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Role of adenoidectomy in correction of anemia in patients with chronic adenoid hypertrophy

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Abstract
Objective: Is to investigate the role of adenoidectomy in correction of anemia in patients with chronic adenoid hypertrophy.
Patients and Methods: A prospective interventional self-controlled study included 60 patients (33 males, 27 females), with adenoid hypertrophy and anemia and diagnosed by nasopharyngeal endoscopic examination, CBC, nasopharyngeal plain X. ray and iron profile. Patients ages ranged from 4 to 12 years and classified into 3 groups A,B and C. In group A, only adenoidectomy was performed. In group B, adenoidectomy was performed and iron therapy was prescribed for four months postoperative. While in group C, no surgery was done but only iron therapy for 4 months.
Results: Rise in the hematological parameters was found in the three groups. Group B shows the most evident rise. This can be explained by the fact that the rise in hematological parameters in the group A was masked by blood loss during adenoidectomy and in group C, no surgery was done, so no blood loss has occurred.
Conclusion: Anemia may be associated with adenoid hypertrophy. The type of anemia which develop in those patients is anemia of chronic illness which is often microcytic hypochromic but other types also present like normocytic hypochromic and microcytic normochromic.

Keywords: adenoid hypertrophy, adenoidectomy, anemia

Introduction
Nasopharyngeal tonsil is a mass of lymphatic tissue situated posterior to the nasal cavity and in the roof of nasopharynx. Normally in children, it forms a soft mound in nasopharynx, just above and behind the uvula. Adenoids, is defined as hypertrophy and / or inflammation of nasopharyngeal tonsil enough to produce symptoms [1]. Children with adenoid hypertrophy, furthermore, are likely to be anemic and ill-nourished and under developed [2]. The pathogenesis of the anemia of chronic illness have focused on three principal abnormalities:
1. Shortened erythrocyte survival.
2. Impaired bone marrow response.
3. Disturbance in iron metabolism [3]

Patients and Methods
60 patients 33 males, 27 females with adenoid hypertrophy and anemia and divided into three groups (A, B, C) and subjected to full history.

Examination
Full evaluation by general and Otorhinolaryngology examination.

Nasopharyngeal endoscopy
Was done by flexible and rigid endoscopy to detect adenoid hypertrophy.

Investigations
a. Nasopharyngeal Plain X. ray (Lateral View).
b. Complete Blood picture.
c. Serum iron profile, TIBC, ferritin and transferrin saturation.
d. Coagulation Profile

Results
This study included 60 patients with adenoid hypertrophy and anemia, in whom adenoidectomy was indicated. Patients were matched for age and sex.

Table 1: Comparison of demographic data among studied three groups, Total **(**N=60)

	Group A N=20		Group B N=20		Group C N=20		P-Value
Age years (Mean±SD)	7.45±2.72		7.2±2.4		7.2±2.61		>0.05 NS*
Sex	N	%	N	%	N	%	
Male	10	50.0	9	45.0	14	70.0	>0.05 NS**
Female	10	50.0	11	55.0	6	30.0	

Table 2: Comparison between preoperative and postoperative values of RBCs count, Hb, MCV, MCH, S.iron level, TIBC and transferrin saturation in group A**.** Total (N=20)

		Mean	±SD	P-Value*
RBCs (million micro/L)	Pre-operative	4.67	0.89	0.486*
	Post-operative	4.85	0.84	
HB (g/dL)	Pre-operative	9.62	2.3	<0.001 S*
	Post-operative	13.4	0.8	
MCV (Micro m3)	Pre-operative	75.1	8.55	0.02 S*
	Post-operative	83.16	12.13	
MCH (pg)	Pre-operative	24.5	3.59	<0.001 S*
	Post-operative	28.48	0.97	
S.iron (mg/dL)	Pre-operative	41.68	6.38	<0.001 S*
	Post-operative	72.91	18.2	
T.I.B.C (mg/dL)	Pre-operative	455	54.76	>0.05 NS*
	Post-operative	454.85	54.7	
Ferritin (ng/ml)	Pre-operative	13.55	6.176	>0.05 NS*
	Post-operative	94.6	59.48	
Transferrin sat (%)	Pre-operative	21.39	7.0645	>0.05 NS*
	Post-operative	24.84	7.083	

