



Biochemical Effect of Gastrointestinal Bacteria in Children with Autism: Report Case

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Abstract

The gut tract of autistic children exhibits an shift in microbiome exacerbating the autistic symptoms. The management of the pathogenic strains by pharmacological and natural pathway is promising. Here, we report the outcome of stool samples analysis. This patient has undergone a myriad of tests. Of these, the mycological testing was discussed in order to shed more light. In addition, a checklist (Rimland E 2) was utilized in order to get more accurate anamnestic information from her parents. We present the case of 10-years Moroccan girl. She has been experiencing a neurocognitive intervention: Applied Behaviour application (ABA) as of window she was diagnosed as child with ASD. She experienced long-lasting difficulties in establishing and maintaining social relationship. She was suffering from slight intermittent gastrointestinal ailments. The mycological and microbiological investigation was carried using comprehensive stools specimen. The pathogenic strain involved has undergone a myriad sensitive testing of both pharmacological and natural agents. The sensitivities evaluation *vs.* yielded pathogenic species was implemented; the antibiotic drugs tests *vs.* underlying cultured strains were: Amoxicillin, Ampicillin, Augmentin, Nystatin. The antifungals used were; Fluconazole, Itraconazole, ketoconazole and Nystatin. Ultimately, the natural agent utilized was; Berberine, black Walnut, Caprylic acid, Cats claw, Citrus seed extract goldenseal, Oregano. The outcomes provided evidence of abnormal levels *Citrobacter freundii* and *Candida albicans*; The sensitive drugs *vs.* *Citrobacter freundii* bacteria were Ciprofloxacin and Trimeth-sulfa. By the same token, the sensitive drugs against *candida albicans* were Ketoconazole and Nystatin. The reported sensitive natural agents *vs.* *Citrobacter freundii* were Caprylic acid, Citrus seed extract, Oregano, Uva ursi. Collectively, the levels *Candida albicans* and *Citrobacter freundii* has been found as peculiar. suggesting that might have a predictive role in maximizing the autistic symptoms *viz.* gastrointestinal issues. The selection of relevant drugs and non-drugs medication could made inroads into mitigating and enhancing the well-being along with the health of the current autistic individual.

Keywords: Autism, *Candida albicans*, *Citrobacter freundii*, Microflora sensibilities, Natural medication, Pharmacological medication

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1. Introduction

Autism spectrum disorder (ASD) is a complex group of developmental disorders characterized by impaired social interactions and communication both verbal and non-verbal along with stereotyped behaviors patterns (1) Of ASDs, autism approached as the primary type. the reported prevalence of autism spectrum disorder (ASD) in the US has tripled, with current estimates indicating a prevalence of 1.85% among children Previous epidemiological studies reported prevalence of autism spectrum disorder (ASD) in the US has tripled, with current estimates indicating a prevalence of 1.85% among children highlighting that ASD affects many families and represents a serious public health problem [2]. A constellation of factors contributing in the pathogenesis of autism ASD including both genetic and environmental factors: e.g. Nutritional deficiencies or overloads, exposure to viruses, errors during embryonic neural tube closure, impaired immune systems and allergies [3, 4]. Gut dysbiosis

could contribute to the low-grade systemic inflammatory state reported in patients with GI comorbidities [5].

The *Candida albicans* is a yeast-like fungus which harbours almost the intestinal tract in all humans. It lives on the moist dark mucous membranes which line the mouth, vagina and intestinal tract. The mushrooming of *Candida albicans*, ordinarily exists in small colonies, may be jeopardized by immune system as well as by competition of their microorganisms colonized the mucous membranes. [6]. And the candida seen as new microbial risk factor for ASD owing to increase of *anti-candida* IgG [7]. Myriad strains are unoffending commensals of hosts including humans. However, other species, or harmless species, since found in unsuitable position were poised to cause disease. *Candida albicans* can cause infections (candidiasis or thrush) in humans and other animals, esp. in immunocompromised patients [8]. The efficacy of antifungals drugs *versus* yeast overgrowth in child with ASD in vivo was reported [9]. The

alternative treatment is *albeit* their efficacy so far inconclusive [10].

Certain antibiotics may be effective in treating gastrointestinal symptoms in individuals with autism by targeting specific gut microbes. The study found that a combination of vancomycin and metronidazole led to significant improvement in symptoms such as diarrhea, constipation, and abdominal pain in a group of children with autism. The researchers suggested that the presence of certain pathogenic microbes in the gut may contribute to the development of autism symptoms and that antibiotic treatment may be a promising therapeutic approach for some individuals with autism [11]. There is a limited evidence to support the use of natural medications for treating ASD symptoms. However, some natural medications that have been studied include omega-3 fatty acids, melatonin, and probiotics. Omega-3 fatty acids, found in fish oil supplements, have been studied for their potential to improve cognitive function and behavior in individuals with ASD, although the evidence is mixed [12].

