Pabd) recruitment during flow, and elevated electromyography (EMG) activity. Dichotomous outcomes consisted of voiding efficiency, Pabd recruitment during flow, intermittent flow pattern, and elevated EMG activity. Continuous outcomes consisted of VAS, PVR, and Pdet@Qmax. Unclear or missing variables from a study were excluded.

Results

Systematic Search and Studies' Characteristics

The search and screening process in this review is presented in the PRISMA flowchart in Figure 1. Upon initial search, we discovered 622 articles from MEDLINE and ScienceDirect based on the keywords. Out of the 622 articles, 236 duplicates were found and excluded. Screening the articles based on the title and abstract produced 17 articles. Three RCTs were considered

Table 2. Studies' Baseline Characteristics

Author	Sample Size		Mean VAS		Voiding Efficiency (%)		PVR Volume (mL)		Pdet@Qmax (cm H_2O)		Pabd during Flow, n		Intermittent Flow Pattern, n		Elevated EMG Activity, n	
	Lidocaine	Placebo	Lidocaine	Placebo	Lidocaine	Placebo	Lidocainee	Placebo	Lidocaine	Placebo	Lidocainee	Placeboo	Lidocainee	Placeboo	Lidocainee	Placeboo
Mckee et al.[9]	8	9	26.7 ± 12.8	36.9 ± 26.8	91.94	75.95	51.56 ± 11.62	89.13 ± 46.94	40 ± 15	44 ± 15	1	1	2	4	1	3
Özel et al.[10]	42	48	14 ± 19	39 ± 30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Kisby et al.[11]	11	12	25.25 ± 8.38	14 ± 7.52	92.8	91.3	70 ± 34.67	43.78 ± 9.38	37.6 ± 19.2	31 ± 18.9	5	1	4	0	8	3

RCT, randomized controlled trial; NR, not reported; PVR, postvoid residual; Pdet@Qmax, detrusor pressure at maximum flow; Pabd, abdominal pressure; EMG, electromyography.

Figure 2. Risk of bias graph of the included RCTs.

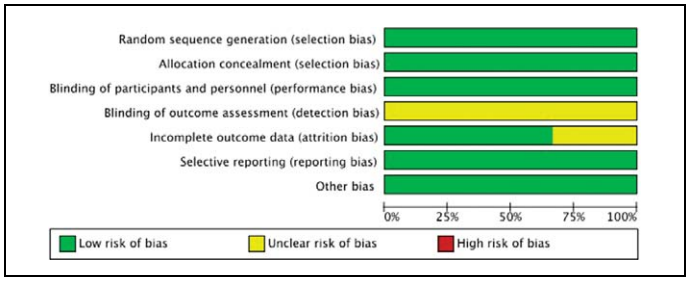

Figure 3. Risk of bias summary of the included RCTs.

eligible out of the 17 articles.[9–11] Table 2 displays the characteristics of the included studies. Figure 2 and 3 showed the risk of bias summary of the studies. There are 130 total samples from the three studies. All studies distributed the samples into two groups based on the interventions given: intraurethral lidocaine or water-based lubricant. Mckee et al.[9] used 4% intraurethral injections, whereas other studies administered 2% intraurethral injections to their samples. The difference in mean VAS of the groups during catheter placement between studies is shown in Table 2. All studies showed an overall higher VAS in the placebo group except for Kisby et al.,[11]

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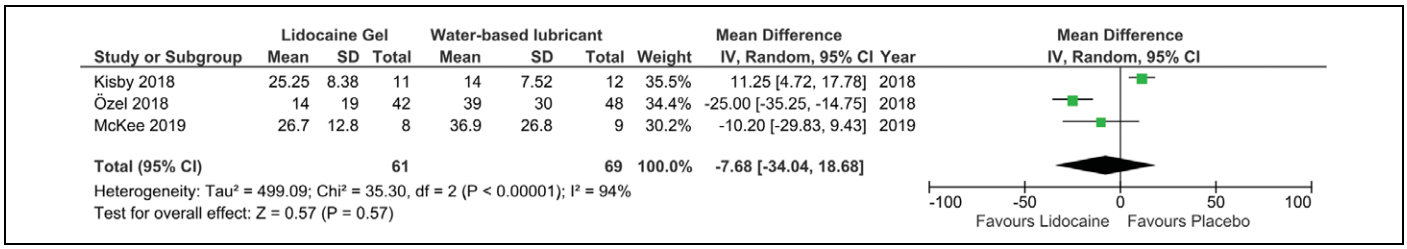

Figure 4. Forest plot of VAS average difference during catheter placement of the included RCTs.

