

Functional results of parathyroid autotransplantation in one single pocket for treatment of secondary hyperparathyroidism

Resultados funcionais do auto-implante de paratireóides em loja única no tratamento do hiperparatireoidismo secundário

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A B S T R A C T

Objective: To evaluate the operation and surgical time of autotransplanted parathyroid in a single site comparing it to the implant performed in five and twenty locations. **Methods:** Patients who underwent total parotidectomy with auto implant (Ptx-AI) for secondary and tertiary hyperparathyroidism were evaluated in groups of 20 implant sites (A), 5 sites (B) and single site (C), compared as for Functional Status (FE) of the implant and the surgical time of the procedure. Four functional states were determined according to the systemic level of PTH: 1-below normal, 2-normal, 3-high, no more than three times and 4 - more than three times higher. **Results:** There were 349 patients subjected to Ptx-AI for renal hyperparathyroidism from 1994 to 2009. For the functional study, 101 patients were eligible for the following observations: group A (n = 30) - 16.6% EF1, 50% EF2, 23.3% EF3 and 10%EF4; group B (n = 41) - 14.6% EF1, 58.5% EF2, 22% EF3 and 4.9% EF4; Group C (n = 30) - 17% EF1, 57% EF2, 20%EF3 and 6% EF4 ($p = 0.9$, χ^2). But in group C the mean operative time of implant was statistically lower (7.9 minutes) compared to the average of 5 site (18.6 minutes) and 20-site (44 minutes) implants in 66 evaluated patients ($p < 0,0001$, ANOVA). **Conclusion:** The self-implantation in a single site decreases the operative time without changing its functionality.

Key words: Secondary hyperparathyroidism. Parathyroidectomy. Autologous Transplantation.

INTRODUCTION

Hyperparathyroidism secondary to chronic renal failure is observed in about 30% of patients and the success of clinical treatment is achieved in up to 95% of cases^{1,2}. Total parathyroidectomy with immediate auto-implant is thus required in 5-10% of patients in chronic renal dialytic therapy and may reach 30% for those in dialyses for more than 20 years^{2,3}.

Described by Wells⁴ in 1975, total parathyroidectomy with immediate auto-implant in the upper limb became the surgeons' first choice for the treatment of hyperparathyroidism secondary to chronic renal failure⁵. This is because it avoids the definitive hypoparathyroidism associated with total parathyroidectomies without auto-implant, and also due to better management of relapse of hyperparathyroidism due to hyperfunction of the implanted fragments. Wells advocated the implant of 20 parathyroid fragments of about 1 x 2 mm each, each at a different site⁴.

In addition to good monitoring of the functioning of the implant, the technique theoretically allows an intervention with less risk of complications in case of treatment of hyperparathyroidism relapses.

On the technique in which the parathyroid fragments auto-implant is made in the brachioradialis muscle of the non-dominant, sound limb, the fragments are placed in small openings between the fascia and muscle.

The most common places for realization of auto-implant are the brachioradialis muscle and presternal region⁶. Other locations can also be used: the sternocleidomastoid, the subcutaneous tissue of upper limbs and abdominal fat^{6,7}.

Modifications of the Wells technique have also been described, such as the subcutaneous injection of fragments of parathyroid in the upper limb², with functionality of 87.5% in 16 months after surgery.

The Head and Neck Surgery Service at the Hospital das Clínicas of the Faculty of Medicine of the University of São Paulo accumulates experience with total

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parathyroidectomy with immediate auto-implant in the forearm muscles since the 1980s. The method employed was the 1975 Wells' description, with the use of twenty sites⁴.

In some patients with greater clinic gravity there has been a reduction in the number of sites by half, to decrease the time of anesthesia. Good developments in these cases led us to reduce them to five sites. Each site receives on average five glandular fragments, totaling twenty-five fragments. With the use of this technique, we noted that 85% of implants produce PTH within the limits of normality. This technique was called "Southern Cross", by analogy of the arrangement of sites with the five main stars of that constellation^{8,9}.

Satisfactory results by reducing the number of sites allowed further decreasing the number to a single site. Although it is possible to assume that some authors already use single-site auto-implants, there is no literature that has shown the functional results effectively attributed to the implants and surgical time.

This study aims to assess the functioning and the surgical time for completion of the parathyroid auto-implant in a single-site by comparing it to the implants commonly held with five and twenty sites.

METHODS

We conducted a longitudinal, case-control type study to examine the functionality of the parathyroid gland implantation in a single-site at the anterolateral surface of the forearm in relation to the techniques that use five and twenty sites (Figures 1, 2 and 3).