The main aim is to assess a comprehensive stool analysis of Moroccan children with autism and to evaluate the sensitiveness of pharmacological and non-pharmacological drugs *versus* the yielded pathogenic microorganism in a child with autism.

2. Case Presentations

The patient (SA) was 10-years old young girl diagnosed with ASD. According to checklist Rimland E2 (serve as diagnostic tool and to collecting anamnestic data), SA had clear-sighted symptoms of autism spectrum disorder (ASD) which were confirmed by Rimland checklist at score of 20. She had experienced long-standing impairments in terms of communication, social relationship, lack of maintaining visual contact. The echolalia was reported by the parents. She was not impulsive and intensive. She was hypoactive and was considered as deaf, she had intermittent gastrointestinal disturbance. No occasional outburst was observed. The patient underwent a long-lasting neurocognitive intervention, in particular, Applied Behavioral Intervention (ABA) inside an associative structure (Morocco). The patients have showed an enhancement in terms of decreasing adverse and acquired adequate behaviors. She should have been able to utter and do some slight tasks as go out, buy to name but a few. The visual contact skills were obviously righteous after receiving intensive intervention. The parents reported that they have been experiencing an awkward experience since they have perceived abnormal development with impaired social and communicative interaction.

Taken together, the child provided a continuum of symptoms which is in compliance with statistical Manual disorder (DSM-V). The patient suffered intermittent GIT troubles; gas-blotting, pain, fever, daily bowel movements and so on. A set of biomarkers were assessed. Of these analysis, the comprehensive micro flora stool were performed. The stool samples were collected and conserved in ad-hoc and adequate recipients. The samples were submitted to be performed in laboratory. The mycological and microbiological investigation was carried using comprehensive stools specimen. The pathogenic strain involved has undergone a myriad sensitive testing of both

pharmacological and natural agents. The sensitivities evaluation *vs.* yielded pathogenic species was implemented; The antibiotic drugs tests *vs.* underlying cultured strains were: Amoxicillin, Ampicillin, Augmentin, Nystatin. The antifungals used were; Fluconazole, Itraconazole, ketoconazole and Nystatin. Ultimately, the natural agent utilized was; Berberine, black Walnut, Caprylic acid, Cats claw, Citrus seed extract goldenseal, Oregano.

The outcomes provided evidence of abnormal levels *Citrobacter freundii* and *Candida albicans*; The sensitive drugs *vs.* *Citrobacter freundii* bacteria were Ciprofloxacin and Trimeth-sulfa. By the same token, the sensitive drugs against *Candida albicans* were Ketoconazole and Nystatin. The reported sensitive natural agents *vs.* *Citrobacter freundii* were Caprylic acid, Citrus seed extract, Oregano, Uva ursi. Of note, The parents reported that the patient with autism after receiving antifungal drugs *viz.* fluconazole, has shown an improvement of GIT ailments. This neurobiological approach is mechanistically combined to neurocognitive and standards supportive therapy, needless to say, ABA-based therapeutic approach.

3. Discussion

Gastrointestinal (GI) symptoms have been described in a number of autism patients, in whom symptoms include abdominal pain, bloating, diarrhoea, and constipation [13, 14]. An accumulating evidence conducted by Horvath and Perman speculated an increase of yeast [15,16]. Other papers reported that there was increased rate of positive fungal culture for yeast in the duodenal juice of children with autism undergoing endoscopies more than had the age-matched controls with other gastrointestinal problems requiring endoscopies. To the best of our knowledge, such investigations were scarcely conducted in Morocco.

The exact prevalence of GI symptoms in autism remains unclear. Two retrospective studies, which analyzed representative populations of children with autism, reported GI symptoms in 20% of young children previously diagnosed with autism [17]. In contrast, prospective reports from pediatric gastroenterology and general autism clinics have described GI symptoms in 46–84% of patients with autism [9] A body of studies have postulated the gastrointestinal (GST) troubles associated with fungal and microbial imbalance participate poorly in the onset of autism [16]. The high levels were found to be slightly higher in several evidences dedicated to autism. We note a significant relation between the autistic children and heavy growth of *Candida albicans* in stool culture [18]. Also, in our study there was significant increase in cases of heavy growth of *Candida albicans* in autistic group compared with the control group. The current report case study postulated an increase abnormal level of *Citrobacter freundii* and *Candida albicans* as outlined in (Table1).

Table 1. Comprehensive stool micro flora analysis; this outlined the presence of *Citrobacter freundii* as pathogenic bacteria.

