THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 12 Issue 12

RESEARCH ARTICLE

Improving patient outcomes: lessons learned from a new kidney biopsy program, a covid-19 era initiative

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OPEN ACCESS

PUBLISHED
31 December 2024

CITATION
Courville, K., Milord, R., et al., 2024. Improving patient outcomes: lessons learned from a new kidney biopsy program, a covid-19 era initiative. Medical Research Archives, [online] 12(12). https://doi.org/10.18103/mra.v12i12.6092

DOI
https://doi.org/10.18103/mra.v12i12.6092

ISSN
2375-1924

ABSTRACT

Kidney biopsy is a critical diagnostic tool in nephrology, often requiring specialized expertise and infrastructure. Prior to the COVID-19 pandemic, our second-level hospital, located in a rural area of Panama, lacked the capacity to perform kidney biopsies in-house. Patients were referred to a distant tertiary care center, leading to delays and limited access to timely diagnosis.

The COVID-19 pandemic disrupted healthcare systems worldwide, exacerbating these challenges. To address this, our hospital implemented an in-house kidney biopsy program. Over the course of the pandemic, we performed our first 30 kidney biopsies, and through the continuing of the program, it has enabled us to characterize a wide range of glomerular pathologies, including nephrotic and nephritic syndromes and chronic kidney disease of unknown cause, with our over more than 100 kidney biopsies.

This study evaluates the impact of this in-house kidney biopsy program. The COVID-19 pandemic served as a catalyst for innovation and adaptation in healthcare delivery. By sharing our experiences, we hope to inspire other healthcare institutions to consider similar initiatives and contribute to the advancement of nephrology care, especially in resource-constrained settings.

Introduction

The COVID-19 pandemic exposed vulnerabilities in global healthcare systems, particularly in regions with limited resources. This crisis underscored the importance of innovative solutions to maintain essential services, including timely access to specialized diagnostic procedures[1,2].

Kidney biopsy is a crucial diagnostic tool in nephrology, providing essential information for the accurate diagnosis and management of various kidney diseases[3]. In Panama, the pandemic exacerbated existing challenges in providing timely kidney biopsy services. Before the pandemic, patients often faced significant delays and limitations in accessing these procedures, particularly in rural areas. This was due to the concentration of specialized services in tertiary care centers, which were frequently overburdened.

To address this critical need, our second-level hospital implemented an in-house kidney biopsy program. This initiative aimed to improve patient access to timely diagnosis, enhance clinical outcomes, and optimize resource utilization. By establishing a dedicated team of skilled professionals and acquiring the necessary equipment, we sought to provide high-quality kidney biopsy services within our institution. This paper delves into the implementation and impact of our program, providing valuable insights for other healthcare institutions considering similar initiatives.

BACKGROUND

Our hospital, a second-level referral center in a rural area of Panama, serves a population of approximately 200,000 individuals. Prior to the COVID-19 pandemic, kidney biopsies were not performed at our institution due to the lack of necessary expertise and infrastructure. Patients requiring these procedures were referred to a tertiary care hospital in the capital city, which became overwhelmed with COVID-19 cases and suspended outpatient services, including kidney biopsies.

IMPLEMENTATION OF THE KIDNEY BIOPSY PROGRAM

To address the unmet need for kidney biopsy services in our region, we developed and implemented an in-house program. We obtained approval from the hospital's medical management board to initiate the kidney biopsy program. A detailed protocol was developed based on international guidelines and recommendations, outlining the indications, contraindications, procedural steps, and post-procedure care[4]. Healthcare professionals, including interventional radiologists, nephrologists, and nursing staff, were prepared in the technical aspects of kidney biopsy procedures. Essential equipment, such as biopsy needles, ultrasound machines, and sterile supplies, was procured to ensure safe and effective procedures.

Methodology

This is a retrospective cohort study to evaluated the impact of our in-house kidney biopsy program implemented in 2021. We compared patient outcomes and resource utilization before and after the program's initiation. Data Collection was performed from data from electronic medical records, including patient demographics, clinical characteristics, biopsy indications, procedural outcomes, and histopathological findings. A dedicated database was established to collect all that information. Descriptive statistics were used to summarize patient characteristics and outcomes. We compared the number of kidney biopsies performed, evaluated kidney biopsy indication, monthly ratio and histopathology results.

