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OPIS PRZYPADKU
CASE REPORT

Iatrogenic Cushing's syndrome caused by local steroid use due to recurrent gingivitis in the boy with chronic kidney disease after heart transplantation

Jatrogenny zespół Cushinga spowodowany miejscowym stosowaniem steroidów z powodu nawracającego zapalenia dziąseł u chłopca z przewlekłą chorobą nerek po przeszczepie serca

Karolina Czyżowska, Małgorzata Stojewska, Agnieszka Zachurzok, Maria Szczepańska

Department of Paediatrics, Faculty of Medical Sciences in Zabrze, Medical University of Silesia, Katowice, Poland

ABSTRACT

Multimorbidity in pediatrics, defined as the coexistence of at least two chronic diseases or developmental disorders in a single patient, poses an increasing clinical, diagnostic, and therapeutic challenge. This phenomenon is associated with medical advancements that enable the survival of children with severe diseases, but at the same time increase the risk of organ damage and adverse effects of long-term treatment. This manuscript presents the case of a 16-year-old boy who had dilated cardiomyopathy since birth, treated with a heart transplant in early childhood, chronic kidney disease, recurrent gingivitis, short stature, delayed puberty, and iatrogenic Cushing's syndrome. The patient was diagnosed for short stature and delayed puberty. His medical history has revealed long-term, cyclical use of topical hydrocortisone on the oral mucosa due to recurrent gingivitis following the initiation of immunosuppressive therapy. Physical examination revealed Cushingoid features, abnormal fat distribution, delayed sexual development, and significant bone age delay. Laboratory tests revealed decreased morning cortisol levels, partially preserved adrenal reserve in the Synacthen test, and normal growth hormone secretions in the glucagon stimulation test. The overall clinical picture indicated iatrogenic Cushing's syndrome with secondary suppression of the hypothalamic-pituitary-adrenal axis. An attempt was made to discontinue hydrocortisone, further endocrinological evaluation was planned, and prophylactic steroid supplementation was recommended for stressful situations. This case demonstrates that even topically applied glucocorticosteroids can lead to serious systemic complications, especially in children with multimorbidity, which justifies the need for close therapeutic monitoring and coordinated multidisciplinary care.

KEYWORDS

multimorbidity, chronic kidney disease, gingivitis, cardiomyopathy, short stature, heart transplantation, delayed puberty, iatrogenic Cushing's syndrome, topical steroids

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Address for correspondence: prof. dr hab. n. med. Maria Szczepańska, Katedra i Klinika Pediatrii, Wydział Nauk Medycznych w Zabrzu ŚUM, ul. 3 Maja 13/15, 41-800 Zabrze, tel. +48 32 380 43 05, e-mail: mszczepanska@sum.edu.pl

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STRESZCZENIE

Wielochorobowość w pediatrii, definiowana jako współwystępowanie co najmniej dwóch przewlekłych chorób lub zaburzeń rozwojowych u jednego pacjenta, stanowi coraz większe wyzwanie kliniczne, diagnostyczne i terapeutyczne. Zjawisko to wiąże się z postępem medycyny, umożliwiającym przeżycie dzieci z ciężkimi chorobami, ale jednocześnie zwiększającym ryzyko powikłań narządowych oraz działań niepożądanych długotrwałego leczenia. W pracy przedstawiono przypadek 16-letniego chłopca, od urodzenia z kardiomiopatią rozstrzeniową, leczoną przeszczepieniem serca we wczesnym dzieciństwie, z przewlekłą chorobą nerek, nawracającymi zapaleniami dziąseł, niskorosłością, opóźnionym dojrzewaniem płciowym oraz jatrogennym zespołem Cushinga. Pacjent był diagnozowany z powodu niskorosłości i opóźnionego dojrzewania płciowego. W wywiadzie zwracało uwagę wieloletnie, cykliczne stosowanie miejscowego hydrokortyzonu na błonę śluzową jamy ustnej z powodu nawrotowych zapaleń dziąseł, występujących po włączeniu leczenia immunosupresyjnego. Badanie przedmiotowe wykazało cechy cushingoidalne, nieprawidłowy rozkład tkanki tłuszczowej, opóźniony rozwój cech płciowych oraz znaczne opóźnienie wieku kostnego. W badaniach laboratoryjnych stwierdzono obniżone stężenie porannego kortyzolu, częściowo zachowaną rezerwę nadnerczową w teście z Synacthenem, prawidłowe wydzielanie hormonu wzrostu w teście stymulacyjnym z glukagonem. Całość obrazu klinicznego wskazywała na jatrogenny zespół Cushinga z wtórną supresją osi podwzgórze–przysadka–nadnercza. Podjęto próbę odstawienia hydrokortyzonu, zaplanowano dalszą ocenę endokrynologiczną oraz zalecono profilaktyczną suplementację steroidów w sytuacjach stresowych. Opisany przypadek dowodzi, że nawet miejscowo stosowane glikokortykosteroidy mogą prowadzić do ciężkich powikłań ogólnoustrojowych, zwłaszcza u dzieci z wielochorobowością, co uzasadnia konieczność ścisłego monitorowania terapii i skoordynowanej opieki wielospecjalistycznej.

