DOI: *10.4081/aiua.2025.14507*

REVIEW

Clinical and functional outcome of salvage vesiculectomy for local prostate cancer recurrence: A single-arm meta-analysis

Branson Thamran, Dhirajaya Dharma Kadar

Department of Urology, Universitas Sumatera Utara, Rumah Sakit Umum Pusat Haji Adam Malik, Medan City, North Sumatra, Indonesia.

Summary *Introduction & objectives: Salvage vesiculectomy has been proposed by several experts to deal with Isolated Seminal Vesicle Recurrence (ISVR). Although initial research has shown that the salvage vesiculectomy is successful, there is still disagreement over its clinical efficacy and safety due to the lack of strong randomized controlled trials. To support the clinical use of salvage vesiculectomy, this study intends to assess its safety, outcome and clinical impact.*
Materials and methods: Electronic databases including PubMed, Embase, Cochrane Library, and Google Scholar were widely searched for studies until 2025. The primary outcome was recurrence rate, and secondary outcomes were overall survival, complications, deaths and time to recurrence. The Joanna Briggs Institute (JBI) critical appraisal was assessed for risk of biases. The registration number in PROSPERO was CRD420251054103.
Results: According to the selection criteria, we identified 6 publications with a total of 227 patients. The results revealed that the pooled overall survival was 96% [95% CI: 0.88-1.00]. The recurrence rate was 63% [95% CI: 0.56-0.70]. The therapy-free survival was 33.15 months [95% CI: 27.45-40.03 months]. The time to recurrence was 19.59 months [95% CI: 17.63-21.78 months]. The incidence of complications rate was 14% [95% CI: 0.03-0.25], and the pooled incidence of death was 3% [95% CI: 0.00-0.07].
Conclusions: Faced with this supporting data, salvage vesiculectomy can be used as a secondary treatment for localized prostate cancer recurrence in the seminal vesicle for highly selected patients.

KEY WORDS: *Local prostate cancer recurrence; Salvage therapy; Seminal vesiculectomy; Seminal vesicle excision.*

Submitted 2 October 2025; Accepted 7 November 2025

INTRODUCTION

Isolated recurrence in the residual of the *seminal vesicles* (SV) following treatment for primary *prostate cancer* (PCa) has become increasingly prevalent due to the increasing application of advanced next-generation imaging techniques (1). Even after radiation therapy or focal therapy, local recurrence involving the SV poses a problem for salvage focal therapy (2). Cryo-probe placement presents technical difficulties and bears a possible increased risk of thermal injury to the posterior bladder wall or ureter in order to guarantee full seminal vesicle ablation (2). Since the invasion of the SV is correlated with disease progression, perhaps it is due to the abundant lymphatic drainage of the SV (3). *Androgen deprivation therapy* (ADT) is the gold standard treatment for patients with prostate cancer recurrence with i*solated seminal vesicle invasion* (ISVI). However, ADT demonstrated plenty of side effects, such as osteoporosis, ED, and other metabolic syndromes, and also leads to decreased quality of life (4-5). Since then, salvage seminal vesiculectomy, either open or robotic excision, has been proposed by several experts to deal with *isolated seminal vesicle recurrence* (ISVR). Although initial research has shown that the salvage vesiculectomy is successful, there is still disagreement over its clinical efficacy and safety due to the lack of strong randomized controlled trials. In order to support the clinical use of salvage vesiculectomy, this study intends to assess its safety and outcome even without comparison studies.

MATERIALS AND METHODS

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines were adjusted to this research, and that was registered in PROSPERO (CRD420251054103) (6). From the initial stage until September 2025, we went through bibliographic databases for all relevant published papers that investigate the role of salvage seminal vesiculectomy in the treatment of prostate cancer recurrence. *PubMed*, *Google Scholar*, *Elsevier*, and the *Cochrane Library* databases were used in this process using the terms "*prostatic cancer recurrence*," "*seminal vesicle invasion*," "*salvage vesiculectomy*," and "*salvage therapy*." The PubMed search approach was carefully modified for the other databases. The systematic search strategy can be accessed in ***Supplementary Material 1***.