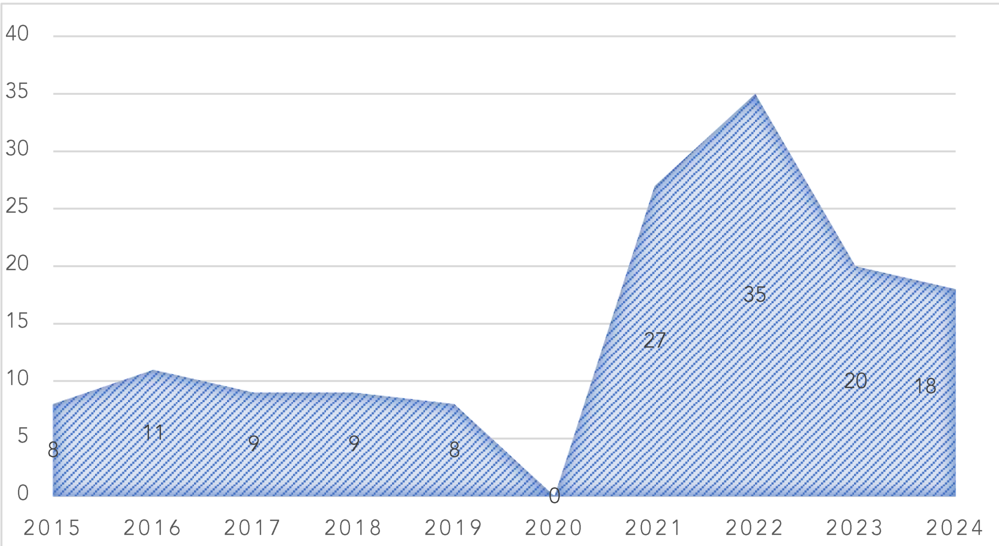
ETHICAL CONSIDERATIONS: The study adhered to ethical principles and was conducted in accordance with the Declaration of Helsinki. All patient data were handled confidentially, and privacy was maintained throughout the study period. Informed consent was obtained from all participants or their legal guardians and detailed information about the procedure, potential risks, and benefits was provided.

Kidney biopsies were performed by an experienced interventional radiologist using ultrasound guidance. Two to three core needle biopsies were obtained from each patient. Cores were immediately stored in 10% buffered formalin for light microscopy and one in Michel's transport media for immunofluorescence[5], labeled with patient name and identification number in a transport cooler, to maintain an adequate temperature, and for transportation to the pathology laboratory center the next morning, to the Referral Hospital where the nephropathologist analyzes the samples and sends the reports via web through the platform of the National Pathology System, from where the reports are downloaded only through the user code of the treating physician[6].

Results

A total of 45 kidney biopsies were performed at the referral center during pre-pandemic period from 2015 to 2019. Since the implementation of our in-house kidney biopsy program in March 2021, a total of 100 biopsies have been successfully performed until October 2024, as seen in Figure 1.

Figure 1. Number of biopsies performed before and after the COVID pandemic.



In patient demographics description, 51% of the patients were female. The minimum age was 17 years (in this center, patients over 16 years of age are considered non-pediatric patients, as established by the institution's standard) and the maximum age was 79 years, with an average age of 44 years.

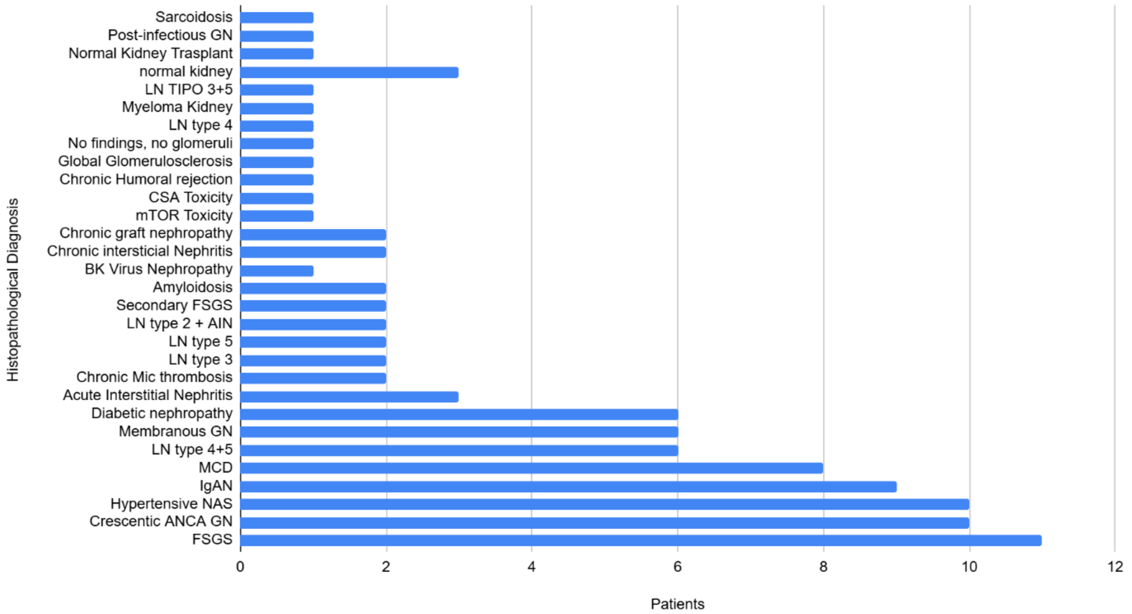
The indications for biopsy were nephrotic syndrome in 37% of cases, chronic kidney disease (CKD) of unknown cause in 22%, nephritic syndrome in 13%, proteinuria in 12%. Other indications are shown in Table 1.

