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THE ANALYSIS STUDY OF RENAL TRANSPLANTATION BENEFITS PATIENTS WITH END-STAGE RENAL DISEASE BY IMPROVING ERECTILE FUNCTION: A COMPREHENSIVE SYSTEMATIC REVIEW

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ABSTRACT

Background: *Renal transplantation is a highly effective treatment for end-stage renal disease (ESRD), addressing the impact of erectile dysfunction on quality of life. Erectile dysfunction, characterized by the inability to achieve and sustain an erection for good sexual activity, affects the physical and psychological well-being of individuals and their partners. However, research on the impact of renal transplantation on erectile dysfunction has yielded conflicting results. Understanding the beneficial impacts of renal transplantation on erectile dysfunction could potentially lead to more successful outcomes.*

Methods: *Adhering to the PRISMA 2020 standards, this systematic investigation sought to examine complete English literature texts published from 2004 until 2024. Only editorials and review articles that had a Digital Object Identifier (DOI) and were published in the same magazine as the submission were considered for acceptance. We utilized many sources, such as ScienceDirect, PubMed, and SagePub, to acquire the literature.*

Result: *The study examined over 40 papers sourced from reliable venues like Science Direct, SagePub, and PubMed. After selecting eight papers for further scrutiny, a comprehensive analysis of the complete corpus of literature was conducted.*

Conclusion: *Renal transplantation has shown significant improvement in erectile function in patients with end-stage renal disease (ESRD), with a lower prevalence of erectile dysfunction and higher function scores. Factors such as pretransplantation IIEF-5 score, age, and anastomosis to the common iliac artery have significant associations with improved erectile function. However, the exact mechanism behind this effect remains unclear.*

Keyword: *Renal transplantation, ESRD, ED, improvement*

INTRODUCTION

Individuals diagnosed with end-stage renal disease (ESRD) who receive hemodialysis therapy encounter a notable decline in their overall well-being. This is mostly attributed to the demanding nature of the treatment, which necessitates patients to attend dialysis sessions lasting 3-4 hours, three times a week. Additionally, the presence of comorbidities further contributes to the degradation of their quality of life.[1] Of all the accompanying medical conditions, it is crucial to emphasize erectile dysfunction (ED) because of its high prevalence. The first scientific research establishing a strong correlation between erectile dysfunction and chronic renal failure was published in 1975.[2] Erectile dysfunction is a significant consequence of end-stage renal disease that is frequently disregarded by healthcare professionals. The physiological processes related to metabolism, maintenance of internal balance, hormone regulation, cardiovascular function, and neurological function in individuals with end-stage renal disease can all contribute to the development of erectile dysfunction.[3]

A recent study has revealed that the occurrence of erectile dysfunction in patients with end-stage renal disease, particularly those on hemodialysis, is as high as 84%. This percentage is more than that observed in the whole population.[4] Erectile dysfunction is a condition characterized by the ongoing inability to achieve and sustain an erection that is enough for good sexual activity. This condition can have a substantial impact on the physical and psychological well-being of individuals and their partners, affecting their overall quality of life.[5-7] Upon analyzing multiple research, it becomes evident that the prevalence of this condition among this particular group of patients ranges from 50 to 80% and reaches a plateau.[8] The vascular risk factors associated with erectile dysfunction include advanced age, type II diabetes, smoking, hypertension, and dyslipidemia. While age is correlated with a higher probability of experiencing various risk factors for erectile dysfunction, it is not justified to assume that ED is an inevitable consequence of the aging process.[5,9]

Effective management of sexual dysfunction in immunosuppressed renal transplant recipients should lead to a satisfactory erection that meets the needs of both the patient and their partner. This should be achieved with minimal risk of infection and without negatively impacting the current or future functioning of the transplanted kidney.[10] Renal transplantation has been largely acknowledged as the most efficacious therapy for end-stage renal disease. Due to the growing popularity and advancement of transplantation technology, there has been a steady rise in the number of patients with end-stage renal disease undergoing kidney transplantation. The survival time of kidney transplantation recipients has dramatically increased.[11]

So far, research on the impact of kidney transplantation on erectile dysfunction has yielded conflicting results. Renal transplantation often leads to the restoration of sexual potency in patients, while certain studies have indicated that the impact of transplantation on erectile dysfunction may be minor.[5,12] Verifying the impact of transplantation on the restoration of erectile function can offer therapeutic possibilities for patients suffering from erectile dysfunction. Moreover, if the beneficial impacts of transplantation on erectile dysfunction are scientifically established, individuals may be inclined to undergo renal transplantation as a means of concurrently resolving their renal and erectile issues. Thus, the purpose of this systematic review was to provide a concise summary of the impact of kidney transplantation on erectile dysfunction.

