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Research Article

Use of Laser-Induced Thermotherapy in the Thyroid Benign Nodular Pathology Treatment

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Abstract

The results of treatment by the laser-induced thermotherapy (LITT) method of 107 patients with the thyroid benign palpable abnormalities are studied. Mean nodes volume before and after the treatment was reduced from 5,0 cm^3 to 2,8 cm^3 (44%). Among palpable abnormalities with the volume up to 1 cm^3 the mean volume decreased by more than 60%. Among large palpable abnormalities with the volume more than 8 cm3 the average size decreased in all a little by more than 40%. Among the nodes with the volume up to 1 cm^3 after the LITT conducting the most part decreased by more than 50% (19 of 33), 8 of them (24,2%) decreased by more than 75%, 6 (18,3%) nodes disappeared completely. Among the nodes of 1 - 2 cm^3 more than a half also decreased by more than 50% (17 of 29), 6 nodes (20,7%) of them by more than 75%. Among palpable abnormalities more than 4 cm3 there was not a single node, which decreased in volume by more than 75%. However, most of them decreased by more than 25%. The statistically significant difference of dependence of a node volume reduction from laser action number of points is noted.

Three patients (2,8%) had a small burn of the skin in the place of the needle puncture.

The LITT method of the thyroid benign palpable abnormalities is highly effective, because in the vast majority of cases leads to either disappearance or significant reduction of a palpable abnormality.

Keywords: *Nodular Goiter; Laser-Induced Thermotherapy*

Introduction

The thyroid nodes are the pathology in common currency and they make great clinical problem. The nodular goiter prevalence amounts to 50 % of all the population [1-5]. The most part of the identified nodes is a particularly benign pathology and at the moment of identifying, as a rule, does not exert a considerable impact on a patient's quality of life [3]. In «The Russian Association of Endocrinologists' the Nodular Goiter Diagnostics and Treatment Clinical Practice Guideline» it is pointed out that the watchful waiting is a preferable approach in the case of the nodular colloid goiter [6]. However, practically all the thyroid nodes eventually grow in size, and their growth hereafter leads to the necessity of the more active treatment policy [7,8].

In such a situation the minimally invasive treatment, the most spread out are the ethanol destruction and the laser-induced thermotherapy (LITT), acquires a considerable accent. Although these methods are used in our country more than 10 years [9,10], there is no their universal inclusion in the method of treatment of patients with the nodular goiter. In «The Clinical Practice Guideline» it is stated that «…these methods did not receive an exhaustive estimation in the long-term prospective studies …, they are the subject of the further study and in the long term, in particular cases, they can be considered as an alternative to the surgical management of the nodular colloid goiter only» [6]. In the American Association of Clinical Endocrinology and European Thyreoidological Organization of the Nodular Goiter Diagnostics and Treatment Guidelines [11] it is pointed out that a node thermal degradation with the use of laser engenders by many patients a clinically meaningful decline of nodes volume and improvement of local symptoms, it is safe and effective but because of the technology originality there lack long-term investigations.

The Goal of Research

To estimate the efficiency of LITT use in the treatment of solid benign thyroid palpable abnormalities.

Materials and Method

Over a period from August 2015 to December 2016 in Tyumen SFHI «Endocrinological Dispensary» with the use of LITT method there was treated 211 patients. The after history was estimated by 107 patients (51%). The remaining 104 patients for various reasons did not come for a follow-up examination (most of them live in other cities and are observed in the endocrinologist at the place of residence).

The average age of patients was 46,2 ± 4,3 years. There were 4 (3,8%) male patients, 103 (96,2%) female patients. Two patients had LITT of three nodes, nine patients – of two nodes, 96 patients – of one node. The total number of laser-treated nodes is 121.

All nodes had solid structure. According to needle biopsy – colloid goiter – 45 (47,9%), colloid goiter with cystic changes – 27 (28,7%), colloid goiter with regressive changes – 22 (23,4%).

The thyroid ultrasound was made with the help of «Toshiba Aplio XG» apparatus before and 3 months later after the treatment.

The operations were made under ultrasound-control. By making LITT there was used «Lakhta-Milon» device model 1060/90. Medium intensity of the beam is 2,7 ± 0,4 W, wave length is 910 Nm.

Results

After LITT carrying out the reduction of nodes volume was registered in all cases. The total volume of nodes before the treatment was 378,8 cm^3. After the course of laser action the total volume was reduced to 203,8 cm^3. Mean nodes volume before and after the treatment was 5,0 cm^3 and 2,8 cm^3, and was reduced to 44%. This measure is much less than in other authors' investigations [12-14]. However, we carried out LITT of large enough nodes that determined so large mean size, the reduction of which after the first session is smaller than little nodes. For more success rate of LITT carrying out we studied the results of its carrying out depending on the priming volume of a palpable abnormality. We observed the dynamics of nodes volume restriction in five groups: nodes with the initial volume to 1 cm^3, 1 - 2 cm^3, 2 - 4 cm^3, 4 - 8 cm^3 and more than 8 cm^3.

