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Research Article

Serum Amylase Activity in Children Living with HIV-1 at the Charles de Gaulle Pediatric University Hospital in Ouagadougou

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Abstract

Biological monitoring is an essential part of the management of HIV infection. The aim of this study was to assess serum amylase activity during follow-up of children living with HIV-1 (CLHIV-1) at the Charles de Gaulle Pediatric University Hospital (CHUP-CDG). This was a descriptive and analytical cross-sectional study, with retrospective data collection from January 1, 2020 to December 31, 2022. Patients under 15 years of age who were being monitored for HIV-1 at CHUP-CDG and who had undergone a serum amylase assay during the study period were included. A total of 746 patients have been included, with a M/F sex ratio of 0.91 and a mean age of 8.52 ±4.08 years. Among CLHIV-1, 88.05% had a TCD4 lymphocyte count > 500/mm^3 and 60.32% an undetectable plasma viral load (PVL). The incidence of hyperamylasemia in the study population was 57.64%. Hyperamylasemia was significantly more frequent in children aged 0-2 years ($p<0.00001$), in patients with a high PVL ($p=0.0016$) and in those on the protocol combining two nucleoside reverse transcriptase inhibitors with a protease inhibitor. Several abnormalities in serum amylase activity were detected in CLHIV-1 during the course of the study. Clinical correlation and adequate follow-up of these abnormalities are essential to reduce the morbidity and mortality associated with pancreatic damage in people living with HIV.

Keywords

Hyperamylasemia, Serum Amylase Activity, Children, HIV-1, Burkina Faso

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1. Introduction

Infection by the human immunodeficiency virus (HIV) and its corollary, acquired immunodeficiency syndrome (AIDS), are responsible for thousands of deaths every year and constitute a major public health problem worldwide. According to UNAIDS statistics, 39 million people worldwide were living with HIV in 2022, including 1.5 million children aged 0-14 [1]. In West and Central Africa, there were 4.8 million people living with HIV, with 51,000 children newly infected in 2022 [1]. In Burkina Faso, 88,000 people were living with HIV, including 6,100 children under the age of 15 [2].

HIV infection is a persistent infection which, after a variable number of years without adequate treatment, induces a profound deficit in cellular immunity. In particular, it infects TCD4+ lymphocytes, destroying the host organism's immune system [3]. The result is the AIDS stage, characterized by the onset of major infectious complications, which are the main cause of HIV/AIDS-related morbidity and mortality. As a result of this immunodepression, all organs can be affected, including the kidneys, liver and pancreas.

Biologically, TCD4+ lymphocyte counts and plasma viral load (PVL) measurements are used to assess treatment efficacy, as well as the severity of viral damage [4]. Biological monitoring also involves monitoring the body's major functions, enabling sub-clinical detection of abnormalities before major complications arise, which are often fatal for patients. Among these major functions, the pancreas takes pride of place. Monitoring its function by measuring pancreatic enzymes (lipase, amylase) is an integral part of the initial biological work-up and therapeutic follow-up of people living with HIV [5].

Indeed, the pancreas is frequently involved in HIV infection, particularly as a result of disseminated infections or neoplasms. However, the most important cause of pancreatic dysfunction in HIV-infected patients remains the toxic effect of antiretroviral drugs [6, 7]. Thus, in the event of a significant rise in serum amylase and/or lipase levels, potentially toxic drugs must be rapidly stopped to avoid major pancreatic damage.

Several studies have highlighted the high incidence of hyperamylasemia in HIV infection, with over 40% in some series [8]. In Burkina Faso, several studies have been carried out on pancreatic enzymes in the context of HIV [8, 9]; but few have focused on the pediatric context. The onset of pancreatic complications at an early age could considerably shorten the life expectancy of these patients. The present study was carried out at the Charles De Gaulle Pediatric Hospital (CHUP-CDG), on serum amylase activity in children living with HIV-1 (CLHIV-1), the most frequent type, to help improve management.