METHODS

PROTOCOL

The study's author meticulously adhered to the PRISMA 2020 standards, a comprehensive set of regulations for conducting systematic reviews and meta-analyses, to ensure full compliance with all essential criteria. In order to provide precise and persuasive research results, a meticulously crafted methodology was employed.

CRITERIA FOR ELIGIBILITY

This paper offers a comprehensive analysis of the research completed in the last two decades on the benefits of renal transplantation for patients with end-stage renal disease in terms of improving erectile function. The aim of this program is to elucidate and improve patient care procedures through thorough data analysis. The main aim of this thesis is to highlight prominent themes that are found in a range of literary works.

In order to guarantee the precision of the data utilized in this study, rigorous criteria for inclusion and exclusion were enforced. Any English-language work that has been formally published or made available to the public between the years 2004 and 2024 is eligible to be taken into account or considered. The exclusion criteria encompass published reviews, editorials, submissions lacking a DOI, and duplicate entries within the same journal.

SEARCH STRATEGY

The study's keywords include "renal transplantation, erectile function, end-stage renal disease, benefits, improve". For this research, the following Boolean MeSH keywords were entered into the databases: (((“renal transplantation”[MeSH Terms] OR “renal transplantation“[All Fields] AND “erectile function”[All Fields]) OR (“end-stage renal disease”[MeSH Terms] OR “ESRD”[All Fields] AND “erectile function”[All Fields]) AND (“renal transplantation”[MeSH Terms] OR “benefits”[All Fields] OR “improve”[All Fields] OR “erectile function”[MeSH Subheading] OR “improving erectile function”[All Fields]))).

DATA RETRIEVAL

Prior to commencing this comprehensive research, the writers meticulously assessed the relevance of each article by extensively scrutinizing its title and abstract. Only research that met the aims and fulfilled the criteria for inclusion in the article were deemed more significant. A discernible and regular pattern became evident after conducting repeated searches. Only contributions written in English were allowed. The screening technique was thorough and produced content that was highly relevant to the study's topic and met all set criteria for inclusion. Research that did not fit these criteria was typically ignored, and its findings were not considered significant. The assessment encompassed a broad spectrum of data, comprising factors, titles, authors, publishing dates, venues, and study methodologies.

QUALITY ASSESSMENT AND DATA SYNTHESIS

The authors meticulously analyze the abstract and title of each article in order to identify those that necessitate additional examination. As a result, every document that was initially being examined had to undergo a comprehensive examination. The evaluation outcomes greatly influenced the selection of the review papers. By employing this criterion, the process of selecting articles was expedited, enabling a more comprehensive assessment of previous research and the conditions under which it was evaluated.