In table № 1 distribution of palpable abnormalities volume change before and after LITT depending on their volume is performed.

	to 1 cm^3	1 – 2 cm^3	2 – 4 cm^3	4 – 8 cm^3	More than 8 cm^3
Number of nodes	33	29	34	16	9
Total volume of nodes before LITT carrying out (cm^3)	15,3	43,9	98,2	90,6	130,9
Mean node size before LITT carrying out (cm^3)	0,5	1,5	2,9	5,7	14,5
Total volume of palpable abnormalities after LITT carrying out (cm^3)	6,1	20,7	48,1	50,7	78,2
Mean node size after LITT carrying out (cm^3)	0,2	0,7	1,4	3,2	8,9
Absolute reduction of mean node size after LITT carrying out (cm^3)	0,3	0,8	1,5	2,5	5,6
Relative reduction of mean node size after LITT carrying out (%)	60,0	52,9	50,2	44,1	40,2

Table 1: *Change of Palpable Abnormalities Volume before and after LITT depending on their volume.*

In table № 2 distribution of relative reduction of palpable abnormalities of different volume size is described.

Reduced after LITT carrying out to-	to 1 cm^3 (n-33)		1 – 2 cm^3 (n-29)		2 – 4 cm^3 (n-34)		4 – 8 cm^3 (n-16)		more than 8 cm^3 (n-9)	
75% and more (abs., %)	8	24,2%	6	20,7%	5	15,6%	-		-	
50-75% (abs., %)	11	33,3%	11	37,9	5	15,6%	7	43,8%	3	33,3%
25-50% (abs., %)	7	21,2%	7	24,1%	16	47,6%	8	50%	4	44,4%
Less than 25 % (abs., %)	7	21,2%	5	17,2%	18	21,7%	1	6,3%	2	22,2%

Table 2: *Relative reduction of palpable abnormalities of different volume.*

We have analysed LITT carrying out depending on the number of points of laser action carrying out and length of laser action on a node tissue (Table № 3). Under the number of laser action points we understand not simply laser waveguide travel, and namely the number of puncture needles followed by the waveguide entry after its decarbonization.

Size of a node		Number of LITT points			
		1	2	3	4
< 1cm^3	Relative reduction of nodes volume after LITT carrying out (%)	58,3	61,8	-	-
	Test of significance (p)	0,051			
	Mean length of LITT carrying out (sec)	85,7 ± 43,2	107,5 ± 53,2	-	-
	Test of significance (p)	0,462			
1 - 2 cm^3	Relative reduction of nodes volume after LITT carrying out (%)	48,9	56,8	-	-
	Test of significance (p)	< 0,05			
	Mean length of LITT carrying out (sec)	111,2 ± 65,9	122,5 ± 51,4	-	-
	Test of significance (p)	0,797			
2 - 4 cm^3	Relative reduction of nodes volume after LITT carrying out (%)	40,9	50,9	55,6	-
	Test of significance (p)	< 0,05			
			< 0,05		
	Mean length of LITT carrying out (sec)	108,8 ± 71,2	127,5 ± 49,9	157,0 ± 27,7	
	Test of significance (p)	0,681			
			0,145		
4 - 8 cm^3	Relative reduction of nodes size after LITT carrying out (%)	41,03	41,1	44,1	-
	Test of significance (p)	0,027			
			< 0,05		
	Mean length of LITT carrying out (sec)	226,0 ± 17,8	253,2 ± 92,4	264,2 ± 96,4	-
	Test of significance (p)	0,524			
			0,560		
> 8 cm^3	Relative reduction of nodes size after LITT carrying out (%)	-	36,3	-	44,43
	Test of significance (p)		< 0,05		
	Mean length of LITT carrying out (sec)		333,3 ± 58,72		210,0 ± 10,4
	Test of significance (p)		0,044		

Table 3: *Dependence of Nodes of Different Volumes Sizes Reduction Depending On the Number of Points and the Length of the Laser Action.*

Discussion

The highest reduction was observed among palpable abnormalities with the volume to 1 cm^3. Their mean volume was reduced from 0,46 to 0,19 cm^3, that is more than 60%. Among large palpable abnormalities with the volume more than 8 cm^3 the mean size reduced only a little more than 40% (from 14,54 to 8,99 cm^3). This observation confirms the results of other authors who designate the high effectiveness of this method by treating nodes with the volume to 1 cm^3 [15-17].

