

ORIGINAL PAPER

The association between etiology of azoospermia and sperm retrieval success rate on male patient in Indonesia: A multi-centre study

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Summary

Introduction: Azoospermia, known as absence of sperm in ejaculation, is a major cause of male infertility, classified as pre-testicular, testicular, post-testicular. Pre-testicular and post-testicular causes allow for fertility intervention, while testicular causes are irreversible with lower success rates. Indonesia have a data scarcity to support doctors to determine the sperm retrieval success rate between different etiology. Doctors could be benefited by knowing the classifications of the causes for azoospermia and how it affects the sperm retrieval success rate. The aim of the study is to investigate the association between etiology of azoospermia and the success rate of sperm retrieval as well as the association between sperm retrieval methods utilized with the sperm retrieval success rate.

Methods: We conducted a cross-sectional analysis of medical records from one public and two private hospitals in Jakarta. The data includes azoospermia patients who have undergone sperm retrieval procedures since 2009 until 2024. Azoospermia etiology was categorized into pre-testicular, testicular, and post-testicular azoospermia. Multi-factorial azoospermia (has two or more simultaneous etiology) was excluded from the analysis. Chi-square tests were used to analyse the association between etiology of azoospermia and sperm retrieval success rate. Sperm retrieval methods association with sperm retrieval success rate was also analysed with chi-square test

Results: The study included 659 patients consisting of 111 (16.9%) pre-testicular azoospermia patients, 112 (17.1%) testicular azoospermia patients, 62 (9.4%) post-testicular azoospermia patients, and 374 (56.6%) multi-factorial azoospermia patients. There was a significant association between azoospermia etiology and sperm retrieval success rate ($p = <.001$). Post-testicular azoospermia has the highest sperm retrieval success rate (97.1%), followed by testicular azoospermia (27.7%), and pre-testicular azoospermia (13.2%). In addition, Percutaneous Epididymal Sperm Aspiration had the highest success rate at 94% (234/249) and TESE demonstrated the lowest success rate at 19.4% (78/402). A significant association between sperm retrieval methods and outcomes was observed.

Conclusions: This study demonstrates that azoospermia etiology significantly influences sperm retrieval outcomes, with post-testicular azoospermia showing the most favorable results. These findings emphasize the importance of accurate etiological assessment to guide clinical decision-making, optimize patient

counseling, and improve fertility management in azoospermic patients.

KEY WORDS: Post-testicular azoospermia; Pre-testicular azoospermia; Sperm retrieval method; Sperm retrieval success rates; Testicular azoospermia.

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INTRODUCTION

Azoospermia is referred to a condition of absence of sperm in the ejaculate. It is the major leading contributor for male infertility (1). Additionally, men suffering from azoospermia are more susceptible to develop cancer (1, 2). It affects roughly 1% of men and is responsible for 10-15% of global infertility cases, making it as the most severe type of male reproductive abnormality. In the United States, the majority of azoospermia cases are affected by pre-testicular and testicular azoospermia (1, 3). The etiology of azoospermia is differentiated into four main types which are pre-testicular, testicular, post-testicular, and idiopathic (4). Pre-testicular azoospermia commonly known as secondary testicular failure which typically caused by endocrine abnormalities such as hypogonadotropic hygonadism (HGH), hyperprolactinemia, and androgen resistance (4). In addition, testicular azoospermia is known as primary testicular failure, where there is an intrinsic abnormality in the testes that disrupt the spermatogenesis process that could be caused by varicocele, undescended testes, Klinefelter syndrome (4). Post-testicular azoospermia is a condition where there is a blockage in the sperm ejection process commonly caused by congenital bilateral absence of the vas deferens (CBAVD), vasal obstruction, and epididymal obstruction (4). Lastly, idiopathic azoospermia is a type of azoospermia without a definitive cause (5, 6). Different type of etiology has shown to have different characteristics and outcome, specifically in sperm retrieval success rates. Pre-testicular and post-testicular azoospermia are reported to

have a better sperm retrieval success rate as compared to testicular azoospermia which is known to be irreversible and has lower success rate (4).

Surgical sperm retrieval is a surgical intervention performed to extract sperm either directly from the testes or the reproductive tract such as the epididymis (7). There are a variety of sperm retrieval methods performed such as *percutaneous epididymal aspiration* (PESA), *testicular sperm extraction* (TESE), needle aspiration biopsy, and others (7). Different type of sperm retrieval methods has their own advantages, disadvantages, and indications (7). PESA have shown to be the best sperm retrieval method with the highest success rates (8).

