Original Article

Children's asthma and the third world: an approach

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Summary. *Background:* More than a million visits/year characterize acute asthma morbidity at Venezuela's (24 million inhabitants) Ministry of Health ambulatory services, caring for 80% or more of the population; acute morbidity from asthma is second to "viral syndrome" but ahead of diarrhea and other diseases. These acute episodes are the only contact of a poor asthmatic child with this health care system and portray the prevailing approach focused around acute care; to be reversed, a simple cost/effective program ought to be implemented during these acute asthma visits. Since convenience of administration is a key factor in compliance, a pilot study to explore the efficacy of budesonide CFC 400 μg administered on a once-a-day basis for adherence was carried out within a naturalistic real-world design. *Methods:* Thirty persistent asthmatic patients attending the Allergology Unit of the Hospital Pediátrico San Juan de Dios in Caracas were enrolled, and their asthma signs/symptoms quantified and registered on diary cards (0-3 scale) as well as peak flow measurements in am/pm for a period of 2 weeks prior to budesonide administration (control data) and until completion of study. Only 12 (mean age: 9 years) of the initial patients were able to properly keep a diary and scheduled visits for a period of 15 weeks. *Results:* Data allowed comparison between pre- and post-treatment symptoms/signs scores and PF values. After 3 weeks treatment with budesonide, statistically significant improvements were shown for all parameters, except for PF, whose minor improvements did not reach statistical significance. *Conclusions:* Budesonide CFC 400 μg administered once a day seems effective in control of asthma signs/symptoms within study design. Confirmation of the above findings in larger groups of patients, treated similarly and for longer periods of time, seems justified. A simple cost-effective intervention, analogous conceptually to the proven successful oral rehydration therapies for diarrhea in public health, should be considered in third world countries with high urban asthma prevalence.

Key words: children, asthma, third world, approach, cost-effectiveness.

Resumen. Más de 1 millón de visitas/año caracterizan la morbilidad por asma aguda en los servicios ambulatorios del Ministerio de Sanidad de Venezuela (24 millones de habitantes), que atienden a un 80% o más de la población. La morbilidad aguda por asma está por detrás del síndrome vírico, pero por delante de la diarrea y otras enfermedades. Estos episodios agudos son el único contacto de un niño asmático pobre con este sistema de sanidad y reflejan el enfoque predominante centrado en los cuidados agudos. Para cambiar esta situación, debería implementarse un programa simple y rentable durante estas visitas por ataques de asma aguda. Puesto que la facilidad de la administración es un factor clave para el cumplimiento, se realizó un estudio piloto para investigar la eficacia de budesonida CFC 400 μg administrada una vez al día para el cumplimiento terapéutico, enmarcado en un diseño práctico basado en el mundo real. *Métodos:* Se incluyeron treinta pacientes asmáticos persistentes que acudían a la consulta de la Unidad de Alergología del Hospital Pediátrico San Juan de Dios de Caracas, y se cuantificaron y registraron sus signos y síntomas asmáticos en diarios (escala de 0 a 3), así como las medidas del flujo máximo por la mañana y por la tarde durante un período de 2 semanas antes de la administración de budesonida (datos de control) y hasta la finalización del estudio. Sólo 12 (edad media: 9 años) de los pacientes iniciales fueron capaces de cumplimentar el diario y asistir a las visitas programadas satisfactoriamente durante un período de 15 semanas. *Resultados:* Los datos permitieron comparar los valores del flujo máximo y las puntuaciones de los síntomas y signos antes y después del tratamiento. Tras 3 semanas de tratamiento con budesonida, se mostraron mejoras estadísticamente significativas en todos los parámetros, excepto en el flujo máximo, cuyas pequeñas mejoras no alcanzaron una significación estadística. *Conclusiones:* Budesonida CFC 400 μg administrada una vez al día parece ser eficaz en el control de los signos y síntomas del asma en el diseño del estudio. La confirmación de los hallazgos anteriores en grupos de pacientes más numerosos, tratados de forma similar y durante períodos de tiempo más prolongados parece justificada. En países del tercer mundo con una prevalencia alta de asma en zonas urbanas, se debería considerar una intervención simple y rentable en el sistema sanitario público, conceptualmente análoga a los tratamientos de rehidratación oral con eficacia probada para la diarrea.

Palabras clave: Niños, asma, tercer mundo, aproximación, rentabilidad.