Inclusion and exclusion criteria

Inclusion criteria were as follows: (1) study type: prospective clinical trials, retrospective cohort studies, and case series; (2) Diagnosis: patients diagnosed with prostate cancer recurrence with seminal vesicle invasion;

(3) Intervention: salvage seminal vesiculectomy; (4) Outcome: recurrence rate; (5) Secondary outcomes: survival rate, therapy-free survival, complications, and time to recurrence.

Exclusion criteria were (1) case reports with fewer than 5 patients; (2) non-human trials, reviews, or meta-analyses; (3) non-English publications; and (4) studies for which full text was not available.

Data extraction

The publications were independently evaluated by two reviewers using their titles, abstracts, and full text. The following information was then independently retrieved by the reviewers from the included studies: introduction, study design, and results, as well as specifics on the study population and interventions. Discussion was used to settle any disagreements. Two reviewers independently made their decisions, and disagreements were settled by discussion.

Risk of bias in individual studies

The risk of bias in this study was assessed using the JBI quality assessment technique. After evaluating each study, we gave it a low, moderate, or high rating. We evaluated each of the included publications to guarantee uniformity. Any differences were solved through an agreement.

Statistical analyses

The RStudio program was used to program effect estimates using the polling random model. The dichotomous data were summarized using the risk ratio. The risk ratio was calculated using the standardized mean differences with 95% confidence intervals. The I^2 and T^2 statistics were utilized to assess the heterogeneity. A p-value of less than 0.05 denoted a statistical difference. Additionally, we conducted a sensitivity analysis to assess the heterogeneity of aggregated data. Lastly, we evaluated possible publication bias using Egger's test, Begg's test, and a funnel plot.

Results

Search results and study characteristics

The PRISMA flow diagram is shown in Figure 1. A total of 362 studies was established. After excluding 15 duplicate studies, a sum of 347 articles were screened, 285