Table 3: Comparison between preoperative and postoperative values of RBCs, Hb, MCV, MCH, S. iron level, TIBC and transferrin saturation in group B. Total (N=20)

		Mean	±SD	P-Value*
RBCs (million micro /L)	Pre-operative	4.67	0.89	0.486*
	Post-operative	4.79	0.3	
HB (g/dL)	Pre-operative	10.19	0.51	<0.001 S*
	Post-operative	13.51	1.002	
MCV (Micro m^3)	Pre-operative	71.535	7.6529509	0.019 S*
	Post-operative	81.435	16.41	
MCH (pg)	Pre-operative	22.89	3.374	<0.001 S*
	Post-operative	28.14	1.386	
S.iron (mg/dL)	Pre-operative	41.62	6.387	<0.001 S*
	Post-operative	84.34	26.36	
T.I.B.C (mg/dL)	Pre-operative	437.3	79.75	>0.05 NS*
	Post-operative	437.3	79.75	
Ferritin (ng/ml)	Pre-operative	12.8	3.87	<0.001 S*
	Post-operative	67.35	41.466	
Transferrin sat (%)	Pre-operative	15.36	6.628	<0.001 S*
	Post-operative	25.375	5.5410311	

Table 4: Comparison between preoperative and postoperative values of RBCs, Hb, MCV, MCH, S. iron level, TIBC and transferrin saturation in group C. Total N=20

		Mean	±SD	P-Value*
RBCs(million micro/L)	Pre-operative	4.71	0.82	<0.001 S*
	Post-operative	4.9	0.83	
HB (g/dL)	Pre-operative	10.16	0.53	<0.001 S*
	Post-operative	14.46	1.3031439	
MCV (Micro m^3)	Pre-operative	74.3	7.5	<0.001 S*
	Post-operative	84.9	3.05	
MCH (pg)	Pre-operative	24.27	3.47	<0.001 S*
	Post-operative	28.06	1.37	
S.iron (mg/dL)	Pre-operative	34.425000	9.021	<0.001 S*
	Post-operative	82.5	25.8	
T.I.B.C (mg/dL)	Pre-operative	374.1	126.3	>0.05 NS*
	Post-operative	374.15	126.3	
Ferritin (ng/ml)	Pre-operative	10.772	3.67	<0.001 S*
	Post-operative	90.55	53.5	
Transferrin sat (%)	Pre-operative	20.52	7.915	<0.001 S*
	Post-operative	24.56	7.793	

Table 5: Comparison of preoperative of RBCs, Hb, MCV, MCH, S. iron level, TIBC and transferrin saturation among studied groups. Total N=60

	Group A (N=20)		Group B (N=20)		Group C (N=20)		P-Value
	Mean	±SD	Mean	±SD	Mean	±SD	
RBCs (million micro/L)	9.62	2.3	10.19	0.509	10.16	0.54	>0.05 NS*
HB (g/dL)	9.62	2.3	10.19	0.509	10.16	0.54	>0.05 NS*
MCV (Micro m^3)	75.08	8.6	71.5	7.65	74.3	7.5027	>0.05 NS*
MCH (pg)	24.52	3.59	22.8	3.37	24.27	3.47	>0.05 NS*
S.iron (mg/dL)	41.6	6.38	41.6	6.38	34.4	9.02	>0.05 NS*
T.I.B.C (mg/dL)	455	54.76	437.3	79.75	374.1	126.3	>0.05 NS*
Ferritin (ng/ml)	13.5	6.17	12.8	3.87	10.7	3.67	>0.05 NS*
Transfrrin sat (%)	21.3	7.06	15.3	6.62	20.5	7.91	>0.05 NS*

Table 6: Comparison of post-operative of RBCs, Hb, MCV, MCH, S. iron level, TIBC and transferrin saturation among studied groups. Total N=60

