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(RESEARCH ARTICLE)

Establishing a kidney transplant program in a post-conflict region: The initial experience of Ibn Sina Teaching Hospital in Sirte, Libya

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Abstract

Background: Kidney transplantation remains the preferred treatment modality for patients with end-stage kidney disease (ESKD). However, establishing kidney transplant programs in developing and post-conflict regions remains highly challenging because of infrastructure limitations, shortages in trained personnel, financial constraints, and limited immunological support systems. In September 2025, a collaborative initiative between Ibn Sina Teaching Hospital in Sirte, Libya, and the Arab Renal Care Group (ARCG), Jordan, led to the establishment of a structured living-related kidney transplant program in central Libya.

Methods: A multidisciplinary transplant system was developed through extensive pre-implementation strategic planning, including virtual meetings, protocol development, infrastructure evaluation, staff training, immunological preparation, and postoperative care planning. The program included nephrologists, transplant surgeons, vascular surgeons, ICU physicians, transplant coordinators, nursing staff, immunology laboratories, and dialysis support services. Patients underwent immunological risk stratification and standardized recipient evaluation according to internationally accepted transplant principles and KDIGO/KDOQI-based recommendations.

Results: Up to the time of this report, 34 kidney transplants had been successfully performed. Follow-up duration ranged between four weeks and seven months, with the majority of recipients followed for more than three months. Complications included one major urinary leak requiring reconstruction, one minor urinary leak, one biopsy-proven acute cellular rejection episode, and one delayed graft function episode likely secondary to acute tubular necrosis caused by prolonged ischemic time during surgery. The latter patient required one hemodialysis session before complete renal recovery and discharge with normal graft function. High-risk recipients received anti-thymocyte globulin induction therapy, while moderate- to low-risk recipients received basiliximab induction therapy. All patients continued on tacrolimus-based maintenance immunosuppression. Progressive transfer of knowledge and local empowerment resulted in the final six transplant procedures being performed predominantly by Libyan physicians and healthcare teams.

Conclusion: The successful establishment of a kidney transplant program at Ibn Sina Teaching Hospital demonstrates that advanced transplant services can be developed in resource-limited and post-conflict environments through structured planning, international collaboration, and progressive local capacity building. The experience highlights the importance of education, multidisciplinary coordination, and sustainable knowledge transfer in establishing long-term transplant programs.

Keywords: Kidney Transplantation; End-Stage Kidney Disease; Libya; Sirte; Transplant Program; Post-Conflict Healthcare; Immunology; Living Donor Transplantation

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1. Introduction

Kidney transplantation remains the gold-standard treatment for patients with end-stage kidney disease (ESKD), providing superior survival, improved quality of life, and lower long-term healthcare costs compared with chronic dialysis therapy.[1–3] Despite major advancements in transplant medicine over recent decades, many developing countries and post-conflict regions continue to face substantial barriers in establishing sustainable transplantation programs, including infrastructure limitations, shortages of trained personnel, limited immunological support, and financial constraints.[4–6]

Libya has historically faced significant challenges in delivering advanced transplant care because of healthcare infrastructure limitations, political instability, and shortages in specialized nephrology and transplant services. Consequently, many patients requiring transplantation were historically referred abroad, resulting in substantial financial, social, and logistical burdens on both patients and the healthcare system.[6,14,15]

Sirte, located in central Libya, represents one of the regions that experienced major healthcare disruption during years of instability and conflict. Rebuilding advanced healthcare services therefore became an important national priority. In response to the increasing burden of chronic kidney disease and ESKD, Ibn Sina Teaching Hospital initiated collaboration with the Arab Renal Care Group (ARCG), Jordan, a transplant and nephrology group experienced in establishing dialysis and transplantation programs throughout the Middle East.[4,5]

The collaboration aimed not only to perform kidney transplantation procedures, but also to establish a sustainable and independent transplant system capable of long-term growth through local physician empowerment, structured education, multidisciplinary institutional development, and progressive transfer of expertise.[16–18]

This article reviews the establishment of the kidney transplant program at Ibn Sina Teaching Hospital, including infrastructure development, immunological preparation, multidisciplinary collaboration, early outcomes, complications, educational achievements, and the challenges associated with developing transplantation services in a post-conflict healthcare environment.

2. Materials and Methods

2.1. Strategic Planning and Program Development

Although the transplant program officially began in September 2025, the preparation phase had started several months earlier through extensive strategic planning and institutional evaluation. Multiple preparatory activities were conducted through Zoom meetings, telephone conferences, electronic correspondence, protocol development sessions, and administrative consultations between the Libyan healthcare leadership in Sirte and the Jordanian ARCG transplant team, (Figure1)

The initial planning phase focused on evaluating institutional readiness and identifying the minimum infrastructure and logistical requirements necessary to establish a safe and sustainable living donor kidney transplant program. Particular emphasis was placed on developing a complete multidisciplinary system capable of managing not only routine transplantation procedures but also complex immunological and surgical complications, including antibody-mediated rejection, acute cellular rejection, delayed graft function, plasmapheresis requirements, and postoperative dialysis support.[7–10]