Due to the scarcity of data in Indonesia, a research to analyse the association of sperm retrieval success rate with both etiology of azoospermia and sperm retrieval method would be beneficial to provide knowledge for patients and medical doctors in understanding the success rate and choosing sperm retrieval methods. This research primary aims is to determine the association of sperm retrieval success rate with the azoospermia etiology. In addition, the secondary aim is to find the association between sperm retrieval methods performed and sperm retrieval success rate.

METHODS

This cross-sectional study was conducted using the medical records of azoospermia patients with a multicenter study including *Dr. Cipto Mangunkusmo Hospital* (public hospital), *Bunda Hospital* (private hospital), and *Siloam Asri Hospital* (private hospital) from the year 2009 until 2024. The selection criteria included male urology patients diagnosed with azoospermia which underwent sperm retrieval intervention and exclusion criteria were patients with contraindications of surgery.

Data collected included hormonal levels (FSH, LH, prolactin, and testosterone), history of *undescended testis* (UDT) and varicocele, sperm retrieval methods (PESA, TESE), and demographic characteristics such as age, wife's age, and marriage duration. The patients were classified into pre-testicular, testicular, and post-testicular azoospermia. Pre-testicular azoospermia is characterized by impaired spermatogenesis resulting from insufficient hormonal stimulation of otherwise normal testes. Testicular azoospermia, or primary testicular failure, refers to intrinsic testicular dysfunction that leads to impaired or absent spermatogenesis. In contrast, post-testicular azoospermia occurs when spermatogenesis is preserved, but sperm is absent in the ejaculate due to disruption of sperm transport or ejection. Patients with multiple etiologies were considered as multifactorial azoospermia. However, patients with multifactorial azoospermia were excluded from the analysis and only included into the description of the population characteristic to provide insight about their number since multifactorial azoospermia was outside of the scope of the study. A chi-square test was used to assess the association between the etiology of azoospermia and sperm retrieval success due to the categorical nature of the variables. The data analysis was performed using IBM SPSS Statistics version 29.

RESULTS

As shown in Table 1 pre-testicular azoospermia accounted for 16.9% of cases, while testicular azoospermia was identified in 17.1% of the men. Post-testicular azoospermia represented the smallest population, comprising 9.4% of cases. The largest group consisted of multifactorial azoospermia (56.6%); however, these cases were excluded from the subsequent analyses. Overall, the majority of participants underwent testicular sperm extraction, with percutaneous epididymal sperm aspiration performed in a smaller but substantial proportion. The cohort was predominantly composed of men in their thirties, while those in their twenties and forties represented smaller groups, and only a minority were over 50 years of age. With regard to marital history, almost half of the participants had been married for less than five years, and about one third reported a marriage duration of six to ten years, whereas marriages lasting more than ten years were less common. Information on spouses was available for a limited subset of cases, among whom most wives were older than 31 years.

This comprehensive demographic and etiological profile of the participants provides valuable insights into the factors that may influence the success rate of sperm retrieval in men with azoospermia. Understanding these associations can help in tailoring more effective treatment strategies and improving the chances of successful sperm retrieval and fertility outcomes.

This study assessed the association between different etiologies of azoospermia and the success rate of sperm retrieval procedures as shown by Table 2. The findings revealed varied success rates corresponding to the different types of azoospermia. For pre-testicular azoospermia,

Table 1.
Characteristics of the subjects.

Characteristic	N	%
Etiology Azoospermia	662	
Pre-testicular azoospermia	112	16.9
Testicular azoospermia	113	17.1
Post-testicular azoospermia	62	9.4
Multifactorial azoospermia	375	56.6
Sperm retrieval method	651	
TESE	402	61.8
PESA	249	38.2
Age	657	
21-30 years	96	14.6
31-40 years	371	56.5
41-50 years	152	23.1
> 50 years	38	5.8
Marriage duration	605	
< 5 years	294	48.6
6 - 10 years	187	30.9
> 10 years	124	20.5
Wife's age	43	
< 30 years	14	32.6
> 31 years	29	67.4

Table 2.

Association between etiology of azoospermia and sperm retrieval methods with sperm retrieval success rate.