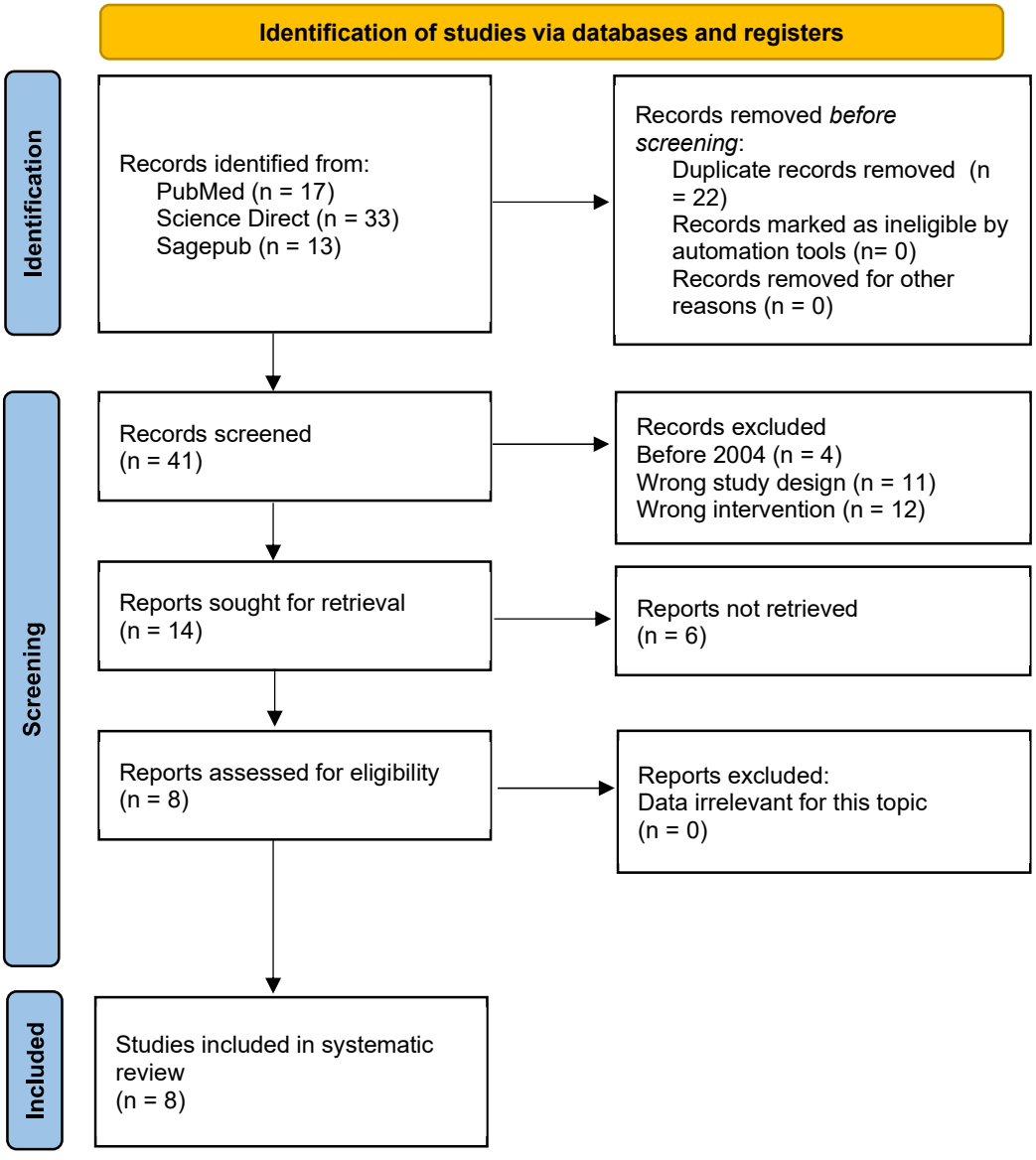

Figure 1. Article search flow chart

RESULT

To initiate the study, our team diligently gathered a wide range of documents from reputable sources including Science Direct, PubMed, and SagePub. After conducting a thorough three-stage screening process, we have selected eight papers that are very relevant to our ongoing systematic inquiry. Subsequently, we selected particular topics to scrutinize in greater

depth and meticulously evaluated each report with meticulous attention to detail. In order to expedite our inquiry, we have provided a concise summary of the evaluated information in Table 1.

Table 1. The literature included in this study

Author	Origin	Method	Sample	Result
Pourmand et al.[13] (2007)	Iran	Retrospective study	64 patients	The study found that ED prevalence in hemodialysis (HD) patients was 87.5%, with no significant difference between patients over 50 years old or dialysis duration. Improvement was observed in HD patients compared to pretransplant IIEF-5 scores. Pretransplant IIEF-5 score, age, and anastomosis to common iliac artery were significant predictors.
Barroso et al.[14] (2008)	Brazil	Case Control	91 patients	The study found significant differences in erectile function, orgasmic function, sexual desire function, intercourse satisfaction, and satisfaction related to sexual life among the control, ESRD, and transplanted groups, indicating significant differences in these areas. The results suggest that these factors play a crucial role in sexual life satisfaction.
Mirone et al.[15] (2008)	Italy	Prospective Study	78 patients	ED was reported by 68 patients before RT, with a mean total IIEF score of 42.46. One year after RT, 71 patients reported ED, with a decrease in the mean total IIEF score to 39.97. Patients aged <45 reported a significant decrease in IIEF scores due to erectile function, sexual desire, and overall satisfaction.
Khallaf[16] (2010)	Saudi Arabia	Review	-	This study evaluated sexual functions in nondiabetic male renal transplant recipients (RTRs) and hemodialysis patients. Results showed depressed erectile function and intercourse satisfaction, but normal orgasmic function. RTRs had better sexual desire and overall satisfaction, suggesting enal transplantation may normalize OS and improve SxD function.
Antonucci et al.[1] (2015)	Italy	Retrospective Study	95 patients	ED is a significant issue in transplanted patients, particularly those over 50. Dialyzed patients, particularly those undergoing dialysis, are more likely to suffer from ED. Patients over 50, who

