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Raising Awareness: Polycystic Kidney Disease

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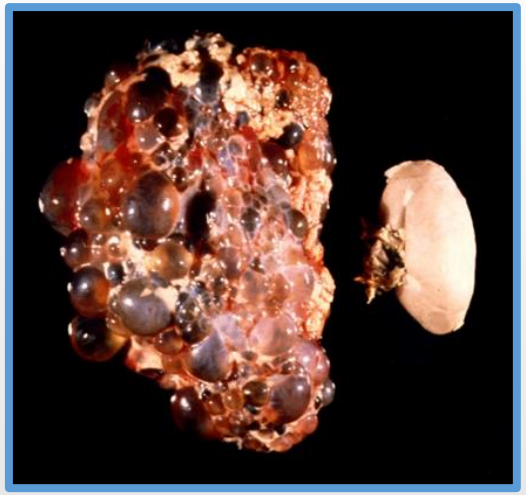
Introduction

A young male patient was recently admitted to the intensive care unit at a local hospital with hypertensive urgency and acute renal failure of unknown etiology. A renal ultrasound showed polycystic kidneys and upon further investigation, it was discovered that the patient's mother passed away last year from end stage renal failure related to polycystic kidney disease (PKD). The aforementioned case and the recent study into inherited disorders are what prompted further investigation into PKD. Liebau and Serra (2013) explain that "inherited cystic kidney diseases, autosomal dominant polycystic kidney disease (ADPKD) and autosomal recessive polycystic kidney disease (ARPKD), are the most common monogenetic causes of end-stage renal disease (ESRD) in children and adults" (p. 1771). It is estimated that one in a thousand individuals will be diagnosed with PKD in adulthood and one in twenty thousand in childhood (Liu et al, 2012, p. 1). Considering this statistic, patients with PKD may be seen throughout all facets of health care. As a health care provider, primary or otherwise, it is important to educate and appropriately treat PKD patients in an effort to prevent unnecessary damage to their bodies related to complications of the disease. The utilization of genetic testing is not standard treatment, but may pose some benefits to certain at risk patients in identifying the disease. However, healthy lifestyle choices are necessary in order to slow disease progression.

Pathophysiology

Eisenberger, et al. (2015) state that "renal cysts are clinically and genetically heterogeneous conditions" (p. 1). ADPKD is the most commonly diagnosed form of PKD and is typically diagnosed during adulthood; it results from a mutation in either of two genes, PKD1, which encodes polycystin 1 (PC1) or PKD2, which encodes polycystin 2 (PC2), both of which are membrane proteins (Reed-Gitomer, 2014, p. 17). Srivastava and Patel (2014) explain that "mutations of PKD 1 (eight-five percent of cases) or PKD 2 (fifteen percent of cases) can lead to signal dysregulation and increased levels of cyclic adenosine monophosphate, culminating into cytogenesis. Given the dominant nature of transmission, there is at least a fifty percent probability that a child of an affected parent will inherit the disease. A spontaneous mutation causes ADPKD in five percent of cases" (p. 303). It is difficult to determine genetic mutations for ADPKD early on due to the sizes and structures of PKD 1 and 2. Since the detection of the aforementioned genetic mutations can be difficult, genetic testing can be costly for patients. Definitive diagnosis of PKD is based on two factors, a positive family history and an age-specific cystic renal phenotype (Bataille, Berland, Fontes, & Burtey, 2011, p. 1). During genetic testing, DNA linkage and gene-based sequencing/mapping are utilized for the diagnosis of ADPKD (Pei, 2011, p. 19). Once an adult is diagnosed with PKD, it is easier to isolate the genetic mutation and test younger generations for the same anomalies.

