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Incidence of growth retardation in children with chronic renal failure

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Abstract:

Pediatric CKD is a gradual loss of kidney function that affects children. The incidence of CKD in Europe is around 11-12 per million for stages 3-5, with a prevalence of 55-60 per million. Children with CKD may experience growth impairment due to various factors. Optimizing diet, managing metabolic imbalances, and treating anemia and renal osteodystrophy can improve growth. Recombinant human growth hormone (rhGH) therapy may be necessary in some cases. Early renal transplantation is the main treatment for CKD.

Keywords: Pediatric CKD, Kidney function, Incidence, Prevalence, Growth impairment, Optimizing diet, Metabolic imbalances, Anemia, Renal transplantation

1. INTRODUCTION - CHRONIC RENAL DISEASE OF CHILDREN

Chronic kidney disease (CKD) is a major health problem worldwide. With the increase in its incidence and prevalence, it threatens to bring about the emergence of a real 'epidemic'. Regardless of the initial cause, CKD is a clinical syndrome characterized by a gradual loss of kidney function. In particular, the Kidney Disease Improving Global Outcomes (KDIGO) guidelines have defined CKD as an abnormality of kidney structure or function that is present for more than 3 months and has health implications. [1]

This definition was formulated for the adult population where CKD is a common and recognized health problem, but the KDIGO guidelines for definition and staging are not fully applicable to the pediatric population. Indeed, pediatric CKD, although it shares the underlying physiopathological mechanisms with the same disease in the adult population, is in some ways considered an independent nosological entity . Pediatric CKD presents clinical features that are specific and completely peculiar to the pediatric age, such as the negative impact of the disease on the growth of children. In addition, some of the typical characteristics of pediatric CKD, such as etiology or cardiovascular complications, represent variables that not only affect the patient's health during childhood, but also have an impact on the adult life that this child will have. . This influence is often underestimated but should not be neglected. Furthermore, CKD has a major psychosocial impact, both on the patient and his family. [1]

According to the National Kidney Foundation, there are five stages of chronic kidney disease [2] :

Stage 1: Kidney damage with normal or increased GFR (≥90)
Stage 2: Kidney damage with mildly decreased GFR (60-89)
Stage 3: Moderately decreased GFR (30-59)

Stage 4: Severely increased GFR (15-29)
Stage 5: Kidney failure (<15)

2. CLINICAL FEATURES OF CKD

Signs pointing towards Chronic Kidney Disease (CKD) tend to differ among children depending majorly on two factors which are how severe it is as well as why it occurred. Most common signs include decreased urine flow rates which could make one need to pee more often than usual. Other tell tale indications include swelling especially areas around the feet along with hands together with ones face indicating edema; BP might also shoot up; Lowered count of red blood cells may lead to Anemia while a delay in growth might also be noted alongside fatigue feelings and muscle cramps; Calcium or Potassium levels might be off leading to bone pain. These symptoms can go unnoticed until the disease has advanced; thus the importance of regular kidney function checks which encourages early detection of CKD for better management.

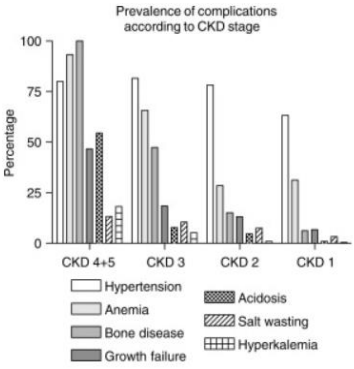

Fig. 2 [3]

CKD is an insidious disease. Although relatively uncommon in children, CKD can be a devastating disease with many long-term consequences (Figure 2 [3]). In fact, the mortality rate for children with ESRD receiving dialysis therapy is 30–150 times higher than in the general pediatric population, and life expectancy for a child on dialysis is ~50 years less than a healthy child. Kidney transplantation is characterized by a significant improvement in prognosis and is the best therapeutic option for children with ESRD. However, most of the complications of this clinical syndrome have consequences on patients' health before kidney function is irreversibly lost, even when it is maintained over time with conservative therapy. [1]

3. DIAGNOSIS AND TREATMENT OF CKD

Based on a child's health issues or symptoms, his or her pediatrician may perform the following tests [4] :

- *Urinalysis*: A child's urine will be collected to check for protein. Protein in the urine can be a sign of kidney damage.
- *Blood tests*: Blood tests can help show many things, including the level of kidney function, blood chemical levels, and red blood cell levels, which check

the kidneys. Sometimes, there are also specialized blood tests that can help diagnose specific kidney diseases such as lupus.