				represent 61% of the total number of ED patients, also exhibit hyperprolactinemia. However, there is no significant correlation between ED and ED onset in transplanted patients. Diabetes and hypotestosteronemia are also significantly correlated with ED.
Kang et al.[11] (2020)	China	Meta Analysis	9 studies	The study found that kidney transplantation patients had a lower prevalence of ED compared to the control group, with higher domain scores for erectile function and sexual desire. Patients with kidney transplantation also had higher serum testosterone levels, lower prolactin levels, and luteinizing hormone levels.
Laguerre et al.[17] (2020)	France	Prospective Study	92 patients	There was a substantial increase in the median FSFI total score among women after 6 months. Among males, there was a significant increase in the median International Index of Erectile Function (IIEF) total score after one year.
Rahman et al.[9] (2021)	Indonesia	Meta Analysis	8 studies	Renal transplantation has been shown to improve erectile dysfunction in some patients with end-stage renal disease (ESRD), but it persists in approximately 20-50% of recipients. A systematic review of 1326 articles found significant improvements in IIEF-5 scores between pre and post-transplantation, and increased testosterone levels. However, the evidence is limited due to the small number of studies, necessitating further investigation.

Pourmand et al. discovered high incidence of ED in hemodialyzed patients, with kidney transplantation being the key treatment. Treatment improves psychogenic factors and quality of life. Due to sensitivity, potency evaluation should be included in posttransplantation list evaluations.[13]

The study by Barroso et al. concluded that kidney transplants can enhance sexual function in patients with ESRD who are on hemodialysis.[14]

Mirone's study highlights the prevalence of ED in hemodialysed men, and suggests that RT, the elective treatment for ESRD, should not be considered a restorative approach in terms of sexual function, as EF worsens in younger patients, lowering expectations of sexual life restoration.[15]

Khallaf's study reveals that hemodialysis and renal transplantation do not fully or malign sexual functions in uremic patients. Sexual dysfunction is prevalent in male hemodialysis patients and renal RTRs, with ED prevalence being more profound in the former group.[16]

ED prevalence in end-stage chronic kidney failure patients, including those undergoing dialysis or transplants, is often overlooked in literature. Hypotestosteronemia is a risk factor, but transplantation may protect sexual capabilities in dialyzed patients and transplant recipients.[1]

Kang's research suggests that kidney transplantation can improve erectile function in patients with ESRD by correcting endocrine hormone disorders, leading to increased serum testosterone and decreased LH and PRL levels. Further studies are needed to validate these findings.[11]

Laguerre's study reveals that successful renal transplantation can significantly improve sexual function in both men and women with chronic kidney failure. Sexuality assessment scores, such as IIEF-15 and FSFI, showed significant improvement in end-stage renal disease patients 6 and 12 months post-transplantation. However, women showed a loss of improvement.[17]

Rahman et al's study confirms that renal transplantation enhances erectile function, resulting in significant improvements in IIEF-5 scores post-transplantation, highlighting the need for further research on its effects.[9]

DISCUSSION

Renal transplantation has been a topic of debate among researchers, with some arguing that it improves erectile function in hemodialyzed patients by normalizing endocrine, metabolic, and psychological issues. However, others have reported no significant improvement in erectile function after transplantation. The causes of erectile dysfunction (ED) among graft recipients include drug side effects, compromised penile vascularity, psychological problems, and underlying diseases. The prevalence of ED in hemodialyzed patients varies, with some studies showing a higher prevalence of ED among patients younger than 50 years.[13,18]

