Nephrology in Ethiopia

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Area	1,104,300 km^2
Population	112 million (2019)
Capital	Addis Ababa
Three most populated cities:	1. Addis Ababa 2. Dire Dawa 3. Makalle
Official language	Amharic
Gross Domestic Product (GDP)[1]	80 billion USD (2016/17)
GDP per capita[1]	863 USD (2016/17)
Human Development Index (HDI)[2]	0.463 (2017)
Official currency	Birr
Total number of nephrologists	26
National society of nephrology	Not formed
Incidence of end-stage renal disease	2018 – Unknown
Prevalence of end-stage renal disease	2018 – ~7 pmp
Total number of patients on dialysis (all modalities)	2017 – Unknown 2018 – ~800
Number of patients on hemodialysis	2017 – Unknown 2018 – ~800
Number of patients on peritoneal dialysis	2017 – 0 2018 – 0
Number of renal transplantations per year	2017 – 32 2018 – 38

Table references:

1. Ethiopia key economic and social indicators, UNDP- https://www.et.undp.org/content/ethiopia/en/home/library/UNDPEthiopia/Ethiopia_Key_Economic_Indicators_May20181.html, Accessed on 23 July 2019
2. UNDP Human development indices & indicators: 2018 statistical update, Ethiopia http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/ETH.pdf, Accessed on 23 July 2019

Introduction

Ethiopia is a country located in the horn of Africa, which occupies part of the North-Eastern part of the continent. It borders with six countries: Eritrea, Djibouti, Somalia, Kenya, South Sudan, and Sudan. It occupies an area of 1.1 million km^2 with geographical diversity ranging from 4620 meters above sea level down to 148 meters below sea level. More than half of the country lies above 1500 m. The predominant climate type is tropical monsoon, with temperate climate on the plateau and hot in the lowlands.

It is the second-most populous country in Africa with a projected population of 112 million in the year 2019. The population is predominately young; with 40.3% under the age of 15 years and 56.1% in the age group between 15 and 64 years. The population in the age group 65 and above accounts for only 3.5% of the population [1].

Ethiopia is one of the least urbanized countries in the world; only 16% of the population lives in urban areas. The majority of the population lives in the highland areas. The main occupation of the settled rural population is farming, while the lowland areas are mostly inhabited by pastoral or partially pastoral people, who move from place to place in search of grazing grounds and water.

Ethiopia is a federal parliamentary republic. It is home to a variety of nations, nationalities, and peoples with more than 80 different languages spoken. The working language of the federal government is Amharic. The country has a rich history, unique cultural heritage with a diverse population mix of ethnicity and religion. It is the oldest independent state and served as a symbol of African independence throughout the colonial period. It is a founding member of the United Nations (UN), the African Union (AU), and hosts several international organizations, including the headquarters of the AU and the UN Economic Commission for Africa.

Although Ethiopia is one of the poorest countries in the region, with a per capita income of $790, the country's economy has been growing very fast in the last decade with an annual average of 9.9% (2007/08 to 2017/18), compared to a

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J. A. Moura-Neto et al. (eds.), *Nephrology Worldwide*, https://doi.org/10.1007/978-3-030-56890-0_4

regional average of 5.4% [2]. Ethiopia has implemented successive Health Sector Development Plans (HSDPs) in four phases since 1997. During this period, huge advances have been made in improving access to primary health care services and health outcomes. Ethiopia's health indicators have remarkably improved from one of the worst in Sub-Saharan Africa to among the outstanding performers.

Brief History of Nephrology in Ethiopia

The first organized renal care facility in Ethiopia was established in 1980 at the Tikur Anbessa Hospital, which is the main teaching hospital of the Addis Ababa University School of Medicine. The service was started with the assistance of a Nephrology team from the Institute of Nephrology, Havana, Cuba. The first hemodialysis (HD) was performed in 1980 and the first peritoneal dialysis (PD) in 1981 in the same unit. The unit provided dialysis for patients with presumed acute kidney injury (AKI) on an on-and-off basis depending on the availability of supplies. It remained the only dialysis providing unit in the country until maintenance HD was started in 2001 in a private hospital in Addis Ababa. Since then, a growing number of dialysis units have cropped up in Addis Ababa and other major cities in the country with all providing only HD. There is as yet no PD service in the country. The first kidney transplant (KT) was done in Ethiopia in September 2015 at the Saint Paul Millenium Medical College (SPMMC), the National Kidney Transplant Center designated by the Federal Ministry of Health [3]. Just over 100 KT, all living-related donor transplants have been done until July 2019.