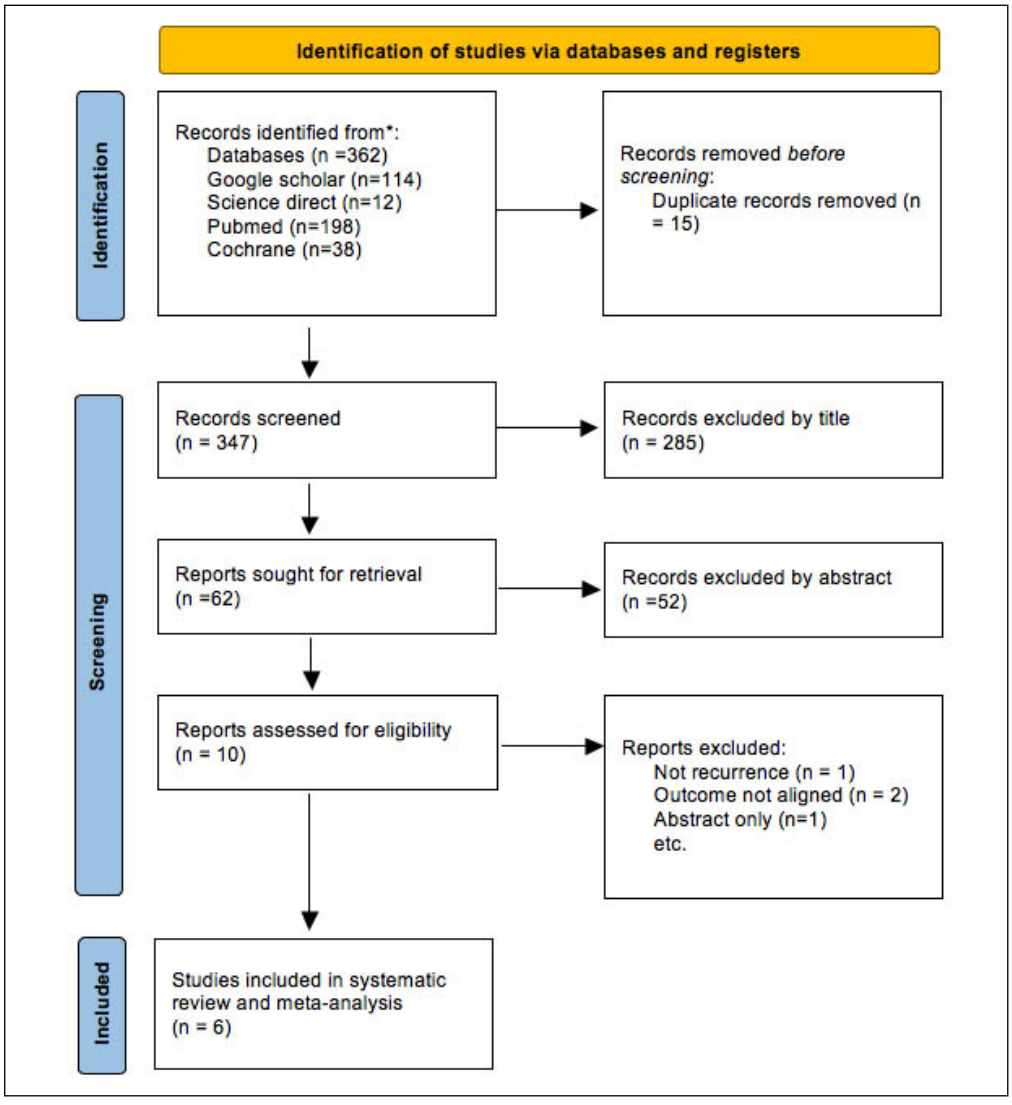


Figure 1.
Flow diagram of meta-analysis for PRISMA [6].

articles were excluded by title screening, and 52 articles were excluded by abstract screening.Ten studies were assessed for eligibility by full text. One article was excluded because of the population's study, and two articles were excluded due to outcomes not aligned. One article lacked full text availability. At the end of the day, 6 studies composed of 227 patients were included (1, 7-11). The characteristic of each study was stated in Table I.

Table 1.
Characteristic of each study.

Study, year	Type	Median age, years (IQR)	Median Follow-up, months	Intervention	Prior therapy	Outcomes	Total patients
Langleh, 2022 (7)	Retrospective case series	64 (53-72)	36 months	Vesiculectomy	LDR-PB	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before and after surgery 6. Hospital stays 7. Death, 8. Complication 9. Blood loss 10. Surgery time	17
Knipper, 2021 (8)	Retrospective case series	67 (63-74)	24.4 months	Vesiculectomy	Radical prostatectomy	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before and after surgery 6. Death, 7. Complication	40
Giesen, 2024 (1)	Retrospective cohort	68 (63-72)	14 months	Robot assisted vesiculectomy	Radical prostatectomy	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before and after surgery 6. Hospital stays 7. Death, 8. Complication 9. Blood loss 10. Surgery time	108
Pfister, 2022 (9)	Retrospective case series	70 (72-77)	29 months	Seminal vesicle resection	Radical prostatectomy	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before and surgery 6. Hospital stays 7. Death, 8. Complication 9. Blood loss 10. Surgery time	32
Wymer, 2019 (10}	Retrospective case series	66 (61-71)	45 months	Vesiculectomy	Radical prostatectomy and radiotherapy	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before surgery 6. Hospital stays 7. Death, 8. Complication	23
Smigelski, 2023 (11)	Case series	65 (-)	17.28 months	Robotic vesiculectomy vesiculectomy and cryoablation	Radical prostatectomy and ablation	1. Recurrence rate 2. Time to recurrence 3. No need for further treatment 4. Overall survival 5. PSA before and after surgery 6. Hospital stays 7. Death, 8. Complication 9. Blood loss 10. Surgery time	7

Table 2.
Quality assessment using the JBI critical appraisal checklist for case series for included retrospective studies.