Introduction

According to the International Study for Asthma and Allergies in Children (ISAAC) study date – Phase 1 [1], the prevalence of childhood asthma in underdeveloped nations is similar to that in the industrialized world. However, a significant difference underscores this fact: 40-50% of the total population is under 15 years of age vs only 20% in more developed nations [2]. Furthermore, despite significant efforts to implement national/ international guidelines, asthma is still considered an acute disease not only by patients/parents but also physicians and other healthcare professionals [3-5]. Traditional treatments (bronchodilators, antihistamines, cough medicines and antibiotics) have not changed significantly in spite of these guidelines, as demonstrated in Brazil [3], a mirror of what is occurring in the rest of Latin America [4], where very little use of controller medications [inhaled corticosteroids (ICS)] is reported. The data contributed by AIRLA [5] confirm these findings. However, when asthma guidelines and management programs are implemented, "adherence" to treatment regimens improves and control of the disease ensues [6,7]. ICS are first line in control of persistent asthma [8] and for better compliance, cost and easier ways to administer inhaled medications need to be considered [9-11].

Asthma is a public health problem and a well recognized urban chronic respiratory disease in Venezuela [12]. Acute asthma ranks second in morbidity after the "viral syndrome" and ahead of diarrhea and other diseases (with more than a million acute asthma crises/year) at the Ministry of Health ambulatory services [12]. This network system attends to the majority (70-80 % or more) of a predominant young and urban - around 80% - population (24 million inhabitants; 40% under 15 years of age) living in crowded urban dwellings in variable conditions of poverty [13,14]. On the other hand, sales [15] of respiratory drugs that favour 9:1 rescue vs controller medications, along with a slow dissemination of pertinent information [12] from national-international asthma guidelines into the medical community, and a shortage of "specialized asthma clinics" across the country [16], rounds up a focused and prevailing general approach centered on acute care.

The only contact an asthmatic child might have with this health care system is via acute episodes; understandably, but far from ideal, logic mandates the use of this opportunity for education in use of controller medications. Key factors in such a context are cost and convenience of administration [9-11]. The cost of a year's treatment of budesonide (BUD) 400 mcg CFC is equivalent to the cost of care of a single acute asthma visit [17]. ISAAC Venezuela 2003 [18] informs of nearly one million urban persistent asthmatics (6-13 years of age) and hence the need for long-term anti-inflammatory medications. A once-a-day schedule is undoubtedly more convenient for patients and families.

We carried out a pilot study, with a naturalistic and real world design, to test the efficacy of a single daily dose of budesonide (BUD) 400 μg in CFC form, since patients are more familiar with its use and in terms of cost it [17] has some advantages over a dry powder inhaler (DPI).

Methodology

A naturalistic or real-world efficacy study of BUD in CFC form 400μg administered once a day through an extension mouth piece device (inhalocamara™) for control of persistent pediatric (0-18 years old) asthma was carried out at the Allergology Unit of Hospital Pediátrico San Juan de Dios, attending low-income patients and families from the metropolitan area of Caracas, Venezuela.

Patients recorded daily symptoms/signs, rescue medicine use, exercise tolerance or physical limitation and peak flow measurements with a portable device in mornings (am) and evenings (pm), for 15 weeks on card diaries. The protocol was approved by the Bioethics Committee of our institution.

Study characteristics were outlined and treatment offered to asthmatic children and families. After informed consent was signed, the following inclusion criteria were considered:

Inclusion Criteria

- Children with persistent disease for the previous six months, as outlined in GINA, and with a negative history of asthma exacerbations 2 weeks prior to enrollment.
- At least a 10% (L /min) airway reversibility improvement, with the Wright's™ peak flow meter device (WPFM, Ferraris Medical Ltd) ,15 minutes after two "puffs" of an aerosol (CFC propellant) combination of albuterol 120μg + ipratropium bromide 21μg (Combivent™), administered through an extension mouthpiece device (inhalocamara™).
- Absence of clinical sinus infection; X-rays of the paranasal sinuses, when affordable, were obtained in the majority of patients and the following criteria for disease observed: total opacity of one or more maxillary sinus and/or maxillary mucosal edema > 4 mm and/or fluid level. Total resolution, confirmed by subsequent X-rays, was needed before inclusion.
- Positive prick tests (greater or equal to 3 mm wheal size of negative control) with readings at 10 minutes for at least two antigens, performed with: *D. pteronyssinus / D. farinae mix**, *Periplaneta americana**, *Blomia tropicalis***, dog epithelia***, cat epithelia***, grass mix*** and mold mix***.
- Willingness of either the patient or parent to keep a registry of symptoms/signs on a 0-3 scale for

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daytime/night-time symptoms/signs, exercise-provoked symptoms/signs or exercise tolerance and use of "rescue" medicine. Also, peak flow (PF) measurements performed with a portable device in am / pm were to be registered on a diary card.
– Willingness to attend follow-up visits for careful review of diaries and supervision of inhalation technique.