2. Material and Methods

2.1. Study Framework

The study was carried out at CHUP-CDG, a public referral hospital for the care of children aged 0 to 15. CHUP-CDG provides clinical, paraclinical and therapeutic care for children living with HIV. Follow-up biological assessments are carried out in the laboratory department, which groups together several units: biochemistry, immunology-serology, bacteriology-virology, parasitology-mycology, hematology and molecular biology.

2.2. Type and Period of Study

This was a descriptive and analytical cross-sectional study with retrospective data collection over a 3-year period, from January 1, 2020 to December 31, 2022.

2.3. Study Population

The study concerned HIV-1-positive patients treated at CHUP-CDG, and sampling was exhaustive. Patients under 15 years of age living with HIV-1 who had undergone an amylasemia test at the CHUP-CDG laboratory during the study period have been included. Patients with incomplete or unusable data were excluded.

2.4. Assessment of Serum Amylase Activity

Venous blood samples were taken in dry tubes, centrifuged at 3500 rpm for 5 minutes. Serum was collected and used to assess serum amylase activity, using an enzymatic method (2-chloro-4-nitrophenyl-α-maltrotrioside or CNPG3). The following values were considered normal: Newborn 4 - 42 IU/L, Infant and Child 15 - 85 IU/L. Elevated serum amylase activity or hyperamylasemia was defined by values above 42 IU/L in neonates and 85 IU/L in infants and older children.

2.5. Data Collection and Analysis

Data were collected from the follow-up registers of patients received in the biochemistry, immunology-serology and molecular biology units. Data were entered into Microsoft Excel 2016 and analyzed using Stata software version 13.0. Comparison of the profile of serum amylase activity according to patient characteristics was carried out using the Chi-square test, with a significance threshold of $p<0.05$.

3. Results

A total of 746 CLHIV-1 were included in the study.

3.1. Socio-Demographic Characteristics

The study population comprised 391 girls (52.41%) and 355 boys (47.59%), with an M/F sex ratio of 0.91. The mean age of patients was 8.52±4.08 years. The most represented age group was 11 to 14 years, with 41.96%. The distribution of patients according to socio-demographic characteristics is

shown in Table 1.

Table 1. *Distribution of patients by socio-demographic, immuno-virological and therapeutic characteristics.*

Characteristics	Number	Percentage (%)
Socio-demographic		
Gender (N=746)		
Male	355	47.59
Female	391	52.41
Age (N=746)		
[0-3 years]	91	12.20
[3-7 years]	150	20.10
[7-11 years]	192	25.74
[11-15 years]	313	41.96
Immuno-virological		
TCD4+ lymphocyte count (N=619)		
< 200 / mm^3	22	3.55
200-500 / mm^3	52	8.40
> 500 / mm^3	545	88.05
Plasma viral load (N=625)		
Undetectable	377	60.32
[20-5000 copies/mL]	134	21.44
[5000-30000 copies/mL]	35	5.60
>30000 copies/mL	79	12.64
Therapeutic		
Therapeutic protocol (N=601)		
2 NRTI* - 1 NNRTI**	35	5.82
2 NRTI - 1 PI***	57	9.49
2 NRTI- 1 IIN****	507	84.36
3 NRTI	2	0.33
Duration of treatment (N=138)		
[1-6 months]	19	13.77
[6-12 months]	16	11.59
> 12 months	103	74.64

*Nucleoside reverse transcriptase inhibitors ** Non-nucleoside reverse transcriptase inhibitors ***Protease inhibitors **** Integrase inhibitors

3.2. Immunovirological Characteristics

In the study population, 545 patients (88.05%) had a TCD4+ lymphocyte count > 500/mm^3. A total of 377 patients (60.32%) had an undetectable PVL (Table 1).

3.3. Therapeutic Characteristics

In the study, 601 patients were on antiretroviral therapy (ART). The treatment regimen combining two nucleoside reverse transcriptase inhibitors (NRTI) with an integrase inhibitor (INI) was the most widely used, accounting for 84.36%. Data on treatment duration were available for only 138 patients (18.50%), of whom 74.60% had a treatment duration of over 12 months (Table 1).

