Case report: Localized xanthogranulomatous pyelonephritis in children: A case report and literature review

Qi-Fei Deng, Han Chu, Bo Peng, Xiang Liu and Yong-Sheng Cao*

The Second Department of Pediatric Urology Surgery, Anhui Provincial Children’s Hospital, Children’s Hospital of Fudan University-Anhui Campus, Hefei, China

Background: Xanthogranulomatous pyelonephritis (XGPN), which is featured by inflammatory destruction of renal parenchyma and fibrosis of kidney, occurs mainly among adults, sporadically among children and rarely among infants. Recurrent urinary tract infections, kidney stone-induced obstructive nephropathy, malnutrition, abnormal lipid metabolism, hypoimmunity, lymphatic obstruction and congenital urinary abnormalities may all cause XGPN among children. Its primary treatment is radical nephrectomy.

Case description: In this study, we describe a rare case of XGPN in a 7-year-old boy infected with Staphylococcus aureus (S. aureus). The child presented with symptoms including recurrent fever, urine culture negative. The postoperative pathology confirmed XGPN. Besides, partial nephrectomy was performed.

Conclusion: XGPN, as a special type of chronic pyelonephritis, is a rare pyelonephritis requiring surgical treatment. Early diagnosis and treatment are crucial to reducing its morbidity and mortality. Although radical nephrectomy is the primary therapeutic option for patients with XGPN, partial nephrectomy surgery should be considered for focal XGPN, aiming to preserve residual renal function in children as far as possible.

KEYWORDS: xanthogranulomatous pyelonephritis, diagnosis, treatment, pediatric, partial nephrectomy

Introduction

Xanthogranulomatous pyelonephritis (XGPN) is a rare and severe chronic granulomatous inflammatory disease of the kidney characterized by substantial infiltration of inflammatory cells and granulomas into the renal parenchyma (1). Its prevalence is low among children, while relatively high among adults. To the present, the number of child cases is less than 300 (2). The etiology of XGPN remains unclear, and it is mostly believed that the urinary flow obstruction and chronic bacterial infection are associated with the development of XGPN (3). The clinical manifestations of XGPN are non-specific, including unexplained fever, abdominal pain, weight loss, anemia or palpable renal mass (4). In this study, we describe a case of XGPN in a child with S. aureus infection who underwent kidney-sparing surgery.
Clinical case

A 7-years-old boy was admitted to the Infectious Department of our hospital on June 21 of 2021 due to “repeated fever for over half a month”. Half a month ago, the child had repeated fever without obvious inducement, whose body temperature was up to 39 °C. Before the fever, he did not have symptoms like chills, convulsions, runny nose cough, rash, skin infection, vomiting, diarrhea or joint pain. Ultrasound at a local hospital suggested a right renal cystic mass. The child received anti-infective therapy for half a month at a local hospital, which yielded undesirable control of body temperature. During the disease course, the child's weight drop by 1–1.5 kg, good mental state, defecation once weekly and normal urination. Post-admission routine examination: 2021.06.22 WBC 14.51*10^9/l; NEUT 68.80%; CRP 57.7 mg/l; ESR 86 mm/h; PCT 0.091 ng/ml; IL-6 54.630 pg/ml; blood and urine cultures (-); mycobacterium tuberculosis antibody (-); liver + kidney functions, electrolytes and urine routine found no obvious abnormalities, and five tumor biomarkers were normal. On 2021.07.05 WBC 13.72*10^9/l; NEUT 69.2%; CRP 36.81 mg/l; ESR 81 mm/h; PCT 0.153 ng/ml; IL-6 45.46 pg/ml. Urinary ultrasound on admission revealed a heterogeneous echo mass (about 5.5 × 4.3 × 4.2 cm in size) at the upper pole of the right kidney extending to the middle, with several scattered flaky liquefactions inside it, and the lesions showed point–strip blood flow signals. The lower half of the kidney was normal, the right perirenal fascia was swollen, while the left kidney showed no abnormalities. In terms of imaging examination, contrast-enhanced CT revealed heterogeneous density of the upper pole of the right kidney, with slightly enlarged shape (Figures 1A,B). The renal parenchymal density enhancement was less intense after enhancement, and scattered low-density foci and peripheral annular enhancement were observed. No hydropneumorh or ureteral dilatation was noted. MRI: The mass in the upper pole of the right kidney had heterogeneous signal and unclear boundary, with scattered lacunae inside it (Figure 1C). The heterogeneous enhancement was delayed after enhancement, and the perirenal fascia was thickened. On 2021.07.02 Urinary ultrasound examination revealed the heterogeneous density of the upper pole of the right kidney were heterogeneous and had slightly hyperechoic areas (infection plus partial liquefaction was considered). The acoustic transmission inside the hyperechoic areas was poor, and there was no good puncture zone.