During this first visit (Visit 0), thirty patients were recruited and educated in portable mini peak flow meter use (True Zone™) and recognition of asthma signs/ symptoms for their registry on a 0-3 scale in diary cards. A special consideration with this low-income and under-educated population was due completion of diaries for "baseline" data, and hence, study validity. Allergy environmental control and general avoidance measures were not emphasized, to avoid a possible interference in the interpretation of results. Only p.r.n. use of 2 "puffs" of an aerosol combination of (CFC) albuterol 120µg + ipratropium bromide 21µg, (Combivent™) every 4 to 6 hours, was allowed for symptom control (cough, wheezing, chest tightness and difficulty breathing).

Visit **1** (BUD treatment), 15 (+/- 2) days after enrollment, a careful review of diaries during this first two weeks (baseline data) was carried out to investigators' satisfaction. Later, self- or parent administration of BUD aerosol (CFC), two 200 mcg "puffs" via an extension mouth piece (inhalocamara™) device at tidal volume (with 10 seconds retention after inspiration) was supervised. Instructions were given to repeat this maneuver, for convenience, once a day at 5 p.m. after returning from school. All patients took no longer than 10 minutes to master this technique. Only p.r.n. use 2 "puffs" of an aerosol (CFC) combination of albuterol 120 µg + 21µg ipratropium bromide (Combivent™) was allowed for symptom control.

Following Visit **1**, the schedule of visits was:

Visit **"2"** at 15 (+/- 2) days; Visit **"3"** at 30 (+/- 2) days; Visit **"4"** at 60 (+/- 5) days; Visit **"5"** at 90 (+/- 5) days and Visit **"6"** at 105 (+/- 5) days. At each visit, after careful review, diary cards were provided to patients.

Quality of Life

Quality of life was explored through a simple questionnaire regarding patient and parents opinion about the general state of health (affected, improved and much improved) based on the presence/absence or virtual absence of asthma symptoms/signs (daytime, night-time and with laughter or exercise) before and after completion of study. This qualitative questionnaire was administered separately to parents and patients.

Clinical parameter evaluation

Quantitative analysis of the efficacy of BUD via aerosol was obtained through a 0-3 scale of symptoms/signs, rescue medicine use and mini PF value registry, as follows:

A- Daytime symptoms/signs; B- evening or night-time symptoms/signs; C- limitation in physical activity or exercise tolerance; D- use of rescue medication (2 puffs = 1 point) and portable peak flow measurements in am and pm.

Scale

0 - No symptoms or signs of asthma (no cough, no wheezing or difficulty breathing)
1- Mild symptoms/signs: "I have some asthma, but very well tolerated"
2 - Moderate symptoms / signs: "Asthma bothers me, affects my sleep or exercise"
3 - Severe or incapacitating symptoms/signs: "Asthma wakes me up at night or prevents me from sleeping; I cannot perform daily activities or exercises because of asthma; I feel I have asthma most of the time"

Statistical analysis

The paired "t" test was used to detect changes or differences in all parameters between initial pre-treatment values and for each subsequent week after treatment; $p < 0.05$ was considered significant.

Materials

Budesonide (Inflammide™ 200µg/puff MDI, CFC, Boehringer-Ingelheim), the combination of albuterol 120 µg/salbutamol + ipratropium bromide 21 µg (Combivent™, MDI, Boehringer – Ingelheim), the mouth extension device ("inhalocamara™") and the mini peak flow meters (True Zone™, Monaghan) were supplied by Boehringer-Ingelheim C.A., Venezuela.

Results

Out of the thirty initial recruited and enrolled patients, only twelve completed the study. Inability to attend scheduled follow-up visits (transportation costs) and difficulties in interpretation/registry of symptoms, even although at the beginning of the study patients and families appeared to reasonably comprehend this task, were among the reasons for such a high dropout rate. Plain lack of interest in complying with study requirements throughout (filling in diary cards, visits, etc), -once free medication was obtained-, was also observed.

A high rate of skin sensitization to *Dermatophagoides pt./Dermatophagoides f* mix as well as for *Blomia tropicalis* (100% with wheal sizes greater than 5 mm) and cockroach allergens (70% with wheal sizes greater than 3 mm) was found [19]; less than 10% of patients were positive to other allergens.