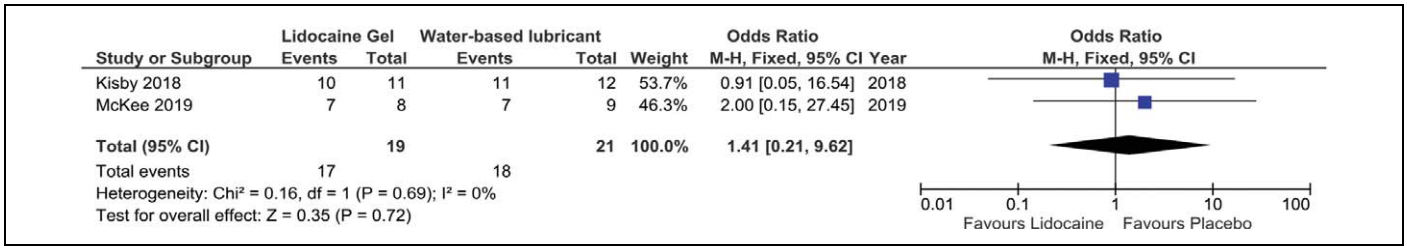

Figure 5. Forest plot of voiding efficiency of the included RCTs.

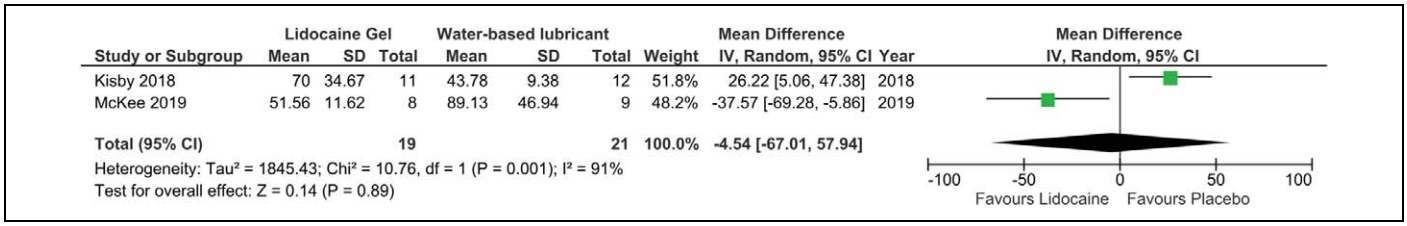

Figure 6. Forest plot of postvoid residual volume difference of the included RCTs.

whose results indicated a higher VAS average in the lidocaine group. Table 2 also displays the urodynamics parameters of the included studies. PVR volume and Pdet@Qmax are evaluated as continuous data, whereas voiding efficiency, Pabd recruitment during flow, intermittent flow pattern, and elevated EMG activity were evaluated as dichotomous data. The overall risk of bias of the studies is low. However, the blinding process of the outcomes was not specified in any of the studies. There is also a possibility of incomplete urodynamics parameter results of the study by McKee et al.[9] as the urodynamic parameters reported was fewer than the ones reported by Kisby et al.[11]

Mean VAS Differences between Interventions

Forest plot analysis of the mean VAS difference of the studies in Figure 4 indicated insignificant difference between the lidocaine and placebo group (MD –7.68; 95% CI –34.04 to –18.68; $P = .57$). A random effects model analysis was used due to the high level of heterogeneity: ($I^2 = 94\%$).

Voiding Efficiency Differences between Groups

The difference of voiding efficiency in Figure 5 between the lidocaine and placebo groups was insignificant (OR 1.41; 95% CI 0.21-9.62; $P = .72$). A fixed effects model analysis was used due to the low level of heterogeneity ($I^2 = 0\%$).