The first Ethiopian nephrologist returned from training in the United Kingdom in 1982 and took over the Renal Unit at the Tikur Anbessa Hospital, from the Cuban team that started the first dialysis service in the country. The number of nephrologists in Ethiopia remained low until the 2000s when a number of physicians were able to get scholarships from the International Society of Nephrology (ISN). A total of six physicians received training through the ISN. These nephrologists were subsequently instrumental in the expansion of renal services and the launching of two local nephrology fellowship programs. There is not yet a National Society of Nephrology in Ethiopia.

Renal Diseases in Ethiopia

There are no national data on kidney diseases in Ethiopia based on epidemiological studies or registry data. Hence, the information available is from hospital-based studies from a few urban centers and estimates from international sources. It is generally assumed that kidney diseases, both acute and chronic, are common in Ethiopia given the double burden of diseases of poverty that continue to plague the population and the rising tide of non-communicable diseases (NCD).

Acute Kidney Injury and Critical Care Nephrology

Hospital-based studies in the 1990s indicated that the main causes of AKI among patients referred to tertiary care were septic abortion, severe malaria, and nephrotoxic medications [4, 5]. In a 4-year-long prospective observational study done between 1989 and 1992 among hospitalized patients in a teaching hospital in the capital Addis Ababa, septic abortion was the leading cause of AKI (52%). Falciparum malaria (21%) and nephrotoxic agents (9%) were the second and third most common causes. In this study, 86% of the patients required dialysis [4]. Another study done in 1990 in the same hospital showed that one-third of the patients with severe *P. falciparum* malaria developed AKI and 38% of them required dialysis [5].

In contrast to the reports from the 1990s, we have observed a significant change in the causes of AKI in the last two decades. A retrospective observational study of 151 patients, who were dialyzed in a teaching hospital in Addis Ababa between 2013 and 2015, demonstrated these changes. In this study, the vast majority of patients with AKI were young, less than 40 years of age, in contrast to the older population with AKI in Western country studies. Hypovolemia, acute glomerulonephritis (GN), and obstetric causes (mainly driven by preeclampsia and puerperal sepsis) were the three major causes of AKI. Malaria contributed to a much lower proportion of causes (7.3%) compared to the observations in the 1990s and septic abortion was a very rare cause of AKI (0.7%). The in-hospital mortality was 29%. This shift in epidemiology is likely to be due to the marked reduction in the incidence of malaria in Ethiopia and changes in the abortion law and practice [6].

Serum creatinine is not universally done among all hospitalized patients in the country, with the exception of a few teaching referral hospitals. This practice might be a result of lack of awareness, clinical inertia, cost, and limited access to the test. Two cross-sectional studies done a few years ago have confirmed this practice [7, 8]. The first study, done in three hospitals in different parts of the country, showed that patients admitted to medical wards are more likely to have their renal function tests checked when compared to those admitted to surgical or obstetrics-gynecology wards. Urine output monitoring was also not routinely done in most medical and surgical wards [7]. The second study, which was done in a single hospital in northwest Ethiopia, indicated that 32% of the patients admitted had no record of renal function measurement during their

hospitalization. These data indicate that there are lots of missed opportunities in detecting AKI among hospitalized patients in Ethiopia [8].

Intensive care units (ICU) are being established in most regions of the country but the majority of the hospitals where these units are located do not have any dialysis service. At best, patients in these ICUs may have a very limited access to a dialysis unit in a hospital in a nearby town. Continuous renal replacement therapy (CRRT) is not available in the entire country. For critically ill patients with AKI, intermittent HD with prolonged duration is occasionally used by some practitioners.

Chronic Kidney Disease

There is a huge information gap regarding chronic kidney disease (CKD) in Ethiopia. There are no population-based studies done on the prevalence, causes, and outcomes of CKD. Nonetheless, population-based surveys on non-communicable diseases and their risk factors indicate that the prevalence of the major risk factors of CKD, i.e., diabetes and hypertension is growing [9].