Age, sex, some pertinent clinical data and results of the quality of life questionnaire before and after treatment with BUD are provided in Table 1.

Table 1. Age, sex, some clinical parameters and quality of life for 12 patients completing the study

		Pre-treatment			Post-treatment			
Patient Visit 0 WPFM pre WPFM post L/min	Age/gender	EIC LIC/K	Weekly night-time symptoms >once/w	>3 asthmatic exacerbtions in previous year	EIC LIC/K	Weekly night-time symptoms >once/w	Asthmatic exacerbations during study	Quality of Life
M, G 345/390	14 ♀	yes	yes	yes	no	no	no	⇑
H, J 110/160	5	yes	yes	yes	no	no	no	⇑
C, P 270/330	10	yes	yes	yes	no	no	no	⇑
J, L 445/480	16	yes	yes	yes	yes	yes	no	⇑
O, A 245/280	9 ♀	yes	yes	yes	no	no	no	⇑
E, R 190/215	6	yes	yes	yes	no	no	no	⇑
G, M 340/380	13	yes	yes	yes	no	no	no	⇑
A, A 280/340	9	yes	yes	yes	yes	yes	yes	Ø
G, A 145/205	6	yes	yes	yes	no	no	no	⇑
M, J 320/375	13	yes	yes	yes	no	no	no	⇑
R, A 205/250	8	yes	yes	yes	no	no	no	⇑
G, A 190/230	8	yes	yes	yes	no	no	no	⇑

yes: presence of; **no:** absence or virtual absence of; **EIC:** Exercise-Induced Cough/wheezing; **LIC:** Laugh-Induced Cough/wheezing; **Ø:** lack of improvement in Q of L; ⇑: Q of L much improved; **K:** daily or almost daily symptoms/signs.

Reliable results (appropriate registry of asthma symptoms/signs and mini PF values) were available for twelve patients until week 11; for 11 patients from weeks 12 to 14 and for 9 patients until week 15. Mean scores (scale 0-3) for daytime and night-time symptoms/signs and physical activity limitation and/or exercise tolerance (0.9767; 1.0917 and 1.0608, respectively) during the pre-treatment period allowed us to categorize these patients as mild to moderate asthmatics (Table 2).

However, during the same period, the rescue medication score was 2.4367, reflecting frequent use and possibly suggesting difficulties in perception of disease severity; numbers were similar, in either am or pm, for PF measurements. A reduction in symptoms/signs of asthma, exercise tolerance or physical limitation and use of rescue medication scores started from the first week of treatment (and continued to descend until the end of the study), except in the case of PF measurements (which remained the same throughout the treatment phase). Statistical significance for the above parameters was achieved by the third week of treatment (40% reduction in symptoms/signs of asthma and 80% reduction in rescue medicine use: $p< 0.01$) as shown in Table 2. From the third week on, all scores continued a statistical significant decline until week 15, in comparison with pre-treatment values ($p < 0.01$), except in the case of daytime symptoms/signs during the ninth week ($p < 0.05$). By the fourth week, scores for daytime and night-time symptoms/signs declined to less than half of initial pre-treatment values and one sixth for rescue medicine use. Exercise tolerance or physical limitation in the fifth week was not statistically significant, though 20% below pre–treatment values. At

Table 2. Average of score means for 12 patients completing the study (see methodology) A: daytime symptoms/signs; B: night-time symptoms/signs; C: Exercise tolerance, D: rescue medicine use.

Week	A	B	C	D
Pre treatment	0.9767	1.0917	1.0608	2.4367
1	0.8575	0.7033	0.7742	1.1667
2	0.6433	0.4408	0.6308	0.7383
3	0.4167*	0.3925*	0.4517*	0.4292*
4	0.4625*	0.3808*	0.4525*	0.4275*
5	0.5242*	0.5000*	0.8333	0.7383*
6	0.2733*	0.4042*	0.4392*	0.2625*
7	0.3458*	0.4058*	0.3692*	0.2625*
8	0.4292*	0.3092*	0.3808*	0.4050*
9	0.4283	0.5117*	0.5233*	0.5008*
10	0.2500*	0.3433*	0.2267*	0.4517*
11	0.2008*	0.2850*	0.2617*	0.3575*
12	0.1300*	0.2473*	0.1418*	0.1827*
13	0.1564*	0.2473*	0.2200*	0.3882*
14	0.0773*	0.0918*	0.0909*	0.0518*
15	0.1433*	0.1433*	0.1267*	0.3811*

* $p<0.01$.

the end of the study, all score values were 80% below pre–treatment. For mini PF measurements, a tendency towards improvement could be observed, though it was not statistically significant. Quality of life questionnaire, with patient/parent opinions alike, showed that treatment with budesonide introduced a "much improved" state in 11 of the 12 studied patients that completed the study.