	Group A (N=20)		Group B (N=20)		Group C (N=20)		P-Value
	Mean	±SD	Mean	±SD	Mean	±SD	
RBcs (million micro)	7.79	2.76	4.85	.809	4.94	.54	<0.001 S*
HB (g/dL)	13.45	0.81	13.51	1.002	14.465	1.3031	<0.001 S*
MCV (Micro m^3)	83.16	12.1	81.43	16.4	84.95	3.051	>0.05 NS*
MCH (pg)	28.4	0.971	28.14	1.386	28.06	1.37	>0.05 NS*
S.iron (mg/dL)	72.91	18.2	84.34	26.36	82.5	25.8	>0.05 NS*
T.I.B.C (mg/dL)	454.8	54.78	437.3	79.7	374.150	126.3	>0.05 NS*
Ferritin (ng/ml)	94.6	59.45	67.3	41.47	90.5	53.52	<0.001 S*
Transfrrin sat (%)	24.8	7.08	25.37	5.54	24.56	7.79	>0.05 NS*

Table 7: Operative complications of 1ry hemorrhage

Group	Operative complications
A	2 (0.1%)
B	2 (0.1%)
P. value	0.804

Discussion

Our study included 60 patients divided to 3 groups (20 patients in each group), matched for age, which ranged from 4 years to 12 years with the mean age was 7.3±1.3 which coincides with Cigdem *et al*., 2010 [4] who studied effect of adenoid hypertrophy on maxillofacial development. Regarding to sex our study included 33 males who represented (55%) and27females represented (45%) this gender preponderance is in agreement with Mohammed *et al*.,2017 [5]. Who studied diagnostic endoscopy in assessment of adenoid hypertrophy and with Acar *et al*., 2009 [6] who found among his population an incidence of (51.7%) malesmto (47.3%) females. Our study rise of hematological parameter comes in agreement with study done by Hans *et al*., 2004 [7] has reported a relationship between iron deficiency and SDB in patients with chronic heart failure, patients were given I.V iron and erythropoietin over 3 months, the mean Hb rise from 10.4 to 12.3 gm/dl, associated with this rise was a significant reduction in episodes of OSA as well as the improvement in anemia.

Our study also comes in agreement with study by Ryan etal., 2008 [8] who studied iron deficiency anemia and SDB in children and suggested that altered immunity due to iron deficiency, may lead to chronic sinonasal inflammation in affected children with resultant adenotonsillar hypertrophy, nasal obstruction and worsening of SDB, conversely, iron deficiency may be a resulting outcome of chronic sinonasal infection.

A study done by Sara *et al*., 2014 [9] support our study results about correlated anemia with adenoid hypertrophy. Our observation comes in accordance with their study as they found that patients with adenoid hypertrophy may have mild to moderate anemia with Hb level ranged from 9-11gm/dl [the lower limit of normal for this age group involved in the study is 11.5gm/dl]**.** Also it agrees with our study in finding that TIBC was below normal level in 90% of patients and was abnormal in 10% of patients. So the type of anemia associated with patients of adenoid hypertrophy is anemia of chronic illness based on decrease in TIBC (which is increased in iron deficiency anemia, both of studies observed anemia associated of chronic illness in patients with adenoid hypertrophy is mostly a result of chronic sinonasal infection and also type of anemia can be determined by Hb level, MCV, MCH, S.iron, TIBC and transferrin saturation. In contrast with Sara *et al*., 2014 [9] we found that their used hematological parameter as MCV was normal in 53% of patients i.e., normocytic anemia, and below normal level in 47% of patients i.e., microcytic anemia also MCH was normal in 57% of patients i.e., normochromic anemia, and below normal level in 43% of patients i.e., microchromic anemia and S. iron was normal in 58% of patients and below its normal level in 42% of patients but in our study MCV was normal in 26.7% of patients i.e., normocytic anemia, and below normal level in 73.3% of patients i.e., microcytic anemia and MCH was normal in 25% of patients i.e., normochromic anemia, and below normal level in 75% of patients i.e., hypochromic anemia**.**while S. iron was below its normal level in all patients of study**.** Regarding to comparison between preoperative and postoperative hematological parameters, our study is in agreement with Sara *et al*., 2014 [9] in the group who had only iron therapy they showed significant statstical difference as RBCs, Hb level, MCV, MCH, S.iron, TIBC and transferrin saturation showed elevated values because the subjects did not have any surgery i.e no blood loss. Also our study agrees with those results obtained by Sara *et al*.,2014 [9] in adenoidectomy groups as TIBC reached postoperatively to significant statstical values and even look to be more comprehensive than those obtained by work done by Sara *et al*., 2014 [9]. Anemia of chronic illness included in our study is oftenly microcytic hypochromic anemia which was observed in 71.7% of patients, while, normocytic normochromic anemia was observed in 23.3% of patients. Also normocytic hypochromic anemia was observed in 3.5% of patients and microcytic normochromic anemia was observed in 1.7% of patients. The patients in our study were classified to 3 groups. In the first group, only adenoidectomy was performed. In the second group, adenoidectomy was performed and iron therapy was prescribed for four months postoperative. In the third group, no adenoidectomy was done but only iron therapy was prescribed for four months. Hematological study was done preoperative and four months postoperative.