Table 1. Kidney biopsy indication.

Biopsy indication	N
Nephrotic syndrome	37
Chronic kidney disease (CKD) of unknown cause	22
Nephritic syndrome	13
Proteinuria	12
Acute kidney failure	9
Acute transplant rejection	6
Microscopic hematuria	1
Total	100

The histopathological results of the biopsies are detailed in Figure 2, the most common being Focal Segmental Glomerulosclerosis, hypertensive nephropathy, ANCA-positive crescentic vasculitis, IgA nephropathy and minimal change disease. In the case of crescentic vasculitis, thrombotic microangiopathies, and transplanted kidney biopsies, or in any other case that the renal pathologist considered to be an important finding, the report was obtained by telephone 48 hours after the biopsy was performed.

Figure 2: Histopathological result of renal biopsy study.



GN: Glomerulonephritis; LN: Lupus Nephritis; CSA: Ciclosporine associated; mTOR: mammalian target of rapamycin; FSGS: Focal segmental glomerulosclerosis; IAN: interstitial acute nephritis; Mic: microangiopathic; MCD: minimal change disease; IgAN: IgA nephropathy; NAS: Nephroangiosclerosis; ANCA: Anti-neutrophilic cytoplasmic antibodies.

A total of sixteen patients with glomerular kidney disease with significant damage as reported in the histopathology report or acute rejection of kidney transplantation progressed to stage 5 kidney disease after the first 12 months of follow up (from 2021 to October 2023). Before the implementation of the in-house program, an average of 0.75 kidney biopsies were performed per month. After the program's initiation, this number increased to an average of 2.52 biopsies per month.

Discussion

The pandemic caused significant disruptions in health care services, including diagnostic, prevention, and treatment services for various conditions such as HIV, tuberculosis, sexual and reproductive health, vaccination of children and adults, to mention a few among many that were affected[7,8]. These disruptions were largely due to the repurposing of health services to focus on COVID-19, as well as travel limitations and the closure of non-essential businesses[9]. A comparative analysis across 32 countries found substantial disruptions in hospitalizations and ambulatory care, with millions of missed hospitalizations and surgical procedures[10].

Prior to the COVID-19 pandemic, our second-level hospital encountered significant hurdles in providing timely and accessible kidney biopsy services. Due to a lack of specialized expertise and necessary infrastructure, we were unable to perform these crucial procedures in-house. Patients requiring kidney biopsies were forced to rely on a tertiary care hospital located 115 kilometers away.

However, this referral system proved to be inadequate. The tertiary hospital, serving as a national referral center, was often overwhelmed with patients from across the country. This overwhelming demand resulted in limited bed availability and extended waiting times for kidney biopsies. Consequently, many patients experienced delays in receiving essential diagnostic services, potentially compromising their health outcomes. A stark reflection of these limitations is evident in the number of kidney biopsies performed during the pre-pandemic period (2015-2019). A mere 45 biopsies were conducted at the referral center during this time.

The COVID-19 pandemic, while a global health crisis, inadvertently catalyzed a significant transformation in our approach to kidney biopsy services. The pandemic exposed the vulnerabilities of centralized healthcare systems and highlighted the need for decentralized solutions[11]. As the tertiary care hospital became overburdened with COVID-19 cases, it was forced to prioritize emergency and critical care, further limiting its capacity to provide elective procedures like kidney biopsies[12].

Recognizing the urgent need to address this gap in care, our hospital embarked on a mission to establish an in-house kidney biopsy program. This initiative was driven by several key factors, such as improving access to timely diagnosis, since by performing biopsies locally, we were able to significantly reduce waiting times and speed up the diagnostic process. This results in a reduction in healthcare costs, by eliminating the need for patient transfers and associated costs, such as transportation, ambulance fuel and accommodation, which substantially reduces costs for both the hospital administration and those of the patient and their families. In addition, this resulted in a strengthening of the health care infrastructure, as the establishment of this program improved the capabilities of our hospital and positioned it as a regional center of excellence for the management of kidney disease. More importantly, it improves patient care, as getting an early and accurate diagnosis is crucial for effective treatment and better patient outcomes[13].