- *Ultrasound and X-rays*: Pictures of the kidneys help show any damage to the kidneys and surrounding structures. They can also hint at what caused the kidney problem.
- *Kidney biopsy*: A small piece of kidney tissue is removed and examined under a microscope to determine the cause and extent of kidney damage. [4]

Managing chronic kidney disease (CKD) in children requires a multi faceted approach that takes into account various aspects such as what stage they're at along with underlying factors. The overall goal is to slow down its progression while managing any associated symptoms/complications and supporting better overall health/well being. Treatment options commonly utilized for pediatric CKD include:

- *Medications*: Certain drugs may be used to keep blood pressure levels steady or address issues related to anemia/proteinuria.

- *Adjusting dietary habits*: A healthy balanced diet with optimal amounts of protein, calories and fluids can help slow down disease progression while also improving symptom control.

- *Dialysis*: In advanced stages of CKD, dialysis may be necessary to remove waste products and excess fluids from the body.

- *Transplantation*: Kidney transplantation is the preferred treatment option for children with end-stage kidney disease, as it can improve quality of life and increase life expectancy.

- *Growth hormone therapy*: Children with CKD may experience growth impairment due to various factors. Recombinant human growth hormone (rhGH) therapy may be necessary in some cases.

- *Management of complications*: Other complications of CKD, such as bone disease, anemia, and metabolic imbalances, may also require specific management strategies.- Management of CKD in children is typically a multidisciplinary approach involving a team of healthcare professionals, including a nephrologist, dietitian, social worker, and other specialists as needed.

4. NEW OPPORTUNITIES IN CKD TREATMENT

Nanotechnology has shown potential for use in the treatment of chronic kidney diseases (CKD) due to its ability to target specific cells and tissues. Some of the possible applications of nanotechnology in CKD treatment include drug delivery, imaging, and diagnosis. One approach involves the use of nanocarriers to deliver drugs directly to the kidneys. These nanocarriers can be engineered to release the drug at a specific location or in response to a specific stimulus, such as a change in pH or temperature. This targeted drug delivery could reduce the amount of drug needed and minimize side effects. Nanoparticles have also been developed for use in kidney imaging. These particles can be designed to bind to specific molecules or cells within the kidney, allowing for improved visualization of kidney function and structure. Another potential application of nanotechnology is in the development of biosensors for monitoring kidney function. These biosensors could detect changes in biomarkers associated with CKD, allowing for earlier diagnosis and intervention. Overall, nanotechnology offers promising possibilities for the development of new treatments for CKD. However,

further research is needed to fully understand the potential benefits and risks of these approaches.

As the technology is breaking every border possible, people are getting worried and worried because of it"s big impact on everyday lives.Nanoparticles have also been examined for their impact on the heart and blood vessels. More specifically, the arming of nanotechnology could be feasible. It will be easier to develop nuclear bombs and new weapons. One alternative is the so-called "smart bullet, "a machine bullet that is very precisely tracked and targeted. These inventions can prove to the military's advantage, but the consequences are serious if they fall into the wrong hands. [5]

5. ETIOLOGY OF GROWTH IMPAIRMENT IN CHILDREN WITH CKD

The effects of chronic kidney disease (CKD) on a childs ability to grow are considerable since this condition is tied into numerous essential functions performed by the kidneys themselves - such as maintaining nutrient balances needed for optimal growth supporting hormone levels required for proper development (erythropoietin) and facilitating correct use of key factoring hormones like growth hormones. Should the kidneys become damaged the outcome can be a host of mineral deficiencies and bone disorders. Additionally there may be imbalances in the body such as electrolyte levels or acidity that hinder proper hormone usage or further complicate concurrent conditions like drug toxicity, inflammation or hypogonadism. Often times CKD responsive treatment begins with dietary modifications aimed at optimizing nutritional uptake and metabolic regulation to manage common ailments such as anemia and renal osteodystrophy. For some patients recombinant human growth hormone therapy is used to address impaired bone density formation. Despite these measures renal transplantation remains the primary treatment for CKD in children. By understanding healthy kidney functions and how they help support typical childhood growth patterns we can help families grapple with underlying reasons behind their childs impaired development from chronic kidney disease.