Nodes with the volume to 1 cm3 after LITT carrying out the most part reduced more than to 50% (19 from 33), and 8 (24,2%) reduced more than to 75%, 6 (18,3%) nodes disappeared completely. Among nodes 1 - 2 cm^3 more than a half also reduced more than to 50% (17 from 29), among them to 75% and more than 6 nodes (20,7%). At the same time among palpable abnormalities more than 4 cm^3 there was registered no one node that would reduce in volume more than to 75%. However, and among these nodes the volume reduction is registered. Thus, the most part of nodes reduced more than to a quarter.

By LITT of palpable abnormalities to 1 cm^3 we have not told the statistically significant difference between a palpable abnormality relative reduction dynamics and the laser action number of points. Thus, relative reduction of nodes volume by the laser action one point was 58,3%, and by two – 61,8% ($p = 0,051$). This fact is quite logic, because by the repeated introduction the waveguide came to the previous zone of action which due to a node size occupied practically all its volume. We have not found any statistically significant difference in the length of laser action by this group of palpable abnormalities ($p = 0,462$).

By LITT carrying out of larger abnormalities the statistically significant difference of dependence of a node volume reduction from laser action number of points is noted. Thus, by LITT of 1 - 2 cm^3 nodes in one point the relative reduction of volume was 48,9%, and by two points – 56,8% ($p < 0,05$). Although the mean time of LITT carrying out by double entry of the laser waveguide was more than by LITT carrying out from one point (122,5 ± 51,4 и 111,2 ± 65,9 accordingly), this difference was statistically invalid ($p = 0,797$).

Nodes with the diameter from 2 to 8 cm^3 we exposed to laser from 1, 2 and 3 points. And the statistically significant difference of relative volume reduction depending on the laser action number of points is noted. However, in spite of increase in LITT mean time expectancy this difference was statistically invalid. Moreover, by LITT carrying out of more than 8 cm^3 nodes from four points the statistically significant difference in relative reduction of volume in comparison with LITT from 2 points (44,4% и 36,3%, $p < 0,05$) is noted, at the same time the length of LITT carrying out statistically significant was less by use of four points of the laser waveguide entry. Other authors [12,13] also did not find the dependence between the power delivered in a node during one session and its reduction ratio. Therefore, other factors markedly affect the treatment effect: a node structure, its density, the blood flow intensity in a node and in the circumflex tissue.

By long-term laser action in one point at the endface a carbonization area appears, that strongly sticks to the latter and significantly reduces power of the laser radiation. For this factor removal the foreign authors suggest in the case of large nodes use several waveguides simultaneously [14,18]. O.V. Seliverstov (2001) [10] suggests successively move the waveguide in every 90 - 120s. We consider that more effective is not only successive moving of the waveguide but its periodic extraction, wiping with a sterile wipe for descaling and repeated introduction through a needle inserted in another point of a node.

The question of necessity of the next LITT session carrying out and terms is nowadays open. Thus, Yu K Alexandrov., *et al*. (2005) [19] recommend to decide the question of the next LITT session necessity in as little as a month. OV Seliverstov (2003) [7], AV Fayzrakhmanov (2006) [12] recommend the next LITT sessions carrying out to the end of 1,5 - 2 months, because to this time aseptic inflammation manifestations from the previous session were usually reversed. We consider the question of the next LITT session necessity solution is necessary to realize not earlier than 3 months, because for more accurate effectiveness estimate it is necessary to wait not only for the inflammation processes remitting which may be observed in 1 - 1,5 months, but to wait for the scar process formation, the estimate of which is possible not earlier than in 3 months. In the beginning of our activity we suggested the next LITT session, if a node size reduced for less than 75%. However, we noticed that if in three months after LITT carrying out a node reduced for more than 50%, its size reduc-

tion hereinafter would continue by means of the scar tissue formation. That is why it is no good to hurry with the next LITT session in this situation. It is better to withhold the reexamination for three months more.

The example of patient B, 56 years of age is quite illustrative. Patient B, 56 years of age, applied to Tyumen Endocrinological Dispensary in April 2012. By examining there was found a node in the right lobe of thyroid gland with the volume of 5,6 cm^3. TNAB – nodular colloid goiter. The thyroid status is within normal limits. A node LITT is carried out. (laser radiation power is 3,7 W, LITT session length was 6 min, 2 points of laser action were used). While examining in 3 months the node size reduced to 52% and was 2,7 cm^3. The patient was suggested the next LITT session. However, for family reasons the patient could come for the next LITT session only in October 2012, i.e. in 7 months. By ultrasound carrying out the node reduced for more 1,2 cm^3, i.e. to 79% from the initial volume, it became more inhomogeneous, did not have distinct outlines. It is decided to refrain from the next LITT session carrying out.