SŁOWA KLUCZOWE

wielochorobowość, przewlekła choroba nerek, zapalenie dziąseł, kardiomiopatia, niskorosłość, przeszczepienie serca, opóźnione dojrzewanie płciowe, jatrogenny zespół Cushinga, steroidy stosowane miejscowo

INTRODUCTION

In pediatrics, multimorbidity is defined as the coexistence of at least two chronic diseases or developmental disorders in a single patient. Although this phenomenon is traditionally associated with the elderly population, it is becoming increasingly common among children and adolescents [1]. Multimorbidity results from both medical advances and the changing epidemiology of chronic diseases in the pediatric population [1,2]. It is estimated that multimorbidity affects 10% to 30% of children with chronic conditions, although the actual prevalence is likely to be higher due to insufficient standardization of the definition and classification of comorbidities. Multimorbidity in pediatrics has a multidimensional impact on health, development, and quality of life. This condition has numerous biological consequences, such as worsening symptoms and an increased risk of exacerbations and complications of pharmacotherapy associated with the simultaneous use of multiple medications by the patient [2]. Moreover, psychosocial consequences (adaptation difficulties, deterioration of mental well-being), economic concerns, and systemic consequences (frequent hospitalizations, increased burden on the healthcare system, need for care coordination between specialists) should be emphasized. When caring for a child with multimorbidity, it is essential to implement integrated and individualized care, including joint therapeutic plans, treatment coordination, and information exchange between specialists and institutions. Currently, multimorbidity in pediatrics is a growing public health problem with significant clinical, economic, and social consequences. It requires a comprehensive, coordinated approach encompassing medical treatment as well as psychosocial and educational support [1,2].

This manuscript presents the case of a boy who underwent heart transplantation and suffered from chronic kidney disease, in whom long-term topical use of steroids for recurrent gingivitis caused iatrogenic Cushing's syndrome.

CASE REPORT

A 16-year-old boy with short stature and delayed puberty was admitted to the Pediatric Endocrinology Department of Independent Public Clinical Hospital No 1 in Zabrze (Poland) for further evaluation. Growth retardation had been observed since the patient was approximately 7-years old.

The perinatal history was abnormal – the child was born from the first pregnancy, which was complicated by cytomegalovirus infection at 36 weeks. Delivery by cesarean section occurred at 38 weeks of gestation. Birth weight was 2830 g, length 52 cm, and Apgar score 3/4/9/10. Dilated cardiomyopathy was diagnosed immediately after birth.

The boy remained under the constant care of a multidisciplinary outpatient clinics:

– cardiology (post-implantation of a left ventricular mechanical assist device at the age of 2.5 years, post-

-heart transplant due to heart failure caused by dilated cardiomyopathy at the age of 3 years)
– nephrology (stage III chronic kidney disease diagnosed at the age of 13)
– ophthalmology (condition after correction of strabismus in the left eye at the age of 13, visual defect at 7)
– otolaryngology (bilateral hearing loss, hearing aid, diagnosed at the age of 4)
– gastroenterology (abdominal pain at the age of 14)
– surgery (right retractile testicle diagnosed at the age of 2).

Furthermore, since the age of three (after the heart transplant), the boy had suffered from recurrent stomatitis and gingivitis. Congenital immunodeficiencies were ruled out. Topical treatment included a preparation containing cetalkonium and choline salicylate, which had little or short-lived effects, and various combination preparations containing topical disinfectants with benzocaine and herbal extracts. For over 10 years, he was treated locally with a hydrocortisone suspension without nystatin. Attempts to discontinue the use of oral brush mixture and change its composition did not produce the desired results in the patient. It was estimated that if the suspension was used for 1–2 weeks per month, twice a day, the approximate daily dose of hydrocortisone could be almost 70 mg. However, the boy's current daily replacement requirement for hydrocortisone, calculated at 10 mg/m², is 13.4 mg. By age 11, the boy's growth remained stable, between the 3rd and 10th percentiles according to Polish growth charts [3]. From this age, a slowdown in growth rate was observed, resulting in the child falling off the percentile chart around 12.5 years of age.