Standardized transplant protocols were established based on internationally accepted transplant principles and KDIGO/KDOQI recommendations.[9,10] These protocols included recipient evaluation, donor selection, immunological risk stratification, perioperative management, ICU monitoring, postoperative surveillance, infectious prophylaxis, rejection monitoring, and long-term immunosuppression management.[18,19]

Figure 1 The Libyan Jordanian surgical transplant team

2.2. Establishment of the Dedicated Transplant Unit

A dedicated transplant unit was established within Ibn Sina Teaching Hospital specifically for kidney transplant recipients. Initially, the unit consisted of five isolated transplant rooms, including two dedicated ICU rooms. As the program expanded and the number of transplant procedures increased, the unit was subsequently expanded to seven rooms and later to nine rooms while maintaining two dedicated ICU beds.

Each transplant room was designed according to infection-control standards and included positive-pressure ventilation systems, private isolated bathrooms, dedicated patient-monitoring systems, and restricted-access protocols. Dedicated nursing care was implemented for all transplant recipients, particularly during the immediate postoperative period. ICU nursing protocols were specifically adapted for transplant recipients, with one nurse assigned per patient during critical postoperative management.[19,20]

2.3. Multidisciplinary Team Structure

The transplant program relied heavily on a multidisciplinary collaborative model involving Libyan and Jordanian healthcare professionals. The transplant team included transplant surgeons, vascular surgeons, nephrologists, ICU physicians, specialized transplant nurses, transplant coordinators, nurse coordinators, dialysis specialists, and laboratory and immunology personnel.

The ARCG Jordanian transplant team provided on-site supervision, surgical collaboration, immunosuppression protocol guidance, postoperative management support, educational activities, and institutional mentorship throughout the establishment phase of the program.

A major objective of the collaboration was to create a sustainable educational model focused on local empowerment rather than long-term external dependence.[4,5,17]

2.4. Immunological and Laboratory Infrastructure

One of the most critical components in developing transplantation programs in resource-limited settings involves establishing adequate immunological support systems.[11] The immunological laboratory established at Ibn Sina Teaching Hospital included cytotoxic crossmatch testing, panel-reactive antibody (PRA) Class I and II analysis, Luminex-based immunological evaluation, tacrolimus and cyclosporine level monitoring, and standard immunological recipient assessment.

Advanced donor-specific antibody (DSA) testing and specialized pathological evaluations were coordinated with Jordanian centers or nearby collaborating institutions when necessary. Kidney biopsy samples requiring specialized pathological interpretation were transported urgently for external review, with most results available within 48–72 hours.[11,18] Logistical systems were also developed to facilitate urgent transport of immunological and pathological specimens for advanced analysis when required.

2.5. Recipient Evaluation and Ethical Considerations

The transplant program initially focused exclusively on living-related kidney transplantation. Ethical protocols were established according to internationally accepted transplantation ethics principles and World Health Organization recommendations.[12,16] All recipients and donors underwent comprehensive medical and psychological evaluation to ensure:

- Appropriate donor-recipient relationships
- Voluntary informed consent
- Medical suitability
- Psychological readiness
- Absence of coercion
- Ethical compliance

Recipient evaluations included cardiovascular assessment, infectious disease screening, immunological risk stratification, dialysis assessment, surgical evaluation, and additional genetic or immunological testing in selected patients, particularly pediatric recipients and patients with suspected hereditary glomerular disease.

2.6. Immunosuppression and Risk Stratification

Recipients were stratified according to immunological risk using KDIGO/KDOQI-based principles and internationally accepted transplant-risk assessment models.[9,10]

High-risk recipients received induction therapy with anti-thymocyte globulin (ATG), intensive immunological monitoring, and enhanced rejection surveillance.[7,8]

Moderate- to low-risk recipients received basiliximab induction therapy.

All patients received tacrolimus (Prograf)-based maintenance immunosuppression. Comprehensive contingency plans were established for the management of acute cellular rejection, antibody-mediated rejection, plasmapheresis requirements, emergency dialysis support, and urgent kidney biopsy evaluation.[11,18] The transplant center maintained availability of medications required for induction therapy, maintenance immunosuppression, infectious prophylaxis, and treatment of both cellular and humoral rejection.

3. Results

3.1. Clinical Outcomes

At the time of this report, 34 living-related kidney transplant procedures had been successfully performed at Ibn Sina Teaching Hospital. Follow-up duration ranged from four weeks to seven months, with the majority of recipients following for more than three months. Donor age ranged between 25 and 65 years, whereas recipient age ranged between 10 and 63 years. Two pediatric transplant recipients were included in the cohort.

The most common causes of ESKD included hypertension-related kidney disease, glomerular diseases, and diabetic nephropathy.[13–15] However, pre-transplant kidney biopsy data remained limited because renal biopsy utilization historically had not been widely available in many regions of Libya (Table 1).