Authors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Risk
Langleh, 2022 (7)	√	√	√	UC	√	√	√	√	UC	√	Low-Moderate
Knipper, 2021 (8)	√	√	√	√	√	√	√	√	√	√	Low
Giesen, 2024 (1)	√	√	√	√	√	√	√	√	√	√	Low
Pfister, 2022 (9)	√	√	√	UC	√	√	√	√	UC	√	Low-Moderate
Wymer, 2019 (10)	√	√	√	UC	√	√	√	√	UC	√	Low-Moderate
Smigelski, 2023 (11)	√	√	√	UC	√	√	√	√	UC	√	Low-Moderate

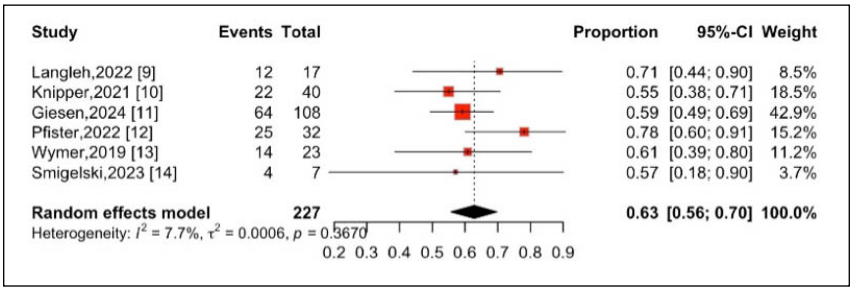
Q1: Were there clear criteria for inclusion in the case series?; Q2: Was the condition measured in a standard, reliable way for all participants?; Q3: Were valid methods used for identification of the condition for all cases?; Q4: Did the case series have consecutive inclusion of participants?; Q5: Did the case series have complete inclusion of participants?; Q6: Was there clear reporting of the demographics of the participants?; Q7: Was there clear reporting of clinical information of the participants?; Q8: Were the outcomes or follow-up results clearly reported?; Q9: Was there clear reporting of the presenting site(s)/clinic(s) demographic?; Q10: Was statistical analysis appropriate? √ (YES); --(NO); UC (Unclear); NA (Not Applicable) (12).

Quality assessment

There were 6 studies reviewed using the JBI quality assessment technique (1, 7-12). As follows, there was a low risk of biases seen in *Knipper* (8) and *Giesen* (1) with all the questions clearly stated as yes; low to moderate risk of biases was seen in *Pfister* (9), *Langleh* (7), *Wymer* (10), and *Smigelski* (11). With an overall low-moderate risk of bias.

Table 2 explains the details concerning each study using the JBI.

Figure 2.
Forest plot about the pooled result of recurrence rate.

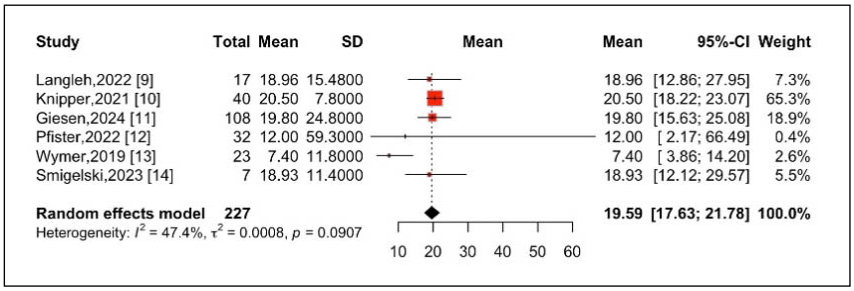


Recurrence rate

As the main outcome, recurrence rate after follow-up still exists in several patients following salvage vesiculectomy, either robotic or open surgery. Low heterogeneity was observed using the random effects size, however, with no statistically significant heterogeneity (I^2 = 7.7%, p = 0.3670).

The pooled recurrence rate was 0.63 (95% CI: 0.56-0.70), indicating 2/3 patients experienced recurrence after salvage surgery (Figure 2).

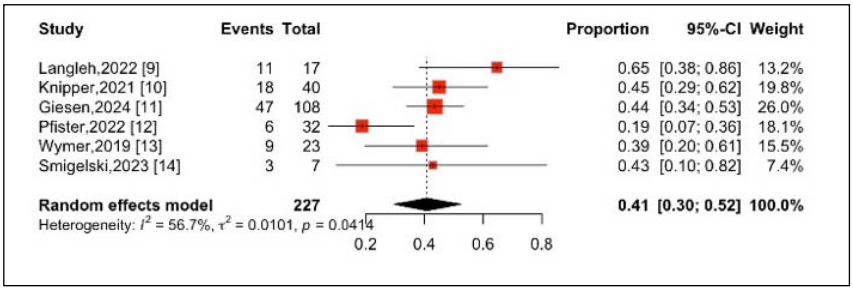
Figure 3.
Forest plot of time to recurrence.