Post-transplantation erectile function deteriorated, not changed, or improved in 12.5%, 43.5%, and 44%, respectively. Factors such as pretransplantation IIEF-5 score, age at the time of transplantation, and anastomosis to the common iliac artery had significant associations with improved erectile function.[19] The risk of vasculogenic ED following end-to-end anastomosis to the internal iliac artery is 10%, but the risk of vasculogenic ED is between 25% and 65% after a second renal transplant.[13] The IIEF showed a 44.4% prevalence of erectile dysfunction among ESRD patients, regardless of severity. Factors such as graft malfunction, side effects of immunosuppressants, etiology for renal dysfunction, and preexisting risk factors like diabetes, hypertension, and tobacco abuse may contribute to the lack of improvement in ED after transplantation.[14,20]

Erectile dysfunction is a prevalent sexual problem among hemodialysis patients, especially in renal transplantation patients (RTRs). Despite improvements in treatment, ED prevalence remains high, with studies showing varying definitions and small sample sizes. The study found a high prevalence of ED in non-diabetic RTRs, with mild-moderate degrees and no severe ED.[16,21,22] The use of beta-blockers is not a significant risk factor for ED in dialyzed patients.[1] Kidney transplantation has shown significant improvement in erectile function in patients with ESRD, with a lower prevalence of erectile dysfunction and higher erectile function scores. Studies have shown that erectile function can be improved in patients receiving kidney transplantation, but there is still debate about whether there is a significant difference between uremic patients who receive kidney transplantation and hemodialysis. The improvement of erectile function in the kidney transplantation group was more significant when using the IIEF-5 scale.[23,24]

Renal transplantation is a treatment for erectile dysfunction, a condition that affects sexual function in both men and women. Studies have shown that the median FSFI score significantly increases in women at M6 but not significantly at M12 or at LOCF after successful transplantation. Treatment of ED includes treating CKD complications, correcting endocrine disorders, chronic anemia, food deprivation, substitute drugs responsible for erectile dysfunction, and treating depression. Sildenafil citrate treatment, a PDEi5 agent, has proven effective in managing ED in kidney transplant recipients. However, the influence of kidney transplantation on sexual dysfunction is high shortly after transplantation and lessens with time and confounding factors such as age.[17,25] Renal transplantation has been shown to improve erectile function in patients with ESRD who are on hemodialysis. However, the exact mechanism behind this effect remains unclear.[26,27] Studies have shown an increase in serum testosterone levels post-transplantation while luteinizing hormone and prolactin levels decrease after 3-6 months. Alternative treatments like Li-SWT and hormonal treatment are being explored.[9,25] Renal transplantation has demonstrated promise in enhancing erectile function in individuals with end-stage renal disease (ESRD). However, additional investigation is required to have a more comprehensive understanding of its effects on patients' quality of life and overall well-being.

CONCLUSION

Renal transplantation has been a topic of debate among researchers, with some arguing that it improves erectile function in hemodialyzed patients by normalizing endocrine, metabolic, and psychological issues. However, others have reported no significant improvement in erectile function after transplantation. Erectile dysfunction (ED) among graft recipients is a prevalent sexual problem among hemodialysis patients, especially in renal transplantation patients (RTRs). Factors such as pretransplantation IIEF-5 score, age at the time of transplantation, and anastomosis to the common iliac artery have

significant associations with improved erectile function. Kidney transplantation has shown significant improvement in erectile function in patients with ESRD, with a lower prevalence of erectile dysfunction and higher erectile function scores. However, the exact mechanism behind this effect remains unclear. Alternative treatments like Li-SWT and hormonal treatment are being explored. Renal transplantation has demonstrated promise in enhancing erectile function in individuals with end-stage renal disease (ESRD), but additional investigation is required to have a more comprehensive understanding of its effects on patients' quality of life and overall well-being.

REFERENCES

[1] Antonucci M, Palermo G, Recupero SM, Bientinesi R, Presicce F, Foschi N, Bassi P, Gulino G. Male sexual dysfunction in patients with chronic end-stage renal insufficiency and in renal transplant recipients. Arch Ital Urol Androl. 2016 Jan 14;87(4):299-305. doi: 10.4081/aiua.2015.4.299. PMID: 26766802.

[2] Levy NB. Sexual adjustment to maintenance hemodialysis and renal transplantation: national survey by questionnaire: preliminary report. Trans Am Soc Artif Intern Organs. 1973;19:138-43. doi: 10.1097/00002480-197301900-00025. PMID: 4579023.