Using the WHO's STEPwise approach to Surveillance (STEPs), a nationwide, community-based survey was conducted in 2015 among 10,000 respondents aged 15–69 years. In this survey, the prevalence of raised blood pressure as defined by SBP >140 and/or DBP >90 mmHg was 15.6%. Additionally, 6% of the study population had increased blood glucose, as defined by a fasting capillary whole blood glucose level of ≥110 mg/dl or being on treatment for diabetes. The prevalence of diabetes mellitus (FBS >126 mg/dl), including those on medication, was 3.2% (3.5% males and 3.0% females) [9].

An old hospital-based observational study done in 1980 in a referral hospital in Addis Ababa reported the commonest cause of CKD to be chronic glomerulonephritis [10]. A recent cross-sectional study done in the same hospital with 247 CKD patients, in order to assess the management practice of CKD showed that hypertension, diabetes, and ischemic heart disease were present in 91%, 41.6%, and 13.4% respectively. Although this study was not specifically designed to investigate the causes of CKD, the findings indicate that diabetes and hypertension are very common comorbidities, and likely etiologies, among Ethiopian CKD patients [11]. The authors' observations in their regular clinical practice concur with the findings in the above-cited study. Diabetes and hypertension are presumed to be the leading causes of CKD in older adults while CKD of unknown etiology is common in younger adults.

The pre-dialysis care of patients with CKD in Ethiopia mainly constitutes management of proteinuria, high blood pressure, fluid overload, and cardiovascular risk reduction [11]. Treatment of anemia is generally inadequate due to inconsistency in the availability and the high cost of erythropoiesis-stimulating agents and intravenous iron. Oral iron is the most commonly used pharmacologic intervention for anemia. Management of CKD-MBD is also suboptimal due to limited availability of laboratories, which determine serum calcium, phosphorus, and PTH, besides the lack of access to calcium-based phosphate binders outside Addis Ababa. The only non-calcium-based phosphate binder, sevelamer chloride, has been made available in the Ethiopian market only in 2019 and yet its prohibitive costs prevent most patients from using it.

It has been observed that CKD awareness among patients at risk of kidney disease is quite low [12]. However, the authors believe that there is excessive fear among the public regarding kidney diseases. This is believed to be due to the influence of the media. Movies have been made based on stories of poor patients with end-stage renal disease (ESRD). Several calls for contributing money for individuals with ESRD, particularly for famous individuals, have been advertised by the media. As this is the commonest type of message passed through the media and as the diagnosis of ESRD is associated with catastrophic out-of-pocket health care expenditure, it has resulted in excessive fear of kidney disease among the general public. Counseling patients and family members about any kidney disease is, hence, a difficult exercise as it causes a lot of anxiety.

Other Kidney Diseases

Although glomerular diseases have not been very well characterized by systematically performed studies, they are common in the nephrology practice in the country. Referrals of patients to nephrologists by general practitioners or internists carrying a diagnosis of "clinical rapidly progressive GN", "acute GN", or "GN" are common. Unfortunately, we have not done studies to examine the causes of these glomerular diseases. In the few kidney biopsies we manage to do from time to time, we have seen all kinds of primary glomerular diseases including minimal change disease, focal & segmental glomerulosclerosis, IgA nephropathy, membranous nephropathy, and membranoproliferative GN. Lupus nephritis is a very common secondary glomerular disease that we see in our practice. Although HIV infection is quite common, we do not see the classic HIV-associated nephropathy clinical presentation in our population, i.e., massive proteinuria with big kidneys and normal blood pressure. This might be due to genetic reasons; a study among Ethiopian Jews in Israel has demonstrated the lack of the high-risk APOL1 variants [13].

An old light microcopy series of adult patients with the nephrotic syndrome treated in one hospital in Addis Ababa

reported membranoproliferative pathology to be the most common histopathology pattern. Amyloidosis was also reported in a substantial proportion of patients. Nonetheless, this report should be interpreted cautiously as no immunofluorescence or immunohistochemistry studies were done [14].