Discussion

XGPN is an extremely rare and severe chronic pyelonephritis, with only 200~ child cases to date. The report of XGPN was first launched by Schlag-enhauser in 1916, and it was not until 1944 that Osterlind started to use this term (5). The etiologies of XGPN are diverse, such as recurrent urinary tract infections (Escherichia coli, Proteus mirabilis and rarely Pseudomonas), kidney stone-induced obstructive nephropathy, malnutrition, abnormal lipid metabolism, altered immune responses and lympathic obstruction. Congenital urinary abnormalities have been reported to predispose individuals to this rare infection of the renal parenchyma (6). Admission to the hospital for medical history, defecation once weekly, CT showed residual rectal stool. The child was diagnosed with constipation, and there was an increased risk of recurrent urinary tract infection. No urinary calculi, congenital malformations of urinary system and previous history of urinary tract infection were found. Hence, this disease was not considered, where further exploration was needed.
The clinical manifestations of XGPN are non-specific and diverse, including abdominal pain, weight loss, fever, anemia, symptoms of lower urinary tract infection, abdominal mass and hematuria (7). The study of Stoica I et al. on 66 children with XGPN found that the most common clinical symptoms were low back pain, systemic disease, fever and urinary tract infection, and these non-specific symptoms were present in over half of the patients (8). Based on a study by Al-Ghazo et al., XGPN was associated mostly with the urinary tract obstruction and bacterial infection. Its early clinical symptoms
According to relevant studies, for over half of the patients, xanthogranulomatous pyelonephritis (XGPN) and corresponding pathological features include the involvement of various inflammatory components (e.g., neutral granulocytes, lymphocytes, plasma cells, cholesterol clefts and multinucleated giant cells), of which the foam cells are specific diagnostic indicators (17). Since the XGPN has low incidence and its clinical and imaging manifestations lack specificity, its diagnosis rate is low. In addition, the disease is often detected in the late stage, with a high rate of nephrectomy.

The therapeutic measures of XGPN are classified into the conservative and surgical treatments. Conservative treatments are primarily antibiotic therapies. It is recommended to select antibiotics based on the susceptibility tests. Extended-spectrum penicillins (e.g., piperacillin-tazobactam), cephalosporins (ceftriaxone or cefotaxime) and ampicillin + gentamicin are all appropriate therapeutic options. Considering the safety of pediatric medication, cephalosporins and extended-spectrum penicillins are generally used. A study carried out Kim et al. found that for children with mild XGPN, antibiotic therapy could achieve full rehabilitation. Conservative treatment usually lasts for approximately 2 weeks. If the high fever persists and the condition shows insignificant improvement, surgery should be considered (18). Depending on the disease type, antibiotics + partial nephrectomy are generally adopted for focal XGPN, while nephrectomy is generally adopted for diffuse XGPN. Partial nephrectomy is curative in localized forms of XGPN. Due to the extensive perinephric inflammatory adhesions, excision of the perirenal soft tissues is of paramount importance. Nonetheless, XGPN is mostly discovered in the late stage, for which nephrectomy is the primary surgical procedure, in accordance with multiple retrospective studies (8, 9). Xie et al. found that 28~ days of preoperative antibiotics could reduce postoperative complications prominently (19). Thus, early diagnosis and treatment are particularly crucial to protecting the renal function of children. For the child patient in the present case, the contrast-enhanced CT revealed ring enhancement around the upper pole mass of the kidney, so tumor could not be excluded. He had persistent fever, and the nature of the mass in upper renal pole could not be determined. Due to the poor efficacy of anti-infective therapy, surgical exploration was adopted for completely removing the lesions in the upper renal pole. After excluding malignancy, the normal kidney was preserved.

Although postoperative pathology showed a good prognosis, the risk of urinary tract infection, hypertension, renal amyloidosis was still increased. Long-term follow-up should be performed after surgery, especially in the pediatric population.

**Conclusion**

As a rare chronic inflammatory disease, XGPN seldom occurs among children and is easily misdiagnosed. Its
preoperative diagnosis remains a big challenge, especially in the case of focal type. Although the clinical diagnosis can be assisted by the increasingly accurate ultrasound B and CT, the final diagnosis needs to rely on histopathology. Antibiotic therapy and nephrectomy are the mainstays of treatment for XGNP, but among pediatric patients, partial nephrectomy remains practical. Individualized therapeutic regimens are crucial, especially for children.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Written informed consent was obtained from the individual(s), and minor(s)’ legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

Author contributions

Y-SC and Q-FD: conception and design. HC: collection and assembly of data. XL and BP: data analysis and interpretation. All authors writing the manuscript and final approval of manuscript.

