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Camel milk: An alternative for cow's milk allergy in children

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ABSTRACT

Treatment of cow's milk allergy (CMA) in children includes avoidance of cow's milk and providing a milk substitute. This study was designed to determine whether CMA children could safely consume camel's milk as an alternative, and skin-prick test (SPT) to camel's milk could be a reliable tool in selecting them. Between April 2007 and February 2010, children with confirmed CMA seen at the Allergy–Immunology Clinic, Hamad Medical Corp., were enrolled into this prospective cohort study. Subjects had a detailed history and medical examination, complete blood count with differential count, total serum IgE, and specific IgE test and SPT to cow's milk. Patients with positive SPT and an elevated cow's milk–specific IgE had negative SPT to camel's milk. Of 35 children (23 male and 12 female children) aged 4–126 months (median, 21 months), 23 patients (65.7%) presented with acute urticaria, 17 (48.6%) with atopic dermatitis, 9 (25.7%) with anaphylaxis, 8 (22.9%) with failure to thrive, and 5 (14.3%) with chronic vomiting. Twenty-eight patients (80%) had family history of allergy. Twenty-six patients (74.3%) were breast-fed for ≤18 months. Mean white blood cell count was 9860.5 cells/μL, absolute eosinophil count was 1219 cells/μL, IgE was 682 IU/mL, and cow's milk–specific IgE was 22.01 kU/L. Only 7 patients (20%) had positive SPT to camel's milk and 28 (80%) were negative to camel's milk. All patients with negative SPT took camel's milk without any reactions. In children with CMA, SPT is a reliable clinical test in ruling out reactivity to camel's milk so these children could safely take camel's milk as an alternative nutrient.

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Cow's milk allergy (CMA) is the most common food allergy during infancy and early childhood.[1] Its only proven present therapy is a total elimination of cow's milk protein from the diet[2] and introduction of alternative formulas.[3,4] Several studies have evaluated the clinical use of animal nonbovine milk as an alternative including that of sheep, goat, donkey, mare, and buffalo.[5–8] The Food and Agriculture Organization commented on camel's milk: "from all the data presented it is clear that the camel produces a nutritious milk for human consumption."[9] It is nutritional and therapeutic benefits are comparable with human milk.[10]

There is scarce medical literature on clinical use of camel's milk in CMA in children. The only studies published had very small sample size or methodological deficiencies.[11,12]

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OBJECTIVES

The aim of this study was to (a) determine whether SPT could be used as a reliable, clinical, diagnostic tool in ruling out camel's milk allergy in children with CMA and (b) determine whether these candidate, nonreactive children could safely be given camel's milk as an alternative food.

SUBJECTS AND METHODS

Subjects

This prospective cohort study was performed from April 2007 to February 2010 on 35 children aged 6–126 months who were referred to the Allergy–Immunology Clinic at Hamad Medical Corp. with symptoms related to CMA. They were exclusively breast-fed for 15.1 (range, 3–24 months) months. The inclusion criteria required clinical history suggestive of CMA with only (a) an elevated cow's milk protein–specific IgE and (b) positive skin-prick test (SPT) to cow's milk protein but not to oral challenge test. Exclusion criteria were use of ß-blockers or immunosuppressive drugs; severe cardiovascular, renal, debilitating disease (*e.g.*, terminal malignancy), marasmic kwashiorkor, or respiratory disease, severe skin disease that precludes skin testing; or persistent daily need for oral antihistamines. Data were collected using a structured interview and a standardized questionnaire. All participants/legal guardian gave written informed consent after receiving full

Table 1 **Cow's milk–allergic children segregated according to skin-prick test (SPT) reactivity to camel's milk**

Variable	Camel's Milk SPT Reaction		*p* Value
	Positive (n = 7) Mean ± SD	Negative (n = 28) Mean ± SD	
Age (mo)	40.43 ± 16.21	33.07 ± 5.66	0.598
BMI	17.87 ± 3.33	16.19 ± 1.90	0.084
WBC (cells/μL)	11,428.57 ± 3673.19	9438.42 ± 5158.3	0.348
AEC (cells/μL)	705.57 ± 188.79	1357.69 ± 504.87	0.316
Total IgE level	348.33 ± 278.29	753.74 ± 180.43	0.514
CMP-specific IgE titers	26.95 ± 15.19	20.88 ± 6.28	0.687

AEC = absolute eosinophil count; BMI = body mass index; CMP = cow's milk protein; WBC = white blood cell count.

explanation of the procedure given individually before testing.

The study was approved by the Research Ethics Committee of Hamad General Hospital, Hamad Medical Corp., in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All children were included in this study after receiving informed consent from parents. We evaluated camel's milk sensitization by using SPT with camel's milk. Unfortunately, parents of children who were positive to camel's milk tests refused offered oral challenge tests.

SPTs and Reagents

Camel's milk was collected from local camel farms. It was sterilized at 100–120°C for 10–20 minutes.[13] After cooling down, it was stored placed at 4°C and used within 3 days. SPTs were performed following the "Updated Practice Parameter of Allergy Diagnostic Testing."[14] All patients had SPTs with homogenized cow's milk. Tests were performed on the volar surface of the forearm with undiluted cow's milk and camel's milk allergens using a sterile lancet (Stallergen, Paris, France). A 50% glycerin/saline solution and HCl histamine solution at 10 mg/mL were used as negative and positive controls, respectively. SPTs were read after 15–20 minutes, and tests were considered positive if the mean diameter of wheal was at least 3 mm to the milk and greater than the negative control. Cow's milk–specific IgE was measured by RIDA Allergy-Screen Panel 3 test kit (R-Biopharm AG, Darmstadt, Germany).