Postvoid Residual Volume Differences between Groups

The forest plot displaying a random effects model analysis ($I^2 = 91\%$) in Figure 6 showed that the postvoid residual volume between the lidocaine and placebo groups was insignificant (MD –4.54; 95% CI –67.01 to –57.94; $P = .89$).

Pdet@Qmax Differences between Groups

The difference of Pdet@Qmax in Figure 7 between the lidocaine and placebo groups was insignificant (MD 0.84; 95% CI –9.7 to –11.37; $P = .88$). A fixed effects model analysis was used based on the homogeneity of the studies ($I^2 = 0\%$).

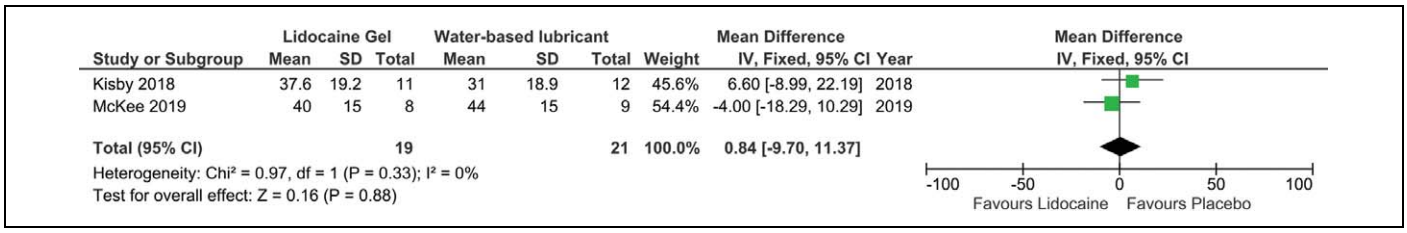

Figure 7. Forest plot of Pdet@Qmax of the included RCTs.

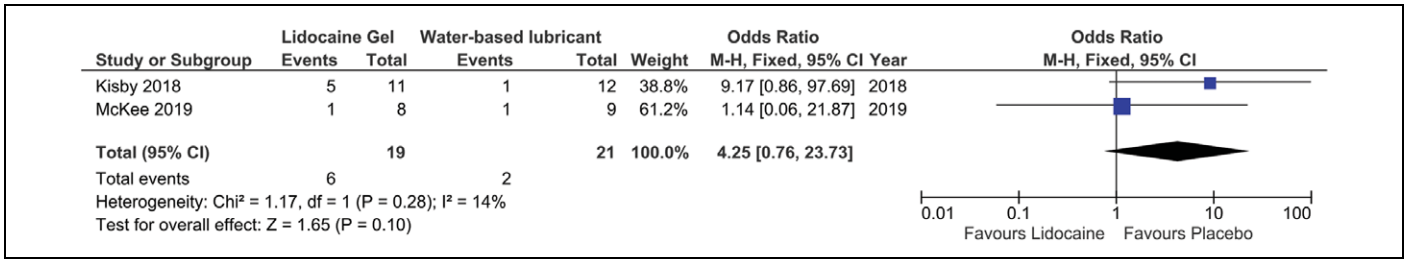

Figure 8. Forest plot of Pabd recruitment during flow of the included RCTs.

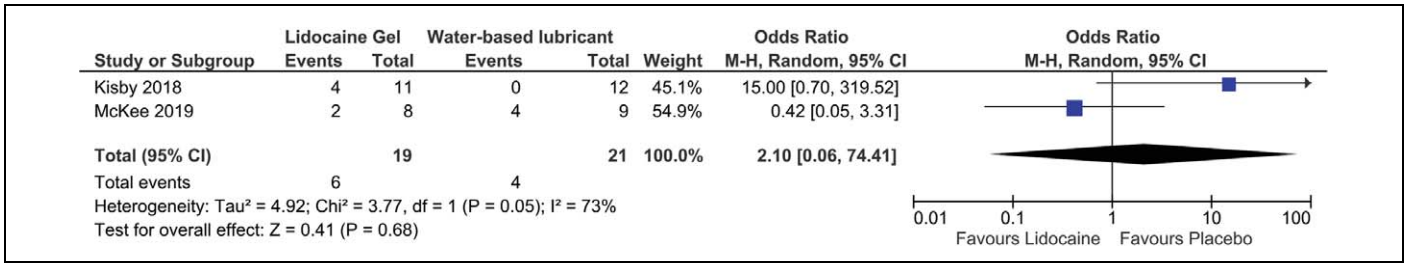

Figure 9. Forest plot of intermittent flow pattern of the included RCTs.