Benficial flora	Imbalnces flora	Dysbiotic flora
Bifidobacterium	Alpha hemolytic strep	<i>Citrobacter freundii</i>
Echecheria coli spp		
Enterococcus spp		
Mycology		yeast

Table 2. Antibiotic susceptibilities vs. *Citrobacter freundii*; the sensitive antimicrobial drugs were viz. Ciprofloxacin and Trimeth-sulfa

	Sensitivities	Intermediate	Resistant
Amoxicilin			R
Ampicilin			R
Augmentin			R
Ciproflxacin	S		
Trimeth-sulfa	S		

Table 3. Natural agent susceptibilities vs. *Citrobacter freundii* ; the sensitive natural agents were Caprylic acid, Citrus seed extract, Oregano and Uva ursi

Berberine			R
Black walnut			R
Caprylic acid	S		
Cats claw			R
Citrus seed extract	S		
goldenseal			R
oregano	S		
Uva ursi	S		

Table 4. Antifungal drugs susceptibilities vs. *Candida albicans*; the sensitive anti-fungal drugs were Ketoconazole, Nystatin.

	Sensitive	Intermediate	Resistant
Fluconazole			R
Itraconazole			R
ketoconazole	S		
Nystatin	S		

Table 5. Natural agent susceptibilities vs. *Candida albicans*; the sesnsitive natural agent were berberine, caprylic acid undeliyacid, Goldenseal.

Berberine	S		
Black walnut			
Caprylic acid	S		
undeliyacid	S		
Tanalbit			R
Goldenseal	S		
Oregano			R
Uva ursi			R

Regarding the *Candida albicans*, such fungus-like yeast may play a predictive a role to cause gastrointestinal ailments, This findings are consistent with previous study of Campbell (1983) [19], who reported that individual with GIT disorders were partially linked to mushrooming of *Candidis* ; a sign of impaired immune functions resulting in the overgrowth of yeast. It is possible that children with autism are more sensitive to even a normal level of yeast. The survey by the Autism Research Institute reports that parent’s antifungal medication may be effective to mitigate the

adverse effect of *Cadinda albicans*. In addition, the possible anti-inflammatory action of antifungals was reported [20]. We report a significant relation between the autistic children and heavy growth of *Candida albicans* in stool culture. Gastrointestinal and immune dysfunction has been linked to aberrant composition of the microbiota, known as dysbiosis. In the present report, C. albicans isolated were sensitive to investigated antifaungul (e.g.; Nystatin, Fluconazole, Itraconazole and Ketoconazole) (Table 4) as well as natural agent Berberine, Caprylic acid, Goldenseal, Undeliycacid

whereas Tanalbit, Oregano, Uva Ursi were resistant (Table 5). According to parental investigation report by checklist Rimland E2 suggesting fluconazole may lessen heavily the candida overgrowth; this findings are corroborated by previous evidence [21].the bacterial versus fungal microbiota are complex and still being investigated, as newer techniques develop to identify them [27].

There is currently limited research exploring the relationship between *Citrobacter freundii* and autism. While *Citrobacter freundii* is a type of bacteria commonly found in the environment and in the human digestive tract, there is no direct evidence to suggest that it specifically contributes to the development or exacerbation of autism symptoms [28, 29]. However, there is ongoing research exploring the potential impact of the gut microbiome on neurodevelopmental disorders such as autism. A recent study found that children with autism spectrum disorder (ASD) had significant differences in the composition and diversity of their gut microbiome compared to typically developing children [30] (Zhang et al., 2021). Other studies have also identified potential associations between gut microbiome dysbiosis and autism symptoms. Solely sensitive both natural and medical drugs vs. *Citobacter freundii* will be discussed; indeed our outcomes provided evidence that Ciprofloxacin and Trimeth-sulfa (Table2) were sensitive against such strains. The parents report stress that child after receiving drugs

The caprylic acid, Citrus seed, Oregano, Uva ursi were reported as sensitive natural agent agins *Citrobacter freundii* (Table 3). No conclusive evidence was suggested its use in managing autism symptoms. The myriad studies showed that natural agents have antibiotic activities against *Citrobacter freundii*; these agents could potentially used as natural alternative to resistant synthetic antibiotic. Previous research revealed that Oregano had antimicrobial activities suggesting that be useful to remove resistant strains [31, 32]. The Caprylic acid referred as fatty acids owning antimicrobial properties, such element combined to other agent reduce effectively the *Citrobacter freundii* strains [33]. In the same vein, Uva ursi refers as a effective in reducing *Citrobacter freundii* overgrowth [34]. Further research is required to corroborate the safety and effectiveness of such medication as therapeutic option for children with autism. These outcomes indicate that medical and natural anti-fungal cannot be used as core treatment option for this patient with microbial imbalances; conversely, instead culture of stool samples paired to sensitivity profiling is mandatory for paving a way to a paramount clinical managing.

4. Conclusion

Microflora such as *Citrobacter freundii* and *Candida albicans* mushrooming could be partially explained by weakness of immune system and metabolic disturbance. Such strains may be determinants of deleterious gastrointestinal outcomes children with ASD. The relevant medical and non- medical drugs seem a substantial therapeutic option in managing the clinical symptoms traced by such pathogenic cultured microflora. This pharmacological and non-pharmacological intervention should be considered as a part of multi-component combined with standards supportive therapy. Further investigation to elucidate the mechanistic

relationship between intestinal lining and autistic symptoms is needed.

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