6. STRATEGIES TO OPTIMIZE GROWTH

Preservation of renal function and dialysis - To optimize growth, it is important to maintain normal GFR levels and provide adequate dialysis in children requiring dialysis. Treatment of elevated blood pressure and proteinuria is also crucial. The use of inhibitors of the renin-angiotensin aldosterone system can help improve blood pressure and proteinuria in children with CKD. Additionally, avoiding nephrotoxic medications and treating urinary tract infections in children with CAKUT can help preserve renal function and improve growth.

Nutrition - Adequate caloric intake is crucial to prevent growth failure, and renal dietitians should counsel patients and families, especially when supplemental nutrition is required. Tube feeding may be recommended in infants and young children not achieving adequate energy intake. Energy intake in children with suboptimal weight gain should be adjusted toward the higher end of the suggested dietary intake. To promote optimal growth, protein intake in children with CKD should be at the upper end of the suggested dietary intake.

Correction of anomalies with Acid-Base / Electrolytes - Metabolic acidosis is associated with poor growth in children with CKD. Therefore, metabolic acidosis should

be corrected by aiming for serum bicarbonate levels equal to or above 22 mEq/L. This can be ensured by sodium bicarbonate treatment and/or the use of bicarbonate- or lactate-based dialysis solutions in dialysis patients. Water and/or electrolyte supplementation is often required in polyuric patients and those with salt-wasting nephropathy. It is important to note that young children on peritoneal dialysis often require supplementation with large amounts of sodium chloride, as significant losses (ie, 2-5 mmol/kg body weight) may occur through peritoneal ultrafiltration. [6]

Physical activity - Reduced physical activity is a common characteristic among children afflicted with CKD, which has been associated with abnormal markers responsible for bone formation and remodeling within their serum. Despite evidence showing that endurance exercise could enhance bone formation within young individuals who underwent subtotal nephrectomy procedures data on similar outcomes among those diagnosed with CKD is scarce

Growth Hormone Treatment- Treatment with recombinant human growth hormone (rhGH) has been shown to improve adult height in short children with CKD. [6] It is able to increase height velocity and height SD score (SDS) value and significantly improve final height in CKD patients. [7] Positive results from initial clinical trials have been confirmed by several large, prospective, observational and registry studies, underscoring the importance of its use in this population in order to improve growth outcome. Clinical practice recommendations for the use of rhGH in pediatric patients have been provided by various expert committees. Infants and early childhood are the most sensitive stages for the stunting effects of CKD, which is at least partially related to GH insensitivity. Any impairment of growth velocity during these stages can result in profound growth impairment. Furthermore, catch-up growth after correcting reversible causes of growth impairment and starting other measures, including rHGH, may not be complete and there is irreversible loss of growth potential. Catch-up growth caused by RhGH is associated with good glomerular filtration, average height as the parents and is negatively correlated with the patient's age. Therefore, rhGH should be started as soon as possible, the moment growth impairment becomes apparent. [6]

Transplantation - Kidney transplantation corrects many of the metabolic and endocrine disorders contributing to stunted growth in children with CKD, but catch-up growth is usually seen only in young children. As a matter of fact studies have demonstrated that postponing steroid withdrawal among patients undergoing calcineurin inhibitor and mycophenolate mofetil therapy has led to better growth rates in those without steroid intake. However noteworthy catch up growth was solely identified in subjects prior to reaching puberty. Early withdrawal or avoidance of steroids may result in better growth outcomes.

7. CONCLUSION

Although progress has been made in treating children with chronic kidney disease (CKD) theres still an increase in the number of individuals diagnosed with stunted growth due to this ailment. Optimizing nutrition providing aggressive dialysis treatment administering recombinant human growth hormone (rhGH) therapy or performing a kidney transplant are among the strategies we use to help these kids grow. Studies reveal that as CKD advances it may become increasingly likely for these children to experience stunted growth. However dialysis or transplantation typically lead to improvements in their rate of growth. Additionally delayed steroid withdrawal

combined with calcineurin inhibitor and mycophenolate mofetil has given promising results. Early rhGH therapy and preventive immunosuppressive measures are crucial components of care for pediatric kidney allograft recipients seeking improved outcomes regarding their rate of growth and overall health status. By taking these steps we can work towards normalizing body proportions and ensuring healthy growth.

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