The patient is receiving pharmacological treatment with tacrolimus, antihypertensive drugs (ramipril, metoprolol), allopurinol, acetylsalicylic acid, sodium bicarbonate, magnesium preparation, calcium carbonate, ferrous sulfate, folic acid, vitamin D, probiotic, rutoside and a small dose of ascorbic acid.

On admission to the Department, the boy was in good general condition and did not report any complaints. Anthropometric measurements showed: height 152.8 cm (<3rd percentile, standard deviation score [SDS]: -4.07); body weight 42.1 kg (<3rd percentile); BMI 18 kg/m^2 (10th percentile). Physical examination revealed, in addition to short stature, scars from cardiac surgery on the skin of the chest, pectus excavatum, bilateral hearing aids, vision defects corrected with glasses, pale striae on the skin around the hips, excessively developed subcutaneous tissue in the abdominal area with slim upper and lower limbs, underdeveloped gluteal muscles, delayed puberty, and a migratory right testicle. The development of secondary sexual characteristics was assessed on the Tanner scale as G1 P1 Ax1, with the left testicular volume of 3 ml and the right 2 ml.

Body composition was measured using bioimpedance (Tanita analyzer model: MC-780MA-N) and showed increased body fat (11.2 kg) and decreased muscle mass (26.8 kg). Blood pressure measurements were within normal limits for age, gender, and height. The growth percentile for blood pressure was below 75, corresponding to a z-score = 0.68.

Laboratory tests revealed elevated creatinine concentration (129 µmol/L corresponding to estimated glomerular filtration rate 43 ml/min/1.73 m^2), mild anemia (hemoglobin 11.2 g/dL; hematocrit 32.2%) with normal ferritin levels, and elevated triglyceride levels. Fasting glucose was 76.4 mg/dl, HbA1c 5.29% (N: 4.8–5.9). Hormonal tests revealed pubertal gonadotropin levels with low testosterone, euthyroidism, normoprolactinemia, normal somatomedin (insulin-like growth factor 1 – IGF-1) levels, low dehydroepiandrosterone sulfate (DHEAS) levels (Table I), and low morning cortisol levels with adrenocorticotropic hormone (ACTH) of 40.5 pg/ml

Table I. Hormonal tests performed in the differential diagnosis of short stature and delayed puberty in the described boy

Parameter	Serum level	Normal value
FSH	1.65 mIU/ml	1.5–12.4 mIU/ml
LH	6.23 mIU/ml	1.7–8.6 mIU/ml
Testosteron	38.7 ng/dl	300–1000 ng/dl (adult men) <10 ng/dl (boys 7–12 years old) 8–14 ng/dl (pre-pubescent boys) 80–180 ng/dl (boys during puberty)
IGF-1	266 ng/ml	129–495 ng/ml
IGFBP-3	5516 ng/ml	3423–7098 ng/ml
Prolactin	20.8 ng/ml	4.6–21.4 ng/ml
GH stimulation test with glucagon	0' – 5.34 ng/ml 60' – 14.5 ng/ml 120' – 6.86 ng/ml 150' – 7.79 ng/ml 180' – 3.76 ng/ml	exclusion of deficiency >10 ng/ml

FSH – follicle-stimulating hormone; LH – luteinizing hormone; IGF-1 – insulin-like growth factor 1; IGFBP-3 – insulin-like growth factor binding protein 3; GH – growth hormone

(normal range 10–60; Table II). During hospitalization, a Synacthen test was performed, which revealed only partially preserved adrenal reserve (Table III). A glucagon stimulation test revealed normal growth hormone (GH) levels (maximum concentration 14.5ng/dl). Based on a wrist X-ray, bone age was estimated at 8–9 years. An abdominal ultrasound revealed the following kidney sizes: right 8.0 × 3.4 cm (<3 pc, kidney length z-score: -2.41), mean parenchymal thickness 0.8 cm; left 7.5 × 3.2 cm (<3 pc, kidney length z-score: -3.29), mean parenchymal thickness 0.8 cm, without signs of congestion or focal lesions, with slightly blurred parenchymal-sinus differentiation [4]. This image is consistent with renal hypodysplasia [5,6]. An ultrasound examination of the scrotum revealed testes with slightly heterogeneous echogenicity, without visible intratesticulars; the right testis had a volume of 1.5 ml, the left 1.2 ml.