[3] Fiuk JV, Tadros NN. Erectile dysfunction in renal failure and transplant patients. Transl Androl Urol. 2019 Apr;8(2):155-163. doi: 10.21037/tau.2018.09.04. PMID: 31080776; PMCID: PMC6503231.

[4] Esen B, Kahvecioglu S, Atay AE, Ozgen G, Okumus MM, Seyahi N, Sit D, Kadioglu P. Evaluation of relationship between sexual functions, depression and quality of life in patients with chronic kidney disease at predialysis stage. Ren Fail. 2015 Mar;37(2):262-7. doi: 10.3109/0886022X.2014.990348. Epub 2014 Dec 18. PMID: 25519210.

[5] NIH Consensus Conference. Impotence. NIH Consensus Development Panel on Impotence. JAMA. 1993 Jul 7;270(1):83-90. PMID: 8510302.

[6] Salonia A, Castagna G, Saccà A, Ferrari M, Capitanio U, Castiglione F, Rocchini L, Briganti A, Rigatti P, Montorsi F. Is erectile dysfunction a reliable proxy of general male health status? The case for the International Index of Erectile Function-Erectile Function domain. J Sex Med. 2012 Oct;9(10):2708-15. doi: 10.1111/j.1743-6109.2012.02869.x. Epub 2012 Aug 15. PMID: 22897643.

[7] McCabe MP, Althof SE. A systematic review of the psychosocial outcomes associated with erectile dysfunction: does the impact of erectile dysfunction extend beyond a man's inability to have sex? J Sex Med. 2014 Feb;11(2):347-63. doi: 10.1111/jsm.12374. Epub 2013 Nov 20. PMID: 24251371.

[8] Procci WR, Goldstein DA, Adelstein J, Massry SG. Sexual dysfunction in the male patient with uremia: a reappraisal. Kidney Int. 1981 Feb;19(2):317-23. doi: 10.1038/ki.1981.22. PMID: 7230618.

[9] Rahman IA, Rasyid N, Birowo P, Atmoko W. Effects of renal transplantation on erectile dysfunction: a systematic review and meta-analysis. Int J Impot Res. 2022 Aug;34(5):456-466. doi: 10.1038/s41443-021-00419-6. Epub 2021 Jun 8. PMID: 34103695; PMCID: PMC9293755.

[10] Lasaponara F, Paradiso M, Milan MG, Morabito F, Sedigh O, Graziano ME, Abbona A, Piccoli GB, Rossetti M, Mezza E, Ferrando U. Erectile dysfunction after kidney transplantation: our 22 years of experience. Transplant Proc. 2004 Apr;36(3):502-4. doi: 10.1016/j.transproceed.2004.02.014. PMID: 15110572.

[11] Kang J, Tian J, Lu Y, Song Y, Liu X. Erectile function after kidney transplantation: a meta-analysis. Transl Androl Urol. 2020 Oct;9(5):1967-1979. doi: 10.21037/tau-20-604. PMID: 33209661; PMCID: PMC7658109.

[12] Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, McKinlay JB. Impotence and its medical and psychosocial correlates: results of the Massachusetts Male Aging Study. J Urol. 1994 Jan;151(1):54-61. doi: 10.1016/s0022-5347(17)34871-1. PMID: 8254833.

[13] Pourmand G, Emamzadeh A, Moosavi S, Mehrsai A, Taherimahmoudi M, Nikoobakht M, Saraji A, Salem S. Does renal transplantation improve erectile dysfunction in hemodialysed patients? What is the role of associated factors? Transplant Proc. 2007 May;39(4):1029-32. doi: 10.1016/j.transproceed.2007.03.038. PMID: 17524883.

[14] Barroso LV, Miranda EP, Cruz NI, Medeiros MA, Araújo AC, Mota Filho FH, Medeiros FC. Analysis of sexual function in kidney transplanted men. Transplant Proc. 2008 Dec;40(10):3489-91. doi: 10.1016/j.transproceed.2008.07.141. PMID: 19100420.

[15] Mirone V, Longo N, Fusco F, Verze P, Creta M, Parazzini F, Imbimbo C. Renal transplantation does not improve erectile function in hemodialysed patients. Eur Urol. 2009 Dec;56(6):1047-53. doi: 10.1016/j.eururo.2008.09.020. Epub 2008 Sep 24. PMID: 18835084.