By the next LITT sessions carrying out the volume of palpable abnormalities reduces less than by the primary LITT session carrying out. We have carried out LITT of 10 nodes. Thus, the relative reduction of the nodes volume was only 23,5%. AV Fayzrakhmanov (2006) [12] also designates that after the second LITT session the reduction of nodes volume median was 22% less. It seems that it is connected with a node inner structure change by means of the scar tissue, which is less exposed to high temperatures, formation after the first LITT session.

Our accumulated experience suggests the following action sequence algorithm by treating the thyroid palpable abnormalities with the use of LITT method (Figure 1).

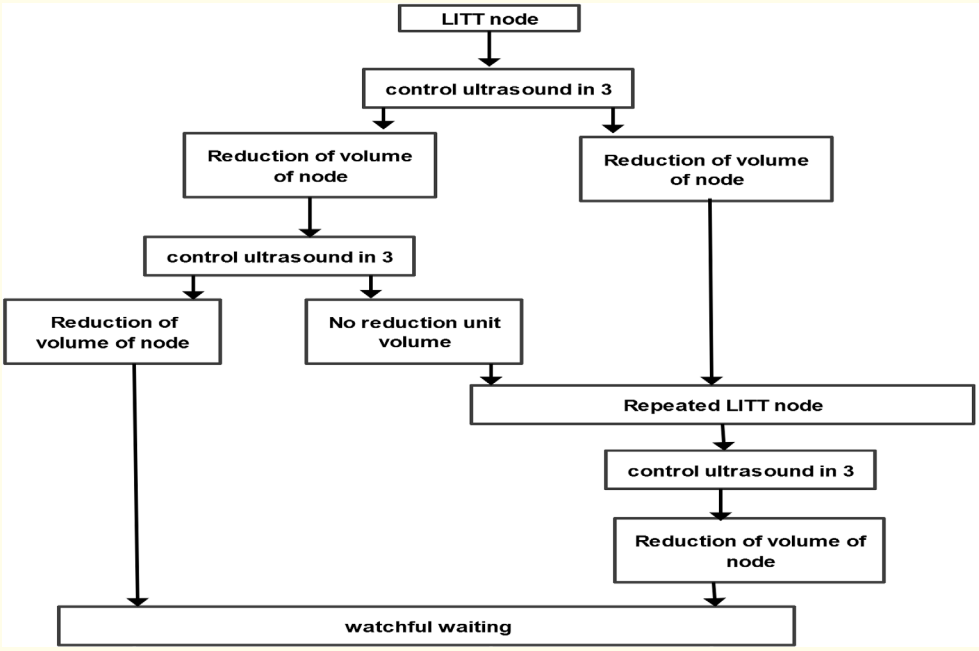

Figure 1: *Algorithm of the Thyroid Nodes Laser Treatment.*

The thyroid control ultrasound is reasonable to carry out in 3 months after a node LITT carrying out. By the node volume reduction by more than 50% we refrain from the question of the next LITT session solving for 3 months. If by the control ultrasound in 3 months the node volume reduction continues, we continue watchful waiting. If there is no the node reduction, it is reasonable to repeat LITT. We carry out the control ultrasound again in 3 months.

If after the first LITT session carrying out a node volume reduced less than to 50%, we raise the question of the necessity the next LITT session carrying out. If after the next session carrying out the node reduction is registered (even if not more than 25%), we continue watchful waiting.

The question of the number of LITT sessions we also leave open. Yu K Alexandrov., *et al*. (2005) [19] points to their unlimited number, and the laser treatment termination criterion is the total disappearance or, more often, formation "a scar" at the node place. Hereinbefore we pointed out that after LITT of nodes less than 1 cm^3 in 6 observations there was their total disappearance. The size of the final scar depends on the node initial size. In our opinion optimal is the total reduction of the node volume to 75% from the initial size.

We have not registered severe complications by LITT carrying out. Only three patients (2,8%) had a small burn of the skin in the place of the needle puncture. This defect was most probably connected with the fact that in the beginning of the method acquisition we disengaged a needle not far enough from the endface, and it caused its heating. Over the past six months there was no such a complication. We have not observed other complications which are described by other authors [14], such as the recurrent nerve paresis.

Conclusion

The LITT method of the thyroid benign palpable abnormalities is highly effective, because in the vast majority of observations it results in either disappearance or significant reduction of a palpable abnormality. The highest effectiveness of this method occurs by treatment of palpable abnormalities of a little size – to 2 cm^3. However, it is the nodes of this size that have the highest prevalence and henceforth by considerable increase they can have adverse impact on the quality of life and need operative therapy. The LITT large-scale implementation in the clinical practice and its inclusion in the nodular colloid goiter treatment protocols in the vast majority of cases will allow to elude the necessity of this type of thyroid pathology operative therapy.

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