Etiology azoospermia	Sperm retrieval success rate	Statistical test value	p-value	Cramer's v
Pre-testicular azoospermia	10.8%	134.179	< 0.001	0.686
Testicular azoospermia	30.4%			
Post-testicular azoospermia	98.4%			
Sperm retrieval methods	Sperm retrieval success rate	Statistical test value	p-value	Cramer's v
TESE	19.4%	342.621	< 0.001	0.725
PESA	94%			

the sperm retrieval success rate was relatively low at 10.8%. This indicates that hormonal or systemic issues impacting sperm production before reaching the testes are challenging to overcome with current retrieval techniques. In cases of testicular azoospermia, the success rate improved to 30.4%. The most favourable outcomes were observed in post-testicular azoospermia, with an impressive success rate of 98.4%. The statistical analysis supported these findings, with p-value of less than 0.001, indicating a highly significant association between the etiology of azoospermia and the success rate of sperm retrieval. The effect size, measured by Cramer's V at 0.686, suggests a strong relationship.

There is a significant association between the sperm retrieval methods and sperm retrieval success rate ($p < .001$), indicating that the success rate differs across the methods. TESE had a relatively low success rate of 19.4%, with Cramer's V of 0.672 indicating a strong association between the method used and retrieval success. PESA proved to be the most effective, achieving a success rate of 94%, although no further statistical details were provided for this method.

DISCUSSION

This study investigates the association between the etiology of azoospermia and the success rates of sperm retrieval. The findings highlight significant differences in success rates based on the type of azoospermia, which are crucial for tailoring patient-specific treatment plans.

Pre-testicular azoospermia is characterized by hormonal or systemic issues that affect sperm production before reaching the testes. The success rate for sperm retrieval in this group was relatively low at 13.2%. In comparison to previous study, the success rate of the sperm retrieval is considerably lower with success rate of around 50% (9). This suggest that prior to sperm retrieval, the underlying issue of pre-testicular azoospermia need to be treated. The best initial management is using FSH/LH or GnRH analogues to help stimulate the spermatogenesis and increase the success rate for sperm retrieval (9).

Testicular azoospermia is where the testes themselves are unable to produce sperm. The sperm retrieval success rate in this group was 27.7%, which is significantly higher than in pre-testicular azoospermia but still relatively low compared to similar study. Two studies have a success rate of sperm retrieval ranging between 54-74% which are still considerably higher than our findings (10, 11).

This may suggest the importance of varicocelelectomy procedure prior to sperm retrieval as this may increase the likelihood of finding sperm during the surgery (12). The variability of the findings and other study may be explained by the variability of the samples such as different demographic factor and different type of sperm retrieval performed.

Post-testicular azoospermia is azoospermia which caused by obstructions or issues in the sperm transport pathway, rather than the production of sperm itself. The success rate for sperm retrieval in this group was remarkably high at 97.1%, indicating that surgical interventions are highly effective in overcoming these obstructions. The finding is in accordance to previous study which mentioned that the sperm retrieval success rate of post-testicular azoospermia is around 99% (13). This highlight the importance of accurate diagnostic procedures to identify post-testicular causes of azoospermia, as these cases are the most amenable to successful intervention.

PESA shows the highest success rate at 94%, making it the most effective method among those compared. The near-perfect retrieval success of PESA suggests that this technique may be the most favourable option for patients undergoing sperm retrieval. This findings supports other study mentioning the high success rate of sperm retrieval by PESA with 90% success rate in obstructive azoospermia (8).

TESE on the other hand, reported a much lower success rate of 19.4%, despite being the most performed procedure, as shown by previous data. This raises concerns about why TESE continues to be widely used despite its relatively low success rate, particularly when compared to other methods like PESA. Our findings are significantly lower in terms of success rate in comparison to other study reporting 40-50% success rate in TESE varied according to the etiology (8, 14).

The findings from this study have several important implications for clinical practice. Firstly, they highlight the need for comprehensive diagnostic evaluations to determine the specific etiology of azoospermia in patients. This allows for personalised treatment strategies that align with the underlying cause of azoospermia. For instance, patients with pre-testicular azoospermia might benefit more from hormonal therapies, while those with post-testicular obstructions could achieve high success rates with surgical interventions.

Furthermore, the study suggests that improving retrieval techniques and developing targeted therapies could

enhance outcomes for patients with testicular azoospermia. The high success rate in post-testicular cases also underscores the potential for successful fertility treatments when appropriate surgical interventions are employed. This study has several limitations. The retrospective design may introduce selection bias, and the sample size do not necessarily match the required minimal sample size. However, it has sufficient power due to the quite large sample size. Additionally, multifactorial azoospermia was excluded from the analysis because it was not included in the scope of study, and we are unable to provide the definitive etiology due to the lack of variables or data. Nonetheless, exploring the association of multifactorial azoospermia and the success rate of sperm retrieval will provide insight of their significance. Lastly, we did not analyse other confounding variables which could provide more insight in the association.