Funding

This study was supported by Anhui Provincial Health Commission. The funding body played no role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher’s note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

1. Sangüesa Nebot C, Pico Aluiga S, Serrano Durba A, Roca MJ. Xanthogranulomatous pyelonephritis in children. Insights Imaging. (2018) 9:643–51. doi: 10.1007/s13244-018-0631-4
2. Nandedkar SS, Malakani K, Sakhi P. Xanthogranulomatous pyelonephritis masquerading as a tumor in an infant. Indian J Urol. (2011) 27:64–8. doi: 10.4103/0970-1591.80680
3. Bolger MP, Henneberry J, Byrne C, Greene L, Stroescu A, Heneghan J. Xanthogranulomatous pyelonephritis: a narrative review with current perspectives on diagnostic imaging and management, including interventional radiology techniques. Int J Nephrol Renovasc Dis. (2021) 14:359–69. doi: 10.2147/IJNRD.S236552
4. Li L, Parwani AV. Xanthogranulomatous pyelonephritis. Arch Pathol Lab Med. (2011) 135:671–4. doi: 10.5858/2009-0769-RSR.1
5. Xanthogranulomatous pyelonephritis. Lancet. (1985) 2:649–50. doi: 10.1016/S0140-6736(85)90011-X
6. Craig WD, Wagner BJ, Travis MD. Pyelonephritis: radiologic-pathologic review. Radiographics. (2008) 28:255–77. doi: 10.1148/rg.281075171
7. Bingöl-Kologlu M, Ciftçi AO, Senocak ME, Tanyel FC, Karnak I, Büyükşanlı N. Xanthogranulomatous pyelonephritis in children: diagnostic and therapeutic aspects. Eur J Pediatr Surg. (2002) 12:42–8. doi: 10.1055/s-2002-25085
8. Stoica I, O’Kelly F, McDermott MB, Quinn FMI. Xanthogranulomatous pyelonephritis in a paediatric cohort (1963-2016): Outcomes from a large single-center series. J Pediatr Urol. (2018) 14:169.e1–169.e7. doi: 10.1016/j.pjpurol.2017.10.017
9. Al-Ghazo MA, Ghalayini IE, Mattała BI, Al-Kaissi NS, Khader YS. Xanthogranulomatous pyelonephritis: Analysis of 18 cases. Asian J Surg. (2006) 29:257–61. doi: 10.1016/S1015-9584(06)00099-3
10. Übetagöneya M, Fernandez MM, Gondra SL. Xanthogranulomatous Pyelonephritis in children. Arch Esp Urol. (2014) 67:214–7.

11. Çalışkan S, Özyoz E, Kaba S, Koca O, Öztürk Mİ. Xanthogranulomatous Pyelonephritis. Arch Iran Med. (2016) 19:712–4.
12. Ergun T, Akin A, Lakadamayali H. Stage III xanthogranulomatous pyelonephritis treated with antibiotics and percutaneous drainage. J Belg Soc Radiol. (2011) 94:209–11. doi: 10.5334/jbr-b.660
13. Artiles-Medina A, Lasso-García I, Lorca-Álvarez J, Mata-Alcaraz M, Duque-Ruiz G, Hevia-Palacios M, et al. Xanthogranulomatous pyelonephritis: a focus on microbiological and antibiotic resistance profiles. BMC Urol. (2021) 21:56. doi: 10.1186/s12894-021-00880-z
14. Smith EA, Slyn N, Wan J, McHugh J, Dillman JR. Xanthogranulomatous pyelonephritis: an uncommon pediatric renal mass. Pediatr Radiol. (2010) 40:1421–5. doi: 10.1007/s00247-009-0153-4
15. Tsi KH, Lai MY, Shen SH, Yang AH, Su NW, Ng YY. Bilateral xanthogranulomatous pyelonephritis. J Clin Med Assoc. (2008) 71:310–4. doi: 10.3389/fped.2021.757377
16. de Carvalho LG, Kobayashi T, Cypriano MDS, et al. Diagnostic Errors in Wilms’ Tumors: Learning From Our Mistakes. Front Pediatr. (2021) 9:757377. doi: 10.3389/fped.2021.757377
17. Jones P, Lazic D, Somani BK, Hawary A. Xanthogranulomatous pyelonephritis: an overview and management guide for clinicians. Br J Hosp Med. (2021) 82:1–8. doi: 10.12968/hmed.2020.0656
18. Kim SW, Yoon BII, Ha US, Sohn DW, Cho YH. Xanthogranulomatous pyelonephritis: clinical experience with 21 cases. J Infect Chemother. (2013) 19:1221–1224. doi: 10.3389/fped.2022.01429