Time to recurrence

The secondary outcome, pooled mean time to recurrence after follow-up after salvage vesiculectomy (either robotic or open surgery), is 19.59 (95% CI: 17.63-21.78, p = 0.09). Moderate heterogeneity was observed in this section (I^2 = 47.44% and p = 0.09) (Figure 3).

Figure 4.
Forest plot of patients not needing further treatment.



No need for further treatment

Follow-up of patients for PSA response was reported, showing 94/227 patients not needing additional treatment during follow-up. Moderate heterogeneity was also reported in this Forest plot (I^2 = 56.7% and p = 0.04) (Figure 4).

Overall survival

Overall survival was reported in all studies to evaluate the

Figure 5.
Forest plot of overall survival rate.

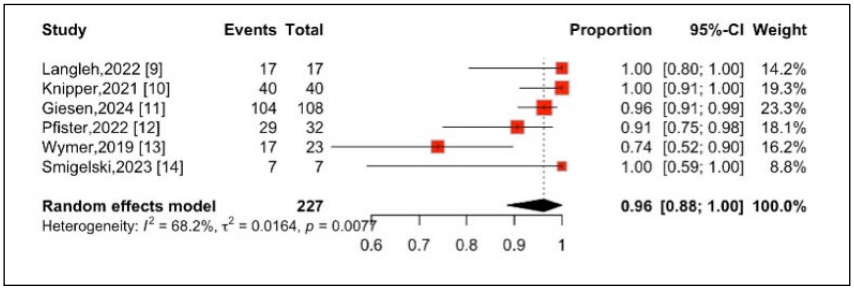


Figure 6.
Forest plot of incidence of death.

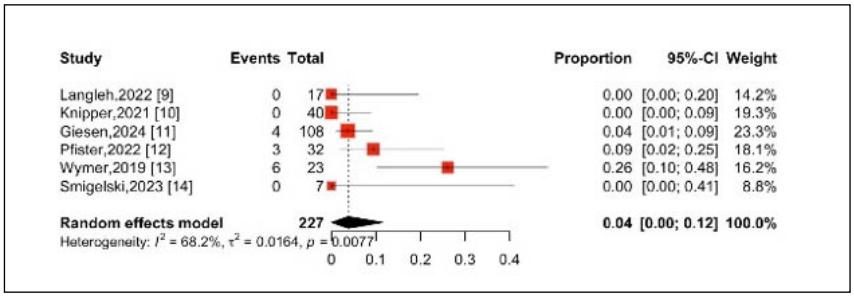
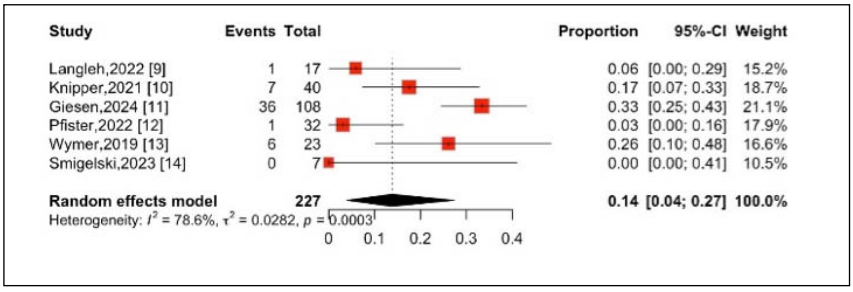


Figure 7.
Forest plot of complications after surgery.



safety and effectiveness of vesiculectomy. High heterogeneity was reported in this Forest plot (I^2 = 68.2% and p = 0.0077) with a pooled rate of 96% (95% CI 0.88-1.00) (Figure 5).

Death

Among the 6 studies, 3 studies reported no incidence of death, while 3 studies reported some deaths. The weighted pooled rate was 4% (95% CI 0.00-0.12). High heterogeneity was reported in this Forest plot (I^2 = 68.2% and p = 0.0077) (Figure 6).