Discussion

At the Ministry of Health ambulatory services, a care network attending to 80% or more of Venezuela's population (24 million inhabitants), acute asthma ranks second in morbidity after the "viral syndrome" and is followed by diseases such as diarrhea and others. This morbidity has steadily increased, tripling over the past fifteen years and surpassing a million acute asthma visits/year by 2002 [16]. In comparison, the United States, with a population 17 times greater, has only twice this number of acute emergency visits for asthma [16].

Treatment for these recurrent episodes - the only contact poor asthmatic children have with the health system - comprises [4,16] several doses of nebulized short-acting beta 2 agonists and a variable assortment of medications on discharge (cough remedies, broncho-dilators and anti-histamines, among others), although scarce use of inhaled steroids, a pattern shared by many Latin American countries [5,20] .

Clinicians must pursue novel approaches in the midst of a third-world context- GINA guidelines notwithstanding - to deal effectively with these health care realities[20]. For simple cost/effective public health interventions to be implemented - in analogy to oral re-hydration therapy programs, where families are instructed *in situ* on how to prepare and administer oral fluids - they need to be given during these acute episodes. ICS are the mainstay of persistent asthma therapies [8], improving symptoms and frequency of recurrent attacks delaying visits to the emergency room and ambulatory health services [21-26]. ICS have a long record of safety and effectiveness [27-32], as does budesonide used daily [33- 48], mostly in powder form. BUD in CFC form (and its affordability [17]) has not been reported for asthma control. A 1-year treatment with 400 μg/day, $5 US dollars/month, is equivalent to the cost of care of a single asthma crisis, and compares very favorably with [49] the monthly minimum wage, $US 127, thus making it a suitable alternative.

Experiences in similar contexts are scant [20]. However, Perera (1995) in Sri Lanka employed inhaled beclomethasone dipropionate/budesonide for a year in 86 persistent asthmatic children on variable dosing schedules of twice or more a day, with very cost effective results [7]. However, and unlike our study, patients were from upper-income groups, received intensive asthma education (2 days in hospital), not one missed a follow-up appointment and all finished the study. Importantly enough, on the basis of this effort, the Sri Lankan Ministry of Health agreed in principle to provide ICS to needy children free of charge [50].

Our pilot study, designed in the hope of reflecting the realities of patient care, has several points worth mentioning:

BUD in aerosol CFC form, at a children's maximum safe [28,30] and once-daily dose (400 mμg), is reported for the first time and is shown to be able to control asthma signs and symptoms over a period of 15 weeks in a selected group of persistent asthmatic children, with no significant influence on portable PF value measurements, as has previously been reported [51-55]. Our patients did not receive intensive asthma education and were all from the lower socioeconomic groups. The inappropriate completion of diaries with lack of comprehension of tasks involved, as well as transportation cost (not contemplated in the original budget), were responsible, among other reasons, for the high dropout rate observed. A trial in larger groups of patients treated similarly for longer periods of time, targeting only asthma symptom/sign control to improve quality of life and minimize visits to acute care facilities, seems justified.

One must acknowledge the potential significance of educational and socioeconomic factors, as well as cultural idiosyncrasies, if an effective asthma control program is to be implemented. Also, awareness to visualize those particularities of health care in a given society subject to change, albeit slowly. When applied, GINA and other guidelines have been successful, mostly in developed countries [6,56]; its cumbersomeness is but one difficulty found in other areas of the world [16].

Although far from ideal, education within this context - a key element in asthma - must find its way in the short term with the help of pictorial handouts, and mastering

of the rule of "2s " or a similar algorithm [57,58] to initiate control medications. User-friendly inhaler devices with cost-effective medications on a once-a-day dosing for adherence can complement this approach. The most recent potent combinations of long-acting beta agonists and ICS could have a place in this scheme [59,60]. Interestingly, cell phone lines are wide-spread and readily available in our urban conglomerates [61] and could be used to improve on follow-up care, as others have shown [62]. In essence, an approach tuned to the particular needs and realities of third-world countries with high urban asthma prevalence and ambulatory/emergency room care practices could drive people away from the widespread use of inappropriate folk remedies [63] and guide medical/ paramedical personnel better in the use of asthma control medications. Less use of health care facilities improves the quality of life for patients and families, and tangible and intangible savings are worth looking into, especially in depressed economies.

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