ADPKD manifests as fluid-filled cystic dilation of renal tubules. Chang and Ong (2013) state that "cyst initiation and expansion arise from a combination of abnormal cell proliferation, fluid secretion, and extracellular matrix defects and results in kidney enlargement and interstitial fibrosis" (p. 524). Current research suggests that the primary reason behind renal cyst formation in both ADPKD and ARPKD is related to defects in cilia-mediated signals (Halvorson, Bremmer, and Jacobs, 2010). The gene products, polycystin 1 and 2, that are affected in ADPKD, regulate the growth of the epithelium in the renal tubules. The genetic defects associated with PKD affect the formation of the epithelial cells and the cilium, resulting in the formation of cysts. The presence of cilia is found on almost all surfaces of nephron cells, which means that cysts have the potential to form on these areas as well. In PKD, the "function of the primary cilium is impaired, resulting in the disruption of a number of intracellular signaling cascades that produce dedifferentiation of cystic epithelium, increased cell division, increased apoptosis, and loss of resorptive capacity" (Halvorson, Bremmer, & Jacobs, 2010, p. 73). As cysts form and grow, they compress the renal vessels and obstruct their flow, this ultimately leads to intracellular ischemia and the activation of the renin-angiotensin-aldosterone system (RAAS); which will eventually lead to progressive cyst growth, renal fibrosis, increased systemic vascular resistance, and the retention of sodium (Halvorson, Bremmer, & Jacobs, 2010, p. 74). The destruction of the renal parenchyma and the loss of functioning nephrons that result from this process is irreversible. The abnormal function of polycystin 1 and 2 also plays a role in vascular manifestations, due to the fact that these gene products may be expressed in the vascular endothelium and smooth muscle. Polycystin 1 and 2 are affiliated with a receptor-ion channel complex on the membranes of cilia, resulting in calcium dependent signals (Halvorson, Bremmer, & Jacobs, 2010, p. 74). When the polycystins present with defects, intracellular calcium homeostasis is affected which produces "alterations of endothelium-dependent relaxation and increased systolic blood pressures" (Halvorson, Bremmer, & Jacobs, 2010, p. 74).



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Clinical Manifestations

The enlarging kidneys of PKD progress over decades, which leads to renal failure in the majority of patients by age sixty (Ma, Tian, Igarashi, Pazour, & Somlo, 2013, p. 1004). Many patients are asymptomatic until later in life; most are diagnosed between the ages of thirty and forty. The gradual loss of nephrons related to the formation and increasing size of cysts is not usually detectable during the first few decades of life. (Srivastava & Patel, 2014, p. 303). The presentation of the disease varies based on the presence of other comorbidities. Early signs or symptoms include:

- Flank or abdominal pain
- Macroscopic hematuria
- Frequent urinary tract infections (UTIs)
- Early-onset hypertension

PKD patients are at a higher risk for:

- UTIs
- Renal stones
- Intracranial aneurysms
- Gross hematuria
- Abdominal manifestations, such as cysts that may appear on surrounding organs
- Renal dysfunction
- Cardiac complications associated with hypertension

The preferred diagnostic tools are imaging studies. Ultrasonography is the preferred method due to its cost effectiveness, however magnetic resonance imaging (MRI) or computed tomography (CT) scans are more sensitive. Once a patient is diagnosed, the best option is to adopt healthy lifestyle choices in an attempt to slow disease progression and minimize the risk of developing other comorbidities.

Implications for Nursing Practice

As a primary health care provider it is important to obtain a detailed family history as well as an in depth evaluation of the patient, including signs, symptoms, social behaviors, diet, etc. The focus of nursing care provided to PKD patients is education; key topics include exercise, diet, and general compliance. Adequate exercise and an appropriate diet are important components in almost any disease process. PKD patients should have a diet that is low in cholesterol to reduce cardiovascular risks, as well as lowering the intake of proteins, phosphorus, sodium, and potassium in an effort to preserve renal function and prevent further renal injury (Maditz, Gigliotti, & Tou, 2013, p. 803). Primary modalities of treatment are related to disease-related symptoms, such as hypertension and pain. It is extremely important for PKD patients to monitor their blood pressure frequently and maintain medication compliance in regards to hypertension, if applicable. Once PKD has progressed to ESRD, patients will likely require hemodialysis and/or a renal transplant. However, over the last few years, a variety of clinical trials with regards to slowing the progression of PKD have made advances in the field (Reed-Gitomer, 2014, p. 177).

Conclusion

In the grand scheme of diseases, PKD is considered rare. However, once it is diagnosed the complications that can/will result from it are life threatening. PKD is frequently misdiagnosed because many of the signs and symptoms that go along with it are similar to other ailments/diseases, such as primary hypertension or a typical UTI. Once a patient is diagnosed with PKD, he or she must be educated on the disease itself, complications that may arise, and diet recommendations. Efforts must be made to decrease risks to the cardiovascular system as well, including smoking cessation if necessary and adequate exercise routines. If it is determined that the patient has ADPKD, it may be beneficial to perform gene mapping on his or her siblings as well as his or her children if applicable. Renal failure is an inevitability in PKD, how quickly a patient gets to that point is up to him or her and their primary care provider.

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