Table 1 Summary of early outcomes of the First 34 Kidney transplants

Parameter	Outcome
Number of kidney transplants	34
Program start date	September 2025
Follow-up duration	4 weeks – 7 months (majority > 3 months)
Donor age (years)	25 – 65
Recipient age (years)	10 – 63
Pediatric recipients	2
Induction therapy	• High-risk: ATG • Moderate/Low-risk: Basiliximab
Maintenance immunosuppression	Tacrolimus-based (all patients)
Surgical complications	• Major urinary leak requiring reconstruction: 1 • Minor urinary leak: 1
Rejection	Biopsy-proven acute cellular rejection: 1
Delayed graft function	1 (ATN secondary to prolonged ischemic time; required 1 hemodialysis session; recovered and discharged with normal graft function
Patient survival	100%
Graft function	All functioning at last follow-up

3.2. Complications

Complications observed during the initial 34 transplant procedures included one major urinary leak requiring surgical re-exploration and reconstruction, one minor urinary leak managed conservatively, and one biopsy-proven acute cellular rejection episode.

In addition, one patient developed delayed graft function most likely secondary to acute tubular necrosis caused by prolonged ischemic time during surgery. The patient required one session of hemodialysis before gradual improvement in graft function and eventual discharge with normal kidney function.[7,8]

Importantly, no catastrophic infectious outbreaks or major uncontrolled immunological complications were observed during the early phase of the program.(Table 1)

3.3. Education, Training, and Local Empowerment

One of the most important achievements of this collaboration was the progressive transfer of knowledge and empowerment of local Libyan healthcare teams.

Education and training represented central pillars of the program and included daily clinical teaching, surgical mentorship, ICU nursing education, immunosuppression protocol training, transplant coordination training, perioperative management education, and multidisciplinary case discussions.[17–20]

During the final six transplant procedures, the work was performed predominantly by Libyan physicians, surgeons, and healthcare teams, including the surgical team, nephrology team, nursing staff, ICU teams, and transplant coordinators. This progressive transition represents one of the strongest indicators of the program's sustainability and long-term success.

4. Discussion

The establishment of a kidney transplant program in Sirte represents an important example of how advanced transplantation services can be developed successfully in resource-limited and post-conflict settings through structured international collaboration, institutional commitment, and local capacity building.[4–6] Several key factors contributed to the success of the program, including early strategic planning, multidisciplinary collaboration, ICU and nursing preparation, development of immunological infrastructure, standardized protocols, continuous educational support, and gradual transfer of responsibility to local healthcare professionals.[5,13,15]

Importantly, the primary objective of the collaboration extended beyond performing transplant procedures alone. The long-term goal was to establish a sustainable and independent Libyan transplant system capable of continuing and expanding without permanent dependence on external teams.[16–18] The progressive transition toward Libyan-led transplantation observed during the latter stages of the program strongly supports the success of this educational and empowerment model. The ability of local teams to independently perform the majority of transplant-related responsibilities within a relatively short time period represents a significant institutional achievement. Although the follow-up duration remains relatively short and the patient cohort remains limited, the early outcomes are encouraging given the complexity of developing such advanced services within a post-conflict healthcare environment.[4,5] The present experience aligns with previous reports demonstrating that successful transplant programs can be established in developing nations when structured planning, institutional support, multidisciplinary coordination, and sustainable educational models are present.[4,5,13–15] Furthermore, the current experience highlights the importance of developing local transplant infrastructure rather than relying solely on overseas referral systems, which are often associated with delayed care, high financial costs, and fragmented postoperative follow-up.[16,17]

Limitations

The present study has several limitations, including the relatively small patient cohort, limited long-term follow-up, and absence of long-term graft survival data. In addition, biopsy-confirmed etiological diagnoses were unavailable in several recipients because renal biopsy services historically had not been routinely accessible.

Nevertheless, this report provides important early evidence regarding the feasibility of establishing advanced transplantation services in post-conflict healthcare environments through structured collaboration and progressive local empowerment.[4–6]

Future Directions

Future objectives of the transplant program include expansion of transplant capacity, development of advanced HLA laboratories, establishment of local renal pathology services, expansion of pediatric transplant programs, development of a national Libyan transplant registry, expansion of transplantation services to additional Libyan cities, and potential future establishment of deceased donor transplantation programs.[18–20]

Continued educational activities and progressive local physician leadership remain essential for ensuring long-term sustainability and institutional independence.

5. Conclusion

The successful establishment of the kidney transplant program at Ibn Sina Teaching Hospital in Sirte, Libya, demonstrates that advanced transplantation services can be successfully developed in resource-limited and post-conflict regions through strategic planning, multidisciplinary collaboration, institutional commitment, and progressive local empowerment.

Through collaboration between Ibn Sina Teaching Hospital and the Arab Renal Care Group, a structured and comprehensive living-related kidney transplant program was successfully established beginning in September 2025. The experience highlights the importance of education, sustainability, and institutional development in building long-term transplant programs.

Most importantly, the gradual transition toward independent Libyan-led transplant care represents a major achievement and provides a promising model for future healthcare development initiatives within Libya and similar developing regions worldwide.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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