Statistical Analysis

The data were analyzed using the Statistical Packages for Social Sciences (SPSS, Inc., Chicago, IL), Windows Version 17. Frequency distributions, one- and two-way tabulations, were obtained. Student's *t*-test was used to ascertain the significance of differences between mean values of two continuous variables and confirmed by nonparametric Mann-Whitney test. Chi-square analysis was performed to test for differences in proportions of categorical variables between two or more groups. Fisher's exact test (two tailed) replaced the chi-square test if the expected frequency was less than five in any cell. The level of $p < 0.05$ was considered as the cutoff value for significance.

RESULTS

A total of 35 children, 23 boys and 12 girls, were included in this study. Their median age was 21 months. Boys outnumber girls by a ratio of 1.9: 1. Nearly 75% of patients were breast-fed for ≤18 months. Family history of allergic diseases was positive in 28 patients (80%). The studied children had the IgE-mediated most common allergic presentations, *viz.*, acute urticaria (65.7%), followed by atopic dermatitis (48.6%). Peripheral blood eosinophilia (absolute blood count, ≥500 cells/μL)[15] was noticed in 20 patients (57.1%), and an elevated total serum IgE was seen in 33 patients (94.3%).[16] Laboratory results revealed the mean (±SD) white blood cell count, 9860.58 ± 852.81cells/μL; absolute eosinophil count, 1219.36 ± 400.67 cells/μL; IgE, 682.19 ± 151.67 IU/mL; and cow's milk–specific IgE, 22.01 ± 5.75 kU/L. Only 7 patients (20%) were SPT^+ to camel's milk and 28 patients (80%) were SPT^- to camel's milk. All patients who were SPT^- to camel's milk were fed camel's milk without any reactions.

Table 1 shows CMA children segregated according to SPT reaction to camel's milk. There was no significant difference between camel's milk SPT^+ children and camel's milk SPT^- children in terms of age (p = 0.598), body mass index (p = 0.084), white blood cell count (p = 0.348), absolute eosinophil count (p = 0.514), total serum IgE (p = 0.316), or cow's milk—specific IgE (p = 0.687). Thus, none of these parameters worked as an indicator in selecting children for camel's milk ingestion. All camel's milk SPT^- patients tolerated oral camel's milk without any reaction. However, parents of children with positive camel's milk tests refused double-blind, placebo-controlled food challenges (DBPCFCs) because there is no literature on risk

of reaction to camel's milk in skin test–positive patients.

DISCUSSION

This pilot clinical study reveals that in our subjects with CMA, camel's milk was tolerated by all 80% who had negative SPT. This indicates low cross-allergenicity between camel's milk and cow's milk proteins. Noh *et al.* showed that peripheral eosinophilia is a good predictor of food allergy.[17] In our study neither total IgE nor peripheral eosinophil count was associated with reactivity to camel's milk.

Previously, the Shabo *et al.* study[11] recommended that food allergic children be given camel's milk. Besides its small sample (eight children), the demographic characteristics, type, and severity of allergic disease, and the absence of any diagnostic allergic test (food allergen–specific IgE or SPT), made that data be rather anecdotal. In a study by Katz *et al.*,[12] there were no data on two-thirds (16 of 24 subjects) of subjects regarding camel's milk SPT status. Of the remaining eight patients, only two (25%) had positive SPT to camel's milk. Contrary to the international guidelines that take only wheal mean diameter as a cutoff to consider reaction as positive, that study considered wheal or flare in regarding a test positive.[14] In addition, in that study none of the patients with negative SPT to camel's milk was given camel's milk because it is from a nonkosher animal.

Our clinical data showed that 80% of CMA children could be safely given camel's milk without reactions. This confirms previous *in vitro* studies that suggested camel's milk as an alternative food in CMA children on the basis of low cross-reactivity.[6,18] The homology between different mammalian milk proteins and cow's milk protein has been the major focus of many studies. Restani *et al.*,[6] revealed that monoclonal antibodies specific for cow's milk proteins reacted with milk proteins of sheep, goats, buffalos, and others, but not that of the camel. Medical literature reveals that cross-reactivity between cow's milk and camel's milk is the least among animal milks.[6] Based on structural similarities the highest homology, in percentage, is noted between cow's milk protein and that of Bovidae (*viz.*, water buffalo, 96.1%), lower with that of Camelidae (the one-humped camel Arabian camel, *Camelus dromedaries*, 60%), and least with human milk (58.4%).[19] Contrary to structural homology, immunologic cross-reactivity by immunoblotting was absent between cow's milk and camel's milk.[20]

A study by El-Agamy [20] revealed that when applying camel's milk protein–specific antisera in immunoblotting analysis, there was no immunologic cross-reactivity between camel's milk and cow's milk proteins. Furthermore, same results were obtained with serum from 40 CMA children, 6 months to 8 years old. That study attributed this no reactivity to dissimilarities between cow's milk protein and camel's milk epitopes. That study was an *in vitro* study and lacked clinical confirmation by SPT or oral challenge.

The strength of our study is that it is a cohort, prospective, clinical study on a relatively medium-sized sample. It also clinically confirmed negative SPT reactivity to camel's milk by taking camel's milk.

However, our study has some limitations. Subjects with positive SPT to camel's milk were not evaluated by a formal, supervised, titrated, oral challenge test (*e.g.*, DBPCCFCs). It also did not have any *in vitro* part to define the similar and/or dissimilar parts of the cow's milk and camel's milk proteins using the sera of our subjects.

CONCLUSIONS

In summary, this study confirms that camel's milk could be safely given to the majority of children with CMA. We have also shown that SPT to camel's milk could work as a dependable diagnostic indicator in selecting candidate children with CMA who could use camel's milk as an alternative nutritious food.

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