Complications

Complication rates were reported to be low in all studies. The pooled complication rate was 14% (95% CI: 0.04-0.27) with high heterogeneity (I^2 = 78.6% and p = 0.0003) (Figure 7).

Other outcomes included in the meta-analysis (Table 3)

The number of outcomes in this section was incomplete for statistical analysis; hence, we arranged it into a table without any Forest plot or other statistical analysis. From these data we got that median PSA dropped significantly after salvage vesiculectomy and median hospital stays varied from 1 day to 5.5 days. The data on median blood loss and surgery time were very minimal and insufficient to provide any evaluation about surgery time and blood loss for salvage vesiculectomy.

Sensitivity analysis

Sensitivity analysis is a type of analysis to examine the source of heterogeneity in meta-analyses. The leave-one-out analysis is the most used technique for looking at the sources. A high heterogeneity was found when pooling the effect sizes for complication rate. The pooled complication rate was 14% (95% CI: 0.04-0.27) with high heterogeneity (I^2 = 78.6% and p = 0.0003) (Figure 7). The analysis showed that the study by *Giesen* had a big effect on the pooled complication rate (11). After excluding this study, the pooled complication

Table 3.
Other outcomes included in the meta-analysis.

Study, Year	Median PSA before surgery (IQR) (ng/dl)	Median PSA post-vesiculectomy (IQR) (ng/dl)	Median hospital stays (IQR) (days)	Median Blood Loss during surgery (IQR) (ml)	Median Surgery time (IQR) (min)
Langleh, 2022 (9)	3.4 (1.9-2.3)	0.1 (0.01-17)	1 (1-2)	50 (10-100)	90 (70-120)
Knipper, 2021 (10)	0.9 (0.5-1.7)	0.1 (0-0.4)	-	-	-
Giesen, 2024 (11)	2.7 (1.4-4.8)	0.63 (0-4.0)	3 (2-5)	50 (50-100)	-
Pfister, 2022 (12)	2.79 (0.4-10.04)	-	5.5 (4-13)	100 (20-500))	132 (75-313)
Wymer, 2019 (13)	2.9 (1.5-7.4)	-	2 (1-3)	-	-
Smigelski, 2023 (14)	3.9 (3.2-4.7)	0.2 (0.06-0.81)	1 (1-1)		-

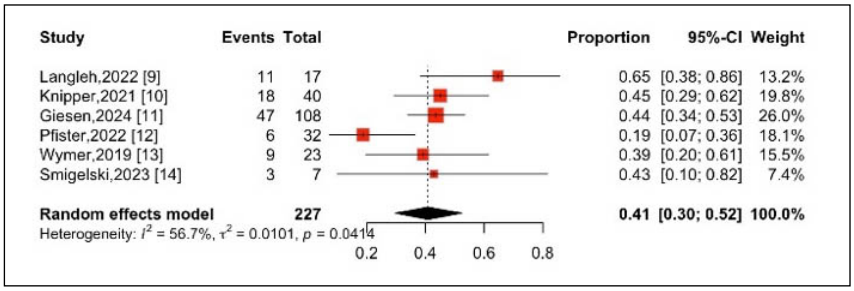


Figure 8.
Complications after sensitivity analysis.

results across all studies were 10% (95% CI 0.02-0.20) with much lower heterogeneity (I^2:53.2% and p = 0.07) (Figure 8).
These results suggest that this meta-analysis is generally reliable when excluding studies of small groups.