Urolithiasis is a common problem in Ethiopia. Stone kidney disease requiring urologic intervention accounts for 13.6–22% of the urologic admissions. Many of these patients have established CKD and stone kidney disease appears to contribute substantially to the CKD burden in Ethiopia [15, 16].

Pediatric Nephrology

Pediatric nephrology services are available in three hospitals in Ethiopia and there are five pediatric nephrologists certified.

AKI in Pediatrics

In a study in the early 2000s with 30 pediatric patients, post-diarrheal hemolytic uremic syndrome (HUS) diagnosed in 23 children was the leading cause of AKI. The mortality was very high at 46.7% [17].

A prospective, hospital-based study showed an AKI incidence of 12.7/1000. The presence of sepsis, heart failure, and cancer were the major risk factors identified [18].

In a recent retrospective review of the pattern of renal diseases in pediatric patients in Addis Ababa, kidney disease accounted for 3.3% of the 14,521 admissions. The three most common renal diseases observed were congenital anomalies of the kidney and urinary tract (CAKUT) seen in 127 children (26.8%), followed by nephrotic syndrome in 80 children (16.9%) and acute GN in 58 children (12.2%). Other renal diseases observed were urinary tract infection 8.0%, urolithiasis 6.7%, Wilms' tumor 6.3%, AKI 4.2%, and CKD 4.0%. Other less frequently detected diseases were bladder exstrophy, lupus nephritis, Henoch Schönlein purpura nephritis, and prune belly syndrome [19].

Renal Replacement Therapy in Ethiopia

Hemodialysis

HD has been available to a very small number of patients with ESRD in a few urban centers in the country for the last 20 years or so. There are about 800 patients on maintenance HD, spread across 25 small centers in the country. This makes the rate of HD at 7 per million population (pmp). Most of the centers are private facilities with a few government facilities providing the services. Patients pay out of pocket for the services as there are no insurance schemes or government funding that cover the costs of dialysis. The average cost of HD per session is 65 USD and that does not include the cost of medications.

The majority of the centers cater for patients with ESRD, with only a few providing dialysis for patients with AKI. The dialysis centers, in the few public hospitals where dialysis is available, provide dialysis for patients with presumed AKI at a very subsidized rate or free of charge depending on the patient's income. There are no use of convective therapies in Ethiopia.

Peritoneal Dialysis

There are no patients with ESRD on PD in Ethiopia. PD has been used for the management of patients with AKI, particularly children in the distant past and also recently at the Tikur Anbessa Hospital. The Saving Young Lives (SYL) initiative of the International Society of Nephrology (ISN) provided supplies and PD training during a few years. Services could not be maintained as there is no consistent supply of consumables.

Renal Transplantation

With the increasing burden of ESRD and public pressure, the government of Ethiopia decided to pilot a living donor kidney transplantation (KT) program in 2013 and selected Saint Paul's Hospital Millennium Medical College (SPMMC) in Addis Ababa for the implementation of the project. The University of Michigan from the United States of America became the external partner for the project. The project was started with the understanding that transplantation is a better and cheaper option for the management of ESRD. The project aimed to provide KT as a first option for the management of patients age 14 and above with ESRD, having hemodialysis as a bridge for transplantation. The collaboration with the University of Michigan was designed to build local competence in performing KT. After painstaking planning and preparation, the first-ever KT in Ethiopia was performed in September 2015. From September 2015 until July 2019, a total of 118 living-related KT have been performed. The 1-year graft and patient survival are 96% and 98%, respectively, while overall outcome to date is 92% graft and 95% patient survival. The standard immunosuppressive protocol used is a combination of tacrolimus, mycophenolate mofetil, and steroids after induction with basiliximab or

antithymocyte globulin depending on the immunologic risk assessment [3].

The center is able to do basic laboratory tests, drug levels, and has a renal pathology service that can process and interpret transplant biopsies. However, neither the center itself nor other labs in the country have the capacity to do HLA typing and crossmatch. Samples are, therefore, sent abroad for these tests. The center has succeeded in training transplant surgeons and supports the training of nephrologists, and has therefore reached self-sufficiency in terms of manpower.