Table II. Hormonal tests performed to assess the corticotropic axis

Parameter	8:00	23:00	Unit of measure
ACTH	40.5	8.27	pg/ml
Cortisol	2.0	0.576	μg/dl

ACTH – adrenocorticotropic hormone

Table III. Synacthen test results

Parameter	0 min	60 min	Unit of measure
Cortisol	2.0	10.8	μg/dl

The overall clinical picture and laboratory test results indicated iatrogenic Cushing's syndrome with secondary partial suppression of the hypothalamic-pituitary--adrenal (HPA) axis. An attempt was made to discontinue the hydrocortisone mixture, and a re--evaluation of the adrenal axis and bone mineral density was scheduled. Furthermore, due to the patient's incomplete adrenal reserve, an additional dose of hydrocortisone was recommended during periods of increased demand, such as during a febrile infection or situations of severe stress.

DISCUSSION

Advances in the treatment of many previously incurable diseases in children have led to multimorbidity, resulting at least in part from complications of the primary disease and the treatment used [2]. The patient presented in this paper is an example of multimorbidity, the primary cause of which was most likely heart failure due to dilated cardiomyopathy. Some of the health problems (renal failure, gingivitis) that the boy experienced were caused by complications following heart transplantation and pharmacological treatment. The boy described suffers from dilated cardiomyopathy, a complex disease characterized by dilation of the heart chambers and decreased systolic function, leading to heart failure [7]. In children, it is one of the most common primary cardiomyopathies and can be diagnosed at any age. It occurs at a rate of approximately 0.5–1.0 per 100,000 children per year and accounts for approximately 50% of all pediatric cardiomyopathies. The diagnosis is based mainly on echocardiography, and treatment includes pharmacotherapy for heart failure, causal treatment, and advanced methods, including heart transplantation, which is the most advanced and effective treatment for end-stage heart failure in children [7,8]. Heart transplantation in children is a complex, interdisciplinary procedure requiring close collaboration between the attending pediatrician, pediatric cardiologist, and the transplant center [8,9]. Early diagnosis of heart failure, appropriate qualification, infection control, and ongoing postoperative monitoring significantly improve prognosis. Children who have undergone a successful transplant can develop normally, function in society, and achieve a good quality of life. However, approximately 3%–10% of heart transplant recipients develop severe renal dysfunction within the first 10 years after transplantation [10]. Many risk factors for chronic kidney disease after heart transplantation have been identified, including: pre-transplant renal function deterioration, recipient morbidity, peri--transplant hemodynamics, and long-term exposure to calcineurin inhibitors. In 2012 according to the 15th report of the International Society for Heart and Lung Transplantation pediatric official registry, 10% of heart transplant recipients required dialysis or kidney transplantation within 15 years after transplantation [11]. It has also been shown that children who developed acute kidney injury during or after cardiac surgery had persistent markers of kidney damage [12]. Our patient was diagnosed with renal failure at the age of 12, and this cannot be ruled out as a complication of heart transplantation. In addition, the development of chronic kidney disease may contribute to endocrine disorders [13].

Gingivitis is the most common inflammatory disease of the oral cavity in children. It can range from mild redness to extensive bleeding, pain, and swelling. If left untreated, it can develop into periodontitis, which, although rare, can be serious in children and associated with systemic diseases [14]. Children treated with immunosuppressants – after transplants, during treatment for autoimmune diseases, nephropathy, inflammatory bowel disease, or oncohematological conditions – have a significantly higher risk of gingivitis. Symptoms may be atypical, the course may be more severe, and complications may develop more quickly and seriously than in immunocompetent children. Causes include the effects of immunosuppressive medications as well as susceptibility to bacterial, viral, and fungal infections. Treatment requires cooperation between the pediatrician, dentist, and the physician administering the immunosuppressant. Prevention plays a key role, including regular dental visits, hygiene monitoring, and patient

and family education [14]. Our patient developed recurrent gingivitis shortly after heart transplantation and initiation of immunosuppressive therapy. The absorption of hydrocortisone through the inflamed mucous membranes can be significant and depends on the surface area to which the drug is applied, the condition of the mucosa, the concentration, and the duration of glucocorticoid administration. This may result in suppression of the HPA axis (systemic effect). It is worth to mention, that HPA axis suppression has been reported after only 5–14 days of corticosteroid therapy [15]. In the patient described, despite only cyclical administration of hydrocortisone at a clinically significant dose, complications associated with hypercortisolism occurred – Cushingoid features, growth retardation, and delayed puberty.