3.4. Characteristics of Serum Amylase Activity

Among patients, serum amylase activity was elevated in 387 (51.88%). The majority of hyperamylasemia cases were between 1N and 2N (Table 2); the highest value was 4.49N.

Table 2. *Distribution of patients by serum amylase activity profile.*

	Number	Percentage (%)
Serum amylase activity (N=746)		
Normal	359	48.12
High	387	51.88
Cases of hyperamylasemia (N=387)		
[1N-2N]	338	87.34
[2N-3N]	40	10.33
> 3N	09	2.33

Table 3 shows the distribution of the serum amylase activity profile according to the socio-demographic, immuno-virological and therapeutic characteristics of the patients in the study. Hyperamylasemia was significantly more frequent in children aged [0-3 years[($p<0.00001$), in patients with a high PVL ($p=0.0016$) and in those on the 2 NRTI+1 PI (protease inhibitor) protocol ($p=0.0245$).

Table 3. *Distribution of serum amylase activity profile according to patient characteristics.*

Serum amylase activity Characteristics	Normal Number (%)	High Number (%)	p-value
Socio-demographics			
Gender (N=746)			
Male	154 (43.38)	201 (56.62)	0.2892
Female	162 (41.43)	229 (58.57)	
Age (N=746)			
[0-3 years]	15 (16.48)	76 (83.52)	<0.00001
[3-7 years]	64 (42.67)	86 (57.33)	
[7-11 years]	101 (52.60)	91 (47.40)	
[11-15 years]	136 (43.45)	177 (56.55)	
Immuno-virological			
TCD4+ lymphocyte count (N=619)			
< 200 / mm^3	6 (27.27)	16 (72.73)	0.1306
200-500 / mm^3	17 (32.69)	35 (67.31)	
> 500 / mm^3	235 (43.12)	310 (56.88)	
Plasma viral load (N=625)			
Undetectable	182 (48.28)	195 (51.72)	0.0016
[20-5000 copies/mL]	48 (35.82)	86 (64.18)	
[5000-30000 copies/mL]	11 (31.43)	24 (68.57)	
>30000 copies/mL	23 (29.11)	56 (70.89)	
Therapeutics			
Therapeutic protocol (N=601)			
2 NRTI* - 1 NNRTI**	19 (54.29)	16 (45.71)	0.0245
2 NRTI - 1 PI***	16 (28.07)	41 (71.93)	
2 NRTI- 1 IIN****	226 (44.58)	281 (55.42)	
Duration of treatment (N=138)			
[1-6 months]	5 (26.32)	14 (73.68)	0.3192
[6-12 months]	5 (31.25)	11 (68.75)	
> 12 months	44 (42.72)	59 (57.28)	

*Nucleoside reverse transcriptase inhibitors ** Non-nucleoside reverse transcriptase inhibitors ***Protease inhibitors **** Integrase inhibitors

4. Discussion

Biological monitoring of people living with HIV is vital to reduce morbidity and mortality attributable to this pathology. The aim of this study was to investigate the profile of serum amylase activity in CLHIV-1 at the CHUP-CDG in Ouagadougou. In terms of exploration of pancreatic enzyme activity, only amylasemia was prescribed during the follow-up of CLHIV-1 at CHUP-CDG. However, several studies have shown that serum lipase is more sensitive than serum amylase in diagnosing pancreatitis, particularly acute pancreatitis. [10, 11]. Lipase also offered a wider diagnostic window than amylase, since it was elevated for a longer period, making it a useful diagnostic biomarker in the early and late stages of acute pancreatitis [10]. We therefore believe that it would be wise to combine the assessment of serum lipase with that of amylase; or, failing that, to retain the assay of lipasemia alone, in order to limit the financial cost to patients.

It should also be noted that the assessment carried out concerned total serum amylase. Yet many organs secrete amylase, with concentrations found in the pancreas and salivary glands several dozen times higher than in other organs. In fact, plasma amylase originates almost exclusively from these two organs [12]. The study should have been able to specifically determine pancreatic amylase activity using commercial kits, in order to truly correlate its elevation with organ damage.