The legal framework governing organ transplantation was established in January 2014 with the Federal Ministry of Health as the authority to prepare directives for organ transplantation. The current directive restricts donations among individuals related by blood or marriage and an independent national organ transplant committee approves each recipient–donor pair before surgery. To date, the government covers all the cost of pre-transplant evaluation, transplant surgery, and perioperative care while transplant patients must be able to pay for immunosuppressive medications that are provided to them at subsidized cost. All the immunosuppressive drugs available are generic medications. The social workers of the hospital provide help to needy patients by finding sponsors to assist the patients meet the cost of medications.

The transplant project is faced with several challenges, the most important of which are the precarious continuity of supplies and the underdeveloped infrastructure. Shortage of kidney donors is another major challenge as the regulations restrict donors to members of the family. The program is unable to offer transplant to sensitized patients and blood group incompatible pairs because of limited facilities and experience. To alleviate the shortage of donors, the option of paired kidney donations is being considered and the possibility of developing a deceased donor program is being explored.

Because the national transplant center cannot care for all patients who need KT, many patients still travel abroad with their donors for KT. There are currently an estimated 350 KT recipients nationwide.

Nephrology Practice in Ethiopia

Although big strides have been made in the provision of renal care in Ethiopia in the last few decades, there is no comprehensive national renal care program in Ethiopia and the service is provided in a policy vacuum and with no national financing plan in place.

There are 26 nephrologists in Ethiopia, including five pediatric nephrologists; and only five nephrologists work outside Addis Ababa, the capital city. There are two nephrology fellowship programs and one KT fellowship program in place. Most nurses in the dialysis units are not certified dialysis nurses, as there are no formal training programs in the country. Most of them get a few weeks of hands-on training during employment by those who have had some experience. Diagnostic services are quite limited including renal pathology, but recently a renal pathology service has been established at the SPMMC.

The few private hospitals and clinics with dialysis units as well as the stand-alone dialysis centers employ nephrologists on a part-time basis. Some dialysis units have no nephrologist to supervise and direct patient care. In those centers where there are no nephrologists, internists or general medical practitioners supervise. Full-time employment for nephrologists is available in public and, particularly, in teaching hospitals but not in the private sector. The average salary, in the public hospitals, for a nephrologist is 5500 USD per year. Due to the high living expenses almost all nephrologists work part-time in the private sector. The average salary for a dialysis nurse is 3100 USD per year. There are no dialysis provider companies operating dialysis units or group practices by nephrologists in Ethiopia, as is common in the developed countries. There is a market for experienced/trained dialysis nurses and technicians as such professionals are generally difficult to find.

Highlight of Nephrology in Ethiopia

The successful transplant project in Ethiopia that was a result of a collaborative effort between the SPMMC and the University of Michigan is an exemplary collaborative model that can be replicated in other developing countries. In a time span of just about 6 years, the collaboration made it possible to transplant over a hundred patients, to develop local workforce to do transplants, and to provide general nephrology service.

Future Perspectives of Nephrology in Ethiopia

Renal care is very likely to grow rapidly in Ethiopia given the increasing burden of kidney disease, the public demand for services, and the government's increasing attention to NCD. There is already an NCD policy expected to be implemented through programs that address NCDs in general as well as programs specific to each NCD. The Ministry of Health's determination to start a KT center and maintain it as well as its efforts to expand dialysis services is a testimony to the government's commitment. This, of course, should be directed by a well thought out comprehensive renal care policy and program as well as a financing strategy. The private (for-profit sector) has been in the lead in the provision of

dialysis services and in the years and decades to come, it is likely to continue as a major provider in the big urban areas.

Regarding the development of human resources for health care, there are already two nephrology fellowship training programs and the number of nephrologists is going to increase. There are also efforts underway to form the Ethiopian Society of Nephrology and this may become a reality very soon.

Conclusion

Although information on kidney disease which is based on well-designed studies or registry data is lacking in Ethiopia, kidney diseases of all types are common. There is a growing prevalence of NCD that are risk factors for CKD and so the incidence of CKD is expected to rise. The services available for patients with kidney disease are far from optimal but there is a significant improvement in the provision of services in the last two decades. This includes the establishment of a national KT program.

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