Iatrogenic Cushing's syndrome induced by pharmacological treatment is a condition resulting from prolonged or excessive exposure to exogenous glucocorticoids, most commonly prednisone, dexamethasone, high doses of inhaled steroids, or topical steroids applied to a large area of the body [16]. Unlike the endogenous form, ACTH and cortisol are reduced due to suppression of the HPA axis. The most important symptoms in children are central obesity, a rounded, "moon-shaped" face, thin, fragile skin, tendency to bruise, striae, muscle weakness and growth retardation, hypertension, osteopenia or osteoporosis, hyperglycemia, insulin resistance [16,17], and increased susceptibility to infectious diseases. Iatrogenic Cushing's syndrome is most often associated with the use of oral steroids in the treatment of chronic diseases (asthma, inflammatory bowel disease, autoimmune diseases), high-dose inhaled steroids (especially with improper administration technique), long-term use of topical steroids (for ophthalmological and dermatological indications) over a large area, and increasingly with the unsupervised use of combination steroid preparations [18]. In the case of iatrogenic Cushing's syndrome, the steroid dose should be gradually reduced, the risk of secondary adrenal insufficiency assessed, and height, weight, blood pressure, glycemia, and, in the case of long-term exposure, bone mineral density monitored. After dose reduction or discontinuation of steroids, slow normalization occurs, but full recovery of the HPA axis may take a long time, and growth may remain limited [19,20]. In children with chronic kidney disease and a heart transplant, the risk of Cushing's syndrome is higher due to underlying immunosuppression [16], as confirmed by the case of the patient described in this study. Medications used (e.g., tacrolimus, cyclosporine, systemic glucocorticoids) affects glucocorticoid metabolism, and some may prolong their action. Furthermore, many children after transplantation continue to receive low doses of systemic glucocorticoids, which lowers the threshold for the development of Cushing's syndrome. Chronic kidney disease increases the risk of systemic effects of topical medications because glucocorticoid metabolites are eliminated more slowly from the body. As a result, even small doses of topical hydrocortisone may have a relatively greater systemic effect.

Iatrogenic hypercortisolemia resulting from chronic exposure to glucocorticoids can cause a number of adverse effects – especially in patients already burdened with multiple comorbidities. Excessive cortisol levels lead to inhibition of GH secretion by inhibiting the hypothalamic-pituitary axis and a reducing the sensitivity of the peripheral tissues to GH and IGF-1, which in pediatric patients causes growth retardation and the risk of short stature. Concurrently, gonadotropin (luteinizing hormone – LH, and follicle-stimulating hormone – FSH) secretion is suppressed, causing delayed or inhibited puberty, further exacerbating growth and bone mineralization disorders.

Metabolic complications, such as insulin resistance, hyperglycemia, and dyslipidemia, also pose a significant problem, increasing cardiovascular risk. In heart transplant patients, these complications are of particular clinical importance, as they may contribute to accelerated development of atherosclerosis in the graft coronary arteries, worsening cardiac contractility, and increasing the risk of cardiovascular events. Long-term hypercortisolemia also has an adverse effect on the skeletal system by inhibiting osteoblast activity, increasing bone resorption, and reducing calcium absorption, which leads to decreased bone mineral density. During development, this impairs the reaching of peak bone mass and, consequently, increases risk of osteoporosis and fractures later in life [16].

CONCLUSIONS

Patients with multimorbidity should receive regular multidisciplinary care, and treatment should be individually tailored and modified, taking into account drug interactions, to avoid additional symptoms and exacerbations of one condition while treating others. Long-term use of steroids in children, regardless of the route of administration (even mucosal), can lead to serious complications such as Cushing's syndrome with growth retardation and puberty suppression.

Authors' contribution
Study design – K. Czyżowska, M. Stojewska, M.Szczepańska, A. Zachurzok
Manuscript preparation – K. Czyżowska, M. Stojewska
Literature research – K. Czyżowska
Final approval of the version to be published – K. Czyżowska, M. Stojewska, M. Szczepańska, A. Zachurzok

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