Elevated serum amylase activity was present in 51.88% of patients in the study. What's more, the majority of these cases (87.34%) showed a moderate elevation, between 1N and 2N. Murthy et al. in their study reported 54% cases of hyperamylasemia [13]. These frequent elevations in serum amylase activity could be explained by the fact that in people living with HIV, various circumstances such as the side effects of certain ARV, bile duct obstruction and opportunistic infections can potentially affect the pancreas and lead to cell destruction. Indeed, numerous studies have highlighted the fact that prolonged use of antiretroviral drugs is associated with varying degrees of pancreatic damage in certain patients. These lesions were reflected biologically by a constant increase in serum amylase levels over the follow-up period. The authors concluded that progressive elevation of serum amylase levels was indicative of acute pancreatitis associated with the use of ARV, notably nevirapine [14, 15].

Cases of elevated serum amylase activity were most frequent in children aged 0-3 years (Table 3). Indeed, 83.52% of them showed hyperamylasemia. These results could be explained by the immaturity of their immune system, which is therefore very vulnerable. In fact, this hyperamylasemia can have multiple etiologies: bacterial infections (cutaneous, oral), visceral pain (pancreatitis, esophagitis) and undernutrition.

Hyperamylasemia was significantly more prevalent in patients with high PVL ($p=0.0016$). Indeed, when the viral load was high, the percentage of children with hyperamylasemia was greater, suggesting that PVL would have an impact on amylasemia elevation. What's more, although the results were not statistically significant, we noted a tendency for the frequency of hyperamylasemia to increase as TCD4+ lymphocytes decreased. Indeed, the frequency of CLHIV-1 (TCD4+<200/mm^3) with hyperamylasemia was 72.73%, while that of children with a normal TCD4+ lymphocyte count (>500/mm^3) was 56.88%. Nadembega et al. also stated that serum amylase levels are higher in immunocompromised patients than in those with a TCD4+ lymphocyte count above 200/mm^3 [16]. Other authors also correlated serum amylase levels with TCD4+ lymphocyte count [14, 17]. Levels of viral load and CD4 lymphocyte count provide information on a patient's immune status. The higher the viral load, the lower the CD4 count, and the greater the risk of contracting opportunistic diseases, with possible pancreatic localization leading to increased amylase activity.

Hyperamylasemia was significantly more prevalent in children treated with the 2 NRTI+1 PI protocol ($p=0.0245$). With regard to treatment, the rate of children with hyperamylasemia following the therapeutic protocol combining 2 NRTI + 1 PI was relatively very high at 71.93%. In fact, hyperamylasemia caused by the combination of 2 NRTI + 1 PI could be linked to protease inhibitors, which are implicated in pancreatitis through immuno-allergic damage or the development of metabolic disorders.

5. Conclusion

The study highlighted that amylase activity was often elevated during follow-up of children living with HIV-1 in Ouagadougou. Children under three years of age, those with a high plasma viral load, and those whose treatment included a protease inhibitor, had significantly higher frequencies of hyperamylasemia. Appropriate biological monitoring of these abnormalities, combined with clinical correlation, would enable better management of these patients.

Abbreviations

AIDS: Acquired Immunodeficiency Syndrome
ART: Antiretroviral Therapy
CHUP-CDG: Charles de Gaulle Pediatric University Hospital
CLHIV-1: Children Living with HIV-1
HIV-1: Human Immunodeficiency Virus Type 1
IIN: Integrase Inhibitors
NNRTI: Non-Nucleoside Reverse Transcriptase Inhibitors
NRTI: Nucleoside Reverse Transcriptase Inhibitors
PI: Protease Inhibitors
PVL: Plasma Viral Load

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] ONUSIDA. Global HIV & AIDS statistics — Fact sheet [Internet]. [cited 2023 Oct 22]. Available from: https://www.unaids.org/en/resources/fact-sheet

[2] Organisation mondiale de la santé Rapport annuel 2022 OMS Burkina Faso [Internet]. Burkina Faso; [cited 2023 Oct 22] p. 86. Available from: https://www.afro.who.int/sites/default/files/2023-08/Rapport%20annuel%202022_OMS%20Burkina%20Faso_Final_1.pdf

[3] Boutitie F, Pocock SJ. Predictive value of repeated measurements of CD4 lymphocyte counts on progression to AIDS. AIDS Lond Engl. 1994 Jan; 8(1): 35–41. https://doi.org/ 10.1097/00002030-199401000-00006

[4] Lamoril J, Bogard M. La quantification en biologie moléculaire: application à l'étude de la charge virale du virus VIH-1. Immuno-Anal Biol Spéc. 1996 Jan 1; 11(5): 325–32.