Despite these limitations, the study has notable strengths. It provides a detailed analysis of the relationship between azoospermia etiology and sperm retrieval success, offering valuable insights for clinical practice.

DECLARATIONS

Ethical approval and consent for participate: This study was approved by the Health Research Ethics Committee of the Faculty of Medicine, Universitas Indonesia – Cipto Mangunkusumo Hospital (FKUI-RSCM) under approval number KET-159/UN2.F1/ETIK/PPM.00.02/2024. All procedures performed in this study were conducted in accordance with applicable ethical standards and regulations.

Availability of data and material: The datasets generated and/or analyzed during the current study are not publicly available due to ethical and confidentiality restrictions imposed by the institutional review board and the presence of sensitive participant information. Data may be made available from the corresponding author upon reasonable request, subject to approval by the Health Research Ethics Committee and in compliance with applicable data protection regulations and institutional policies.

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Moreover, the study's focus on multicentre from different hospital capture to increase statistical power and capture samples with different demographic factors.

Future research should focus on enhancing the sample size to capture the full spectrum of azoospermia etiologies and the variability, provide a better understanding of the condition. Additionally, it is important to explore definitive etiology of the multifactorial azoospermia success rate. Identifying the confounding variables which could alter the association is also needed as well as identifying whether prior treatment will improve the sperm retrieval success rate.

In conclusion, this study demonstrated a significant relationship between the underlying cause of azoospermia and the success of sperm retrieval, with post-testicular cases achieving the highest success rates. Pre-testicular azoospermia constituted the largest proportion of cases, followed by testicular and post-testicular types. A significant association was also identified between the sperm retrieval technique and retrieval success, with percutaneous epididymal sperm aspiration outperforming other methods. Collectively, these findings highlight the importance of tailoring both etiologic assessment and retrieval strategy to improve outcomes in men with azoospermia.

REFERENCES

1. Sharma M, Leslie S. Azoospermia. *StatPearls*. 2023.
2. Association MIBPPCotAU, Medicine PCotASfR. Report on management of obstructive azoospermia. *Fertil. Steril.* 2004; 82:137-41.
3. Franco G, Misuraca L, Tuderti G. Azoospermia. *Clinical Management of Male Infertility*: Springer; 2014. p. 41-54.
4. Cocuzza M, Alvarenga C, Pagani R. The epidemiology and etiology of azoospermia. *Clinics*. 2013; 68:15-26.
5. Mou L, Wang Y, Li H, et al. A dominant-negative mutation of HSF2 associated with idiopathic azoospermia. *Hum Genet.* 2013; 132:159-65.
6. Cai Z, Zhang J, Xiong J, et al. New insights into the potential mechanisms of spermatogenic failure in patients with idiopathic azoospermia. *Mol Hum Reprod.* 2020; 26:469-84.
7. Leung A, Mira J, Hsiao W. Updates on sperm retrieval techniques. *Transl Androl Urol.* 2014; 3:94.
8. Vicari E, Grazioso C, Burrello N, et al. Epididymal and testicular sperm retrieval in azoospermic patients and the outcome of intracytoplasmic sperm injection in relation to the etiology of azoospermia. *Fertil Steril.* 2001; 75:215-6.
9. Jarvi K, Lo K, Grober E, et al. The workup and management of azoospermic males. *Can Urol Ass J.* 2015; 9:229.
10. Pantke P, Diemer T, Marconi M, et al. Testicular sperm retrieval in azoospermic men. *Eur Urol Suppl.* 2008; 7:703-14.
11. Naredi N, Agrawal A. Testicular Sperm Extraction: Can we Combat Both Obstructive and Non Obstructive Azoospermia. *Endocrinol Metab Syndr.* 2016; 5:2161-1017.1000218.
12. Sajadi H, Hosseini J, Farrahi F, et al. Varicocele may improve results for sperm retrieval and pregnancy rate in non-obstructive azoospermic men. *Int J Fertil Steril.* 2019; 12:303.
13. Schlegel P. Causes of azoospermia and their management. *Reprod Fertil Dev.* 2004; 16:561-72.

14. Deng C-Y, Liu D-F, Zhao L-M, et al. Development of a predictive model for increasing sperm retrieval success by microdissection testicular sperm extraction in patients with nonobstructive azoospermia. *Asian J Androl* 2023; 25:598-603.

15. Ananda N, Birowo P. Asosiasi antara etiologi azoospermia dan tingkat keberhasilan pengambilan sperma pada pasien pria [thesis]. Depok: Faculty of Medicine, Universitas Indonesia; 2025.

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