Results of T-test comparing the pre- and postoperative values in the three groups revealed that: In group A, there is rise in the postoperative values of RBCs count, Hb, MCV, MCH, TIBC and transferrin saturation and found to be statistically significant, but, a more strong statistically significant rise we found in the value of S. iron and feritin which reflects increase in the amount of circulating iron that is bound to transferrin. This justifies that adenoidectomy have a role in correction of anemia of chronic illness in patients with adenoid hypertrophy**.** Disturbance in iron metabolism plays an important role in the pathogenesis of anemia of chronic illness, Fillet *et al*., 2004 [10] reported that the hypoferremia associated with the anemia of chronic illness appears to result from impaired flow of iron from cells to plasma. All cells that normally participate in supplying iron to plasma appear to be affected**.** In group B, there is rise in the postoperative values of RBCs count, Hb, MCV, MCH and S.iron, this rise was found to be statistically significant. There is also rise in the value of TIBC and S,iron. This reflects increase the blood's capacity to bind iron with transferrin which is the most dynamic carrier for iron. This rise in TIBC reflects improvement in anemia of chronic illness**.**In group C, there is statistically significant rise in the values of RBCs count, Hb, MCV, S.iron, transferrin saturation and feritin after four months of iron therapy. The rise in Red cell count (RBCs) reflects the rise in the number of red blood cells in a volume of blood. The rise in Hemoglobin (Hb) reflects rise in the amount of hemoglobin in a volume of blood. The rise in the RBCs value indicates the rise in the ratio of the volume of red cells to the volume of the whole blood. The rise in transferrin saturation reflects the rise in serum iron which is actually bound to transferrin. The significant rise in the previous parameters indicate the role of iron therapy in correction of anemia of chronic illness in patients with adenoid hypertrophy**.**

And so there is rise in the hematological parameters in the three groups which was most evident in group B. which could be explained by the fact that the rise in hematological

parameters in group A was masked by blood loss during adenoidectomy and in group C, no surgery was done, so no blood loss and so the rise in hematological values was reasonable. So, we recommend retesting after 6 months rather than 4 months to get more fair results but we could reach to solid conclusion about the value of adenoidectomy alone in correction of anemia of chronic illness in patients with adenoid hypertrophy so we recommend more studies later on larger scale of patients.

Anova test was used to compare the follow up values of the hematological parameters of the three groups, its results revealed that there is no significant difference between the values of hematological parameters in the three groups**.**

As regard the only complication occurred through this study (intra and postoperative) we found 4 cases (10%) suffered from 1ry hemorrhage which was in accordance with Oyebola *et al*., 2016 [11] who studied blood transfusion during adenoidectomy but disagrees with Stanislaw *et al*., 2000 [12] who reported that only one patient had 1ry hemorrahage in their study which comprised 87 patients.

Conclusion

Adenoidectomy, done to eradicate the pathology which is the cause of anemia. Iron therapy can improve anemia in patients with adenoid hypertrophy as abnormal iron metabolism is implicated in the pathogenesis of anemia of chronic illness.

Recommendation

Patients with adenoid hypertropy who are candidates for surgical intervention and have anemia should undergo adenoidectomy to eradicate the pathology which is the cause of chronic sinonasal infection that can cause anemia of chronic illness, and iron therapy should be prescribed for those patients postoperatively.

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