In Latin America and the Caribbean, the pandemic disrupted routine health services. A systematic review highlighted that the pandemic led to interruptions and reduced adherence to chronic therapies[14]. Factors contributing to this included fear of infection, difficulty accessing healthcare facilities, and medication unavailability[15]. In Panamá city, the tertiary referral hospital, overwhelmed by COVID-19 cases, prioritized emergency and critical care, limiting its capacity to perform elective procedures like kidney biopsies. Delays in obtaining biopsy results led to suboptimal patient outcomes. In addition, some treatments were put on hold, either because of lack of access to therapy, lack of medication, lack of diagnosis or due to the lack of appointments, caused by the closure of day hospital consultations[16,17].

However, telemedicine and community pharmacists played a role in maintaining continuity of care for some patients, and also led to innovative strategies such as telemedicine and public-private coordination to sustain and recover services. These adaptations highlight the potential for strengthening healthcare systems through innovation and reform[18].

In response to the challenges posed by the pandemic, our hospital seized the opportunity to establish an in-house kidney biopsy program. Since the implementation of our in-house kidney biopsy program in 2021, we have successfully performed 100 biopsies up until October 2024. This increase in the number of procedures underscores the significant impact of this initiative.

By implementing our in-house kidney biopsy program, we have achieved several significant benefits. We can now provide timely kidney biopsy services to our patients, eliminating the need for long-distance referrals and reducing wait times. Early diagnosis and targeted treatment based on histopathological findings have led to improved patient outcomes and reduced complications. (Figure 2). By minimizing the need for patient transfers, we have significantly reduced transportation costs, accommodation expenses, and other associated costs. The cost of a bed day in our second-level hospital is less than in a third-level hospital, even though it is the same public system, costs in the city are higher than in this small town. Third-level hospitals, being more specialized, often have higher operational costs due to advanced equipment, specialized staff, and complex procedures[14]. COVID-19 proved to be, in some situations, a window of opportunity to strengthen health policies and to find financing mechanisms that allowed states to continue providing universal health with a different perspective that had not been required in the last 50 years[19].

Timely kidney biopsy is critical for accurate diagnosis and effective management of various kidney diseases. For conditions such as nephrotic syndrome, nephritic syndrome, and acute renal failure in transplant recipients, prompt diagnosis can significantly impact patient outcomes[20]. Nephrotic syndrome is characterized by significant proteinuria and hypoalbuminemia. A timely kidney biopsy can help determine the underlying cause, such as minimal change disease, focal segmental glomerulosclerosis, or membranous nephropathy. Early diagnosis allows for appropriate treatment, which may include immunosuppressive therapy or other targeted interventions[21]. Nephritic syndrome is characterized by inflammation of the kidney's glomeruli. A timely biopsy can help identify the specific type of glomerulonephritis, such as IgA nephropathy, lupus nephritis, or ANCA-associated vasculitis. This information is crucial for tailoring treatment and monitoring disease progression[22]. Acute renal failure in transplant recipients can be caused by various factors, including acute rejection, drug toxicity, or recurrent disease. A prompt kidney biopsy can help identify the underlying cause and guide appropriate management strategies, such as adjusting immunosuppression or initiating specific therapies[23].

The establishment of our in-house program has enhanced our hospital's capabilities and positioned us as a regional center of excellence for kidney disease management. Despite presenting 16% progression to chronic kidney disease in our 12-month follow-up, thanks to the information that the biopsies were able to provide us, we achieved 100% patient preparation and planning for admission to renal replacement therapy and 0% urgent initiation in this group of patients, which improves the patient's overall prognosis.

This study was limited by its retrospective design and relatively small sample size. More research is needed, including biopsy diagnoses from the rest of the country, in order to obtain data such as the prevalence of glomerular diseases in our region.

Conclusion

The COVID-19 pandemic, while a global health crisis, presented an opportunity for our hospital to innovate and improve patient care. By implementing an in-house kidney biopsy program, we have successfully addressed the challenges of limited access to specialized services. It is crucial to collaborate with other healthcare institutions to share best practices and promote the development of similar programs. By working together, we can improve access to specialized care for patients in underserved areas and ultimately enhance the overall quality of healthcare delivery.

Conflict of Interest:

The authors have no conflicts of interest to declare.

Funding Statement:

None.

Acknowledgements:

Thanks to the nephrology assistants, who collaborate in the daily care of patients and to the work team of the interventional radiology department that collaborates in the performance of biopsies at the Dr. Gustavo N. Collado Hospital. Thanks to the renal pathology team at the Metropolitan Hospital Complex, without which we could not obtain patient results to interpret and translate into treatments that improve the lives of our patients.

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