[5] Yeni P. Prise en charge médicale des personnes infectées par le VIH: rapport 2010—Recommandations du groupe d'experts. Flammarion Médecine-Sciences. Paris, France; 2008. 412 p.

[6] Brivet FG, Naveau SH, Lemaigre GF, Dormont J. Pancreatic lesions in HIV-infected patients. Baillières Clin Endocrinol Metab. 1994; 8(4): 859–77. https://doi.org/10.1016/S0950-351X(05)80306-4

[7] Cappell MS. The pancreas in AIDS. Gastroenterol Clin North Am. 1997; 26(2): 337–65. https://doi.org/10.1016/S0889-8553(05)70298-3

[8] Ilboudo B. L'amylasémie au cours de l'infection à VIH [Internet] [Thèse de doctorat en médecine]. [Ouagadougou, Burkina Faso]: Universite de Ouagadougou; 1973 [cited 2023 Oct 26]. Available from: https://beep.ird.fr/collect/uouaga/index/assoc/M09682.dir/M09682.pdf

[9] Sagna Y, Koulidiaty J, Diallo I, Sanou AF, Bagbila PA, Sagna T, et al. Profil biologique des patients nouvellement pris en charge pour une infection à VIH à Ouagadougou (Burkina Faso). Médecine Santé Trop. 2014; 24(3): 307–11. https://www.jle.com/10.1684/mst.2014.0381

[10] Smith RC, Southwell-Keely J, Chesher D. Should Serum Pancreatic Lipase Replace Serum Amylase as a Biomarker of Acute Pancreatitis? ANZ J Surg. 2005; 75(6): 399–404. https://doi.org/ 10.1111/j.1445-2197.2005.03391.x

[11] Ismail OZ, Bhayana V. Lipase or amylase for the diagnosis of acute pancreatitis? Clin Biochem. 2017 Dec 1; 50(18): 1275–80. https://doi.org/10.1016/j.clinbiochem.2017.07.003

[12] Lévy P. Amylases et lipases. Hépato-Gastro Oncol Dig. 2013; 20(8): 650–5. https://doi.org/10.1684/hpg.2013.0918

[13] Murthy UK, DeGregorio F, Oates RP, Blair DC. Hyperamylasemia in patients with the acquired immunodeficiency syndrome. Am J Gastroenterol. 1992; 87(3): 332–6.

[14] Mgogwe J, Semvua H, Msangi R, Mataro C, Kajeguka D, Chilongola J. The evolution of haematological and biochemical indices in HIV patients during a six-month treatment period. Afr Health Sci. 2012 Mar; 12(1): 2–7.

[15] Idigbe EO, Adewole TA, Eisen G, Kanki P, Odunukwe NN, Onwujekwe DI, et al. Management of HIV-1 infection with a combination of nevirapine, stavudine, and lamivudine: a preliminary report on the Nigerian antiretroviral program. J Acquir Immune Defic Syndr 1999. 2005 Sep 1; 40(1): 65–9. https://doi.org/10.1097/01.qai.0000159516.39982.1b

[16] Nadembèga Christelle WM. Depistage anonyme du VIH, etude de l'evolution des proteines serique et des C+ chez les personnes vivant avec le VIH/SIDA. 2001; 45.

[17] Jin Y, Yang T, Xia T, Shen Z, Ma T. Association between serum amylase levels and CD4 cell counts in newly diagnosed people living with HIV: A case-control study. Medicine (Baltimore). 2023 Jan 13; 102(2): e32638. https://doi.org/10.1097/MD.0000000000032638