Pabd Recruitment during Flow Occurrence Differences between Groups

The difference of Pabd recruitment during flow between the lidocaine and placebo groups in Figure 8 was insignificant (OR 4.25; 95% CI 0.76-23.73; $P = .10$). The analysis was displayed in a forest plot using a fixed effects model due to the low level of heterogeneity ($I^2 = 14\%$).

Intermittent Flow Pattern Occurrence Differences between Groups

The forest plot displaying a random effects model analysis ($I^2 = 73\%$) in Figure 9 showed that the difference of intermittent flow pattern occurrence between the lidocaine and placebo groups was insignificant (OR 2.10; 95% CI 0.06-74.41; $P = .68$).

Elevated EMG Activity Occurrence Differences between Groups

An insignificant elevation difference of EMG activity was exhibited by the lidocaine and placebo groups (OR 1.69; 95% CI 0.06-44.42; $P = .75$) in Figure 10. A random effects model was chosen due to the heterogeneity of the studies ($I^2 = 77\%$).

Discussion

The main purpose of a urodynamic study is to evaluate patients with micturition abnormalities. The examination involves urethral manipulation, especially during catheterization.[12] In the included RCTs, the researchers administered intraurethral lidocaine to reduce pain and discomfort.[13] The studies were concerned that the local anesthetic could affect the urodynamics parameters, resulting in misrepresentative findings.[14] The analysis in this systematic review provided interesting findings based on the included RCTs results. All included trials evaluated in this review had only included subjects with normal baseline characteristics to prevent the possibility of bias in urodynamics findings or pain scale results.

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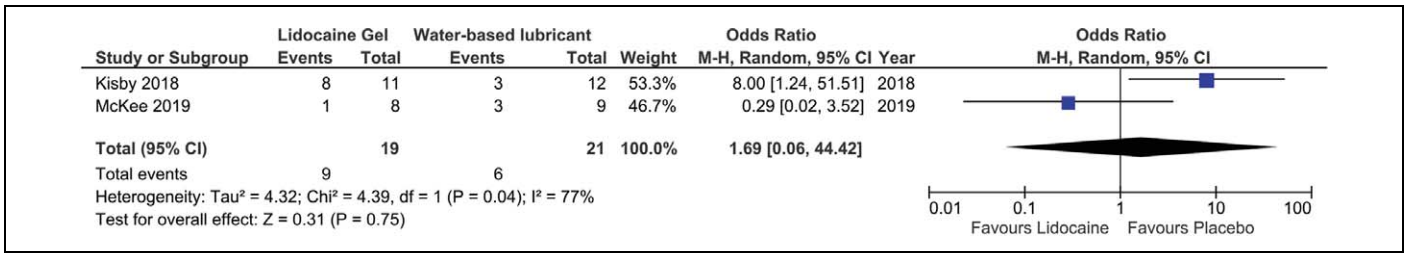

Figure 10. Forest plot of elevated EMG of the included RCTs.

Intraurethral Lidocaine and Pain

Pain is an important variable to be considered in a urodynamic study. Several studies claimed that urodynamic studies are well tolerated in patients. Yeung et al.[15] also documented pain intensity in patients undergoing an urodynamics examination using VAS. They reported that urodynamic testing is well tolerated in women. Suskind et al.[16] also reported that the examination is well tolerated regardless of gender. Studies evaluating pain intensity in examinations that involve urethral manipulation, like a cotton-tipped swab test, recommend intraurethral lidocaine administration.[12] The evaluation of pain during cystourethroscopy also reported similar findings regarding lidocaine administration.[17] A meta-analysis evaluating the use of intraurethral lidocaine for reducing pain during cystoscopy resulted in significant pain reduction compared to the control group. This finding is considerable since cystoscopy involves a long duration of urethral instrumentation.[18] Previous reports suggested that the pain during a urodynamics testing is especially apparent during catheterization, which was measured in this meta-analysis.[19]