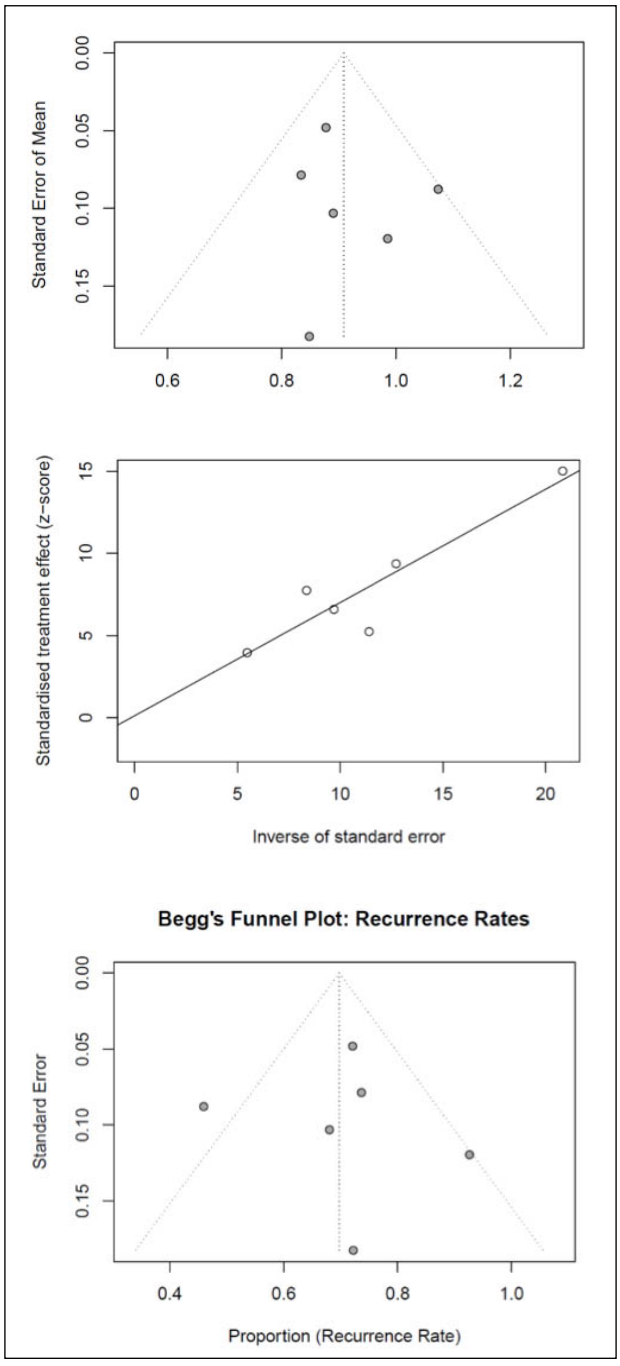
Publication bias

To prevent publication bias and maximize the validity of the results, funnel plots and Egger's and Begg's tests were calculated. Inspection of the funnel plot showed no overt signs of asymmetry. Statistical evidence of small-study effects was not found in either Egger's test (p > 0.05) or Begg's test (p = 0.36) (Figure 9).

Discussion

Salvage vesiculectomy can be an alternative salvage or secondary treatment for local prostate cancer recurrence with seminal vesicle invasion after primary treatment such as radical prostatectomy, cryoablation, radiotherapy, and androgen deprivation therapy. Our findings suggest that seminal vesiculectomy, whether performed as open surgery or robot-assisted, provides encouraging oncological control with low morbidity and mortality.
The result suggests that salvage vesiculectomy can delay systematic therapy in selected patients. However, disease progression still outgrows in a significant number; some suggest that it comes from contralateral or systemic progression. These emphasize the need for accurate staging, including advanced diagnostic tools such as mpMRI and PSMA PET/CT (1, 7-11).
Robot-assisted surgery showed a more prominent outcome than the open surgery on blood loss and recovery period (11).
Findings supported the recommendation from Smigelski that excision of the contralateral lesion should also be applied, especially in postradiation patients, to reduce the risk for recurrence (11).
This review includes data from multiple centers, with outcomes following salvage seminal vesiculectomy. However, the sample size is still small, the studies included had retrospective designs, there is moderate heterogeneity upon outcomes and long-term data on cancer control are lacking. Publication bias showed low risk of bias, as stated in Table 2.
Salvage vesiculectomy should be considered for selected patients with biopsy-proven or imaging modality of localized recurrence involving the seminal vesicle, excluding systematic disease recurrence. When comparing with sal-

Figure 9.
(a) Funnel plot. (b) Egger's test, (c) Begg's test.



vage prostatectomy, whole gland ablation, radiotherapy, and androgen deprivation therapy, salvage vesiculectomy offers a lower morbidity and mortality rate while potentially maintaining local disease control. The usage of the salvage vesiculectomy should be taken into account for selected patients with recurrent lesions in relation to prior therapies, disease progression, and patients' comorbidities. For future studies, since this paper is a single-arm meta-analysis in which only one experimental group is applied without a control group, multicenter studies with longer follow-up in comparison with other salvage prostate cancer treatments should be studied to clarify the oncological control usage of seminal vesicle excision specifically in local recurrence prostate cancer. Imaging modalities have improved in recent years and patients' outcomes can be improved by detection of local recurrence or systematic progression.