[16] Al Khallaf HH. Analysis of sexual functions in male nondiabetic hemodialysis patients and renal transplant recipients. Transpl Int. 2010 Feb;23(2):176-81. doi: 10.1111/j.1432-2277.2009.00972.x. Epub 2009 Sep 23. PMID: 19778342.

[17] Laguerre M, Bouvier N, Guleryuz K, Doerfler A, Parienti JJ, Ait Said K, Tillou X. Sexual Dysfunction Improvement after Kidney Transplantation: A Prospective Study in Men and Women. Int J Sex Health. 2020 Dec 11;33(1):1-8. doi: 10.1080/19317611.2020.1842575. PMID: 38596472; PMCID: PMC10807801.

[18] Rosas SE, Joffe M, Franklin E, Strom BL, Kotzker W, Brensinger C, Grossman E, Glasser D, Feldman HI. Prevalence and determinants of erectile dysfunction in hemodialysis patients. Kidney Int. 2001 Jun;59(6):2259-66. doi: 10.1046/j.1523-1755.2001.00742.x. PMID: 11380829.

[19] El-Bahnasawy MS, El-Assmy A, El-Sawy E, Ali-El Dein B, Shehab El-Dein AB, Refaie A, El-Hammady S. Critical evaluation of the factors influencing erectile function after renal transplantation. Int J Impot Res. 2004 Dec;16(6):521-6. doi: 10.1038/sj.ijir.3901222. PMID: 15029223.

[20] Arslan D, Aslan G, Sifil A, Cavdar C, Celebi I, Gamsari T, Esen AA. Sexual dysfunction in male patients on hemodialysis: assessment with the International Index of Erectile Function (IIEF). Int J Impot Res. 2002 Dec;14(6):539-42. doi: 10.1038/sj.ijir.3900937. PMID: 12494292.

[21] Malavaud B, Rostaing L, Rischmann P, Sarramon JP, Durand D. High prevalence of erectile dysfunction after renal transplantation. Transplantation. 2000 May 27;69(10):2121-4. doi: 10.1097/00007890-200005270-00027. PMID: 10852609.

[22] Espinoza R, Gracida C, Cancino J, Ibarra A. Prevalence of erectile dysfunction in kidney transplant recipients. Transplant Proc. 2006 Apr;38(3):916-7. doi: 10.1016/j.transproceed.2006.02.045. PMID: 16647509.

[23] Rosen RC, Riley A, Wagner G, Osterloh IH, Kirkpatrick J, Mishra A. The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. Urology. 1997 Jun;49(6):822-30. doi: 10.1016/s0090-4295(97)00238-0. PMID: 9187685.

[24] Navaneethan SD, Vecchio M, Johnson DW, Saglimbene V, Graziano G, Pellegrini F, Lucisano G, Craig JC, Ruospo M, Gentile G, Manfreda VM, Querques M, Stroumza P, Torok M, Celia E, Gelfman R, Ferrari JN, Bednarek-Skublewska A, Dulawa J, Bonifati C, Hegbrant J, Wollheim C, Jannini EA, Strippoli GF. Prevalence and correlates of self-reported sexual dysfunction in CKD: a meta-analysis of observational studies. Am J Kidney Dis. 2010 Oct;56(4):670-85. doi: 10.1053/j.ajkd.2010.06.016. PMID: 20801572.

[25] Bertero E, Hallak J, Gromatzky C, Lucon AM, Arap S. Assessment of sexual function in patients undergoing vasectomy using the international index of erectile function. Int Braz J Urol. 2005 Sep-Oct;31(5):452-8. doi: 10.1590/s1677-55382005000500006. PMID: 16255791.

[26] Eckersten D, Giwercman A, Pihlsgård M, Bruun L, Christensson A. Impact of Kidney Transplantation on Reproductive Hormone Levels in Males: A Longitudinal Study. Nephron. 2018;138(3):192-201. doi: 10.1159/000484992. Epub 2017 Dec 14. PMID: 29248921.

[27] Reinhardt W, Kübber H, Dolff S, Benson S, Führer D, Tan S. Rapid recovery of hypogonadism in male patients with end stage renal disease after renal transplantation. Endocrine. 2018 Apr;60(1):159-166. doi: 10.1007/s12020-018-1543-2. Epub 2018 Feb 1. PMID: 29392618.