The gold standard of measurement evaluating pain in the field of urology, including urodynamics, is VAS.[20] The analysis in this review showed that there is no significant difference of mean VAS between the lidocaine and control groups (MD –7.68; 95% CI –34.04 to –18.68; $P = .57$). The study results of Kisby et al.[11] showed a peculiar finding, in which the mean VAS was actually higher in the lidocaine group compared to the placebo group. Based on these findings, it is possible that pain due to catheterization in the patients of the placebo group was sufficiently reduced by water-based lubricants. The trials included in this review only examined female subjects. Similar studies in the past have attempted the administration of intraurethral lidocaine injection to reduce pain on male patients during urethral instrumentation. However, the intervention evaluated in the studies was cystoscopy. Nevertheless, the studies reported no difference between intraurethral lidocaine injection and lubricating gel.[21,22]

Urodynamics Parameters

The evaluation of parameters in this systematic review is extracted from the reports of Kisby et al.[11] and Mckee et al.[9] Voiding efficiency is the evaluation of bladder emptying by measuring the percentage of voided urine and total urine volume before micturition. The efficiency is considered normal if it is more than 90%.[23] The difference between the control and treatment group was insignificant (OR 1.41; 95% CI 0.21-9.62; $P = .72$).

Shafik et al.[24] reported that the desensitization of patients due to 5% xylocaine gel intraurethral administration during an urodynamics examination causes the PVR volume to increase and patients with normal urinary function to strain during micturition.[25] The two trials currently available for review reported contradictory results. Kisby et al.[11] reported that there are a greater proportion of subjects receiving lidocaine, demonstrated interrupted urinary flow patterns, and elevated EMG activity, indicating a sensory feedback disruption during voiding. On the contrary, Mckee et al.[9] reported that intraurethral lidocaine does not significantly affect urodynamic parameters. However, both studies concluded that its use, prior to or during routine urodynamics, is not recommended as it does not alter the VAS pain score following catheterization. Shafik et al.[25] examined the effects of intraurethral xylocaine in both male and female patients undergoing micturition studies. After 15 minutes of incubation and cystometric filling, they reported increased strain voiding due to vesical pressure increase. Elevated PVR was seen in the xylocaine group but not voiding efficiency. However, these findings are taken from both male and female patients. The urethral length of males is longer than females; thus, the effects are most likely different when compared to the findings among female patients.[11]

Study Limitations and Future Suggestions

The main limitation of this review is the small number of available RCTs, thus making the sample size relatively small. Due to this limitation, it was not possible to conduct several

analyses based on different subgroups. The currently published RCTs only evaluated female patients, while the anatomical difference of the male urethra may generate different findings. Future reviews may focus on the use of intraurethral lidocaine in other procedures, such as mixing it with chlorhexidine gluconate during cystoscopy in male patients to reduce pain and prevent infection.

Conclusion

There is no significant difference in pain intensity between an intraurethral lidocaine injection and a water-based lubricant in a urodynamic study. The urodynamic parameters between the groups are also similar, indicating that intraurethral lidocaine injection does not significantly affect urodynamic findings. The findings in this review do not support the use of routine intraurethral lidocaine injection based on its insignificant effect on pain.

Author Contributions: Concept - D.P.O, S.S.; Design - D.P.O., Y.P.K., F.H., Z.R.A., S.S.; Supervision - M.A.S., S.S.; Resources - M.A.S., S.S.; Materials - D.P.O., M.A.S., S.S.; Data Collection and/or Processing - D.P.O., Y.P.K., F.H., Z.R.A.; Analysis and/or Interpretation - D.P.O., Y.P.K., F.H., Z.R.A., S.S.; Literature Search - D.P.O., Y.P.K., F.H., Z.R.A.; Writing Manuscript - D.P.O., M.A.S., Y.P.K., F.H., Z.R.A., S.S.; Critical Review - D.P.O., S.S.

Conflict of Interest: The authors have no conflicts of interest to declare.

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