Conclusions

Our meta-analysis demonstrates the efficacy and safety of salvage vesiculectomy as a secondary treatment for local prostate cancer recurrence in the seminal vesicle bed, providing evidence for its clinical impact for future cases. Nonetheless, on account of the small sample size, the reliability of this conclusion requires additional randomized controlled trials.

Declarations

Ethical approval and consent for participate: *Non-Available because this study is a single-arm meta-analysis study.*

Availability of data and material: *The authors confirm that the data supporting the findings of this study are available within the article. Raw data that confirm the findings of this study are available from the corresponding author, upon reasonable request.*

Competing interests: *All authors reported that no conflicts of interest were declared.*

Funding: *No funding was received.*

Authors' contributions: *All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Kadar DD and Thamran B. The first draft of the manuscript was written by Thamran B and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. Thamran B act as the corresponding author for this study.*

Acknowledgments: *I would like to express my sincere gratitude to fellow urologists and residents in Haji Adam Malik Hospital Medan City for the invaluable feedback and clinical support for this paper.*

References

1. Giesen A, Van den Broeck T, Develtere D, et al. Salvage vesiculectomy for local prostate cancer recurrence: surgical technique and early post-operative outcomes. World J Urol 2024; 42:81.

2. De Castro Abreu AL, Bahn D, Leslie S, et al. Salvage focal and salvage total cryoablation for locally recurrent prostate cancer after primary radiation therapy. BJU Int 2013; 112:298

3. Potter SR, Epstein JI, Partin AW. Seminal vesicle invasion by prostate cancer: prognostic significance and therapeutic implications. Rev Urol 2000; 2:190-195.

4. Goy BW, Finley DS. Robotic-Assisted Seminal Vesicle Excision vs Brachytherapy for Isolated Seminal Vesicle Recurrence: 2 Case Reports. Appl Radiat Oncol 2025; (1):34-36.

5. Ahmadi H, Daneshmand S. Androgen deprivation therapy: Evidence-based management of side effects. BJU Int 2013; 111:543-548.

6. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021; 372:n71.

7. Langley S, Eden C, Perry M, et al. Robot-assisted salvage seminal vesicle excision for isolated recurrence after low-dose-rate prostate brachytherapy. BJU Int 2022; 129:731-736.

8. Knipper S, Ascalone L, Ziegler B, et al. Salvage Surgery in Patients with Local Recurrence After Radical Prostatectomy. Eur Urol 2021; 79:537-544.

9. Pfister D, Nestler T, Hartmann F, et al. Feasibility and Oncologic Outcome of Salvage Surgery in Isolated Seminal Vesicle Remnants after Radical Prostatectomy. Urol Int 2022; 106:44-50.

10. Wymer KM, Sharma V, Davis BJ, et al. Evaluating the Potential Role of Salvage Vesiculectomy for Prostate Cancer Recurrence. Clin Genitourin Cancer 2019; 17:e536-e540.

11. Smigelski MB, Wysock J, Taneja SS, Lepor H. Salvage Cryoablation and Robotic Seminal Vesiculectomy: A Novel Salvage Treatment for Locally Recurrent Prostate Cancer. J Endourol. 2023; 37:876-881.

12. Barker TH, Hasanoff S, Aromataris E, et al. The revised JBI critical appraisal tool for the assessment of risk of bias for analytical cross-sectional studies. JBI Evid Synth. 2025 Jun 10.

Correspondence

Branson Thamran (Corresponding Author)
dr.bransontham@gmail.com

Dhirajaya Dharma Kadar
dhira303@yahoo.com

Department of Urology, Universitas Sumatera Utara, Rumah Sakit Umum Pusat Haji Adam Malik
Bunga Lau Road No.17, Medan City 20136, North Sumatra, Indonesia