In the study we included patients subjected to total parathyroidectomy with immediate auto-implant of parathyroid gland fragments due to hyperparathyroidism secondary to chronic renal failure, in dialytic treatment, or after successful renal transplantation, also called tertiary hyperparathyroidism.

We excluded patients in which it was not possible to demonstrate the gradient between the PTH level detected in the limb with the implant and the one found in the contralateral limb (when the secretion of PTH can be assigned to an extraneurary gland located in the neck that has not been resected during the parathyroidectomy) and cases in which there was no record of the post-operative PTH level.

The following groups were considered as for the number of parathyroid tissue implant sites: group A: patients with 20 sites implants (based on a historical series on the first parathyroidectomies performed on the service); Group B: patients with five sites of implant; and Group C: patients with implant in a single site.

Functional implant situation was classified according to the systemic levels of serum PTH obtained in the upper limb contralateral to the implant: Functional



Figure 1 - Implant with twenty sites.

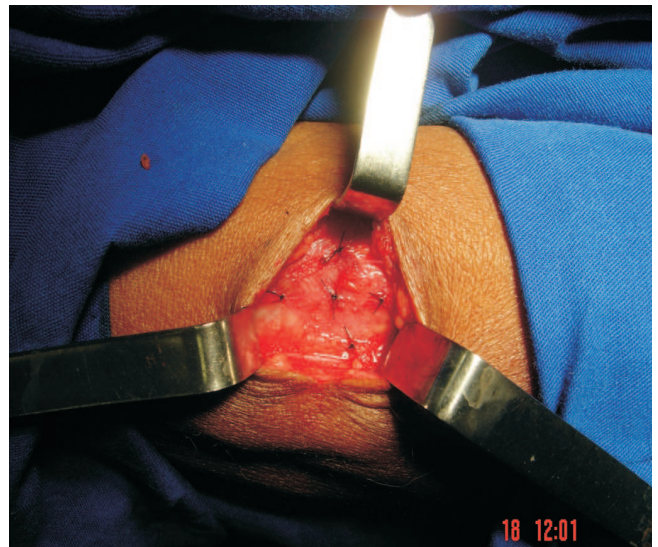


Figure 2 - Implant with five sites.



Figure 3 - Implant in a single site.

State (EF) 1: PTH level below the normal range for the method employed; EF 2: PTH level within the normal range for the method employed; EF 3: elevated PTH level, not greater than three times the upper limit of normality for the method employed; and EF 4: high PTH level, greater than three times the upper limit of normality for the method employed.

As the method of determination of PTH has varied over time (1980-2009), we adopted the criterion concerning bands of normality for each of the methods instead of fixed values.

The location of the implant was assessed by clinical examination until the 3rd day for record of postoperative hematoma or infection.

We registered the time required for the preparation of the single-site implant and compared it to the implants with five and twenty sites.

In a preliminary study developed in our institution total parathyroidectomy without auto-implant was compared to the technique with auto-implant⁸. One of the data recorded in that study was the time required for the implant, since the skin incision until its synthesis.

The record of implant time was done in some other cases, even after the completion of that work.

RESULTS

Three hundred and forty-nine patients were subjected to total parathyroidectomy with auto-implant in the sub-fascia of the brachioradialis muscle due to secondary or tertiary hyperparathyroidism in the period from July 1994 to May 2009, 153 being male and 196 female.

After consideration of the eligibility criteria, 30 patients for Group A (follow-up of 12 months), 41 patients for Group B (follow-up of 12 months) and 30 patients to group C (up to six months) were assessed as for the implant's functional state. Also in Group C we evaluated 15 patients in relation to functional State for a period of 12 months (Table 1).

There was no functional difference between the groups A, B and C (including, in the latter, the separate comparison between the periods of six and 12 months). Through the test χ^2 we found a *p* value = 0.9971 (Figure 4).

In Group A, the 12 months measurement of postoperative serum PTH varied from zero to 947 pg/ml (average 43.1 pg/ml). The measure of PTH in the implant ranged from 0.8 to 12,350 pg/ml (average 80.1 pg/ml) also in the 12 month period.

In Group B, in the period of 12 months after parathyroidectomy with auto-implant, serum PTH ranged between zero and 1,048 pg/ml (average 39 pg/ml). We obtained the value of PTH in the limb with the implant in just 25 patients, ranging from 20 pg/ml to 3,833 pg/ml (average of 245 pg/ml).

In Group C, on six months there were serum PTH values from zero to 362 pg/ml (average 80.36 pg/ml), and values of PTH in the implant limb between zero and 22,326 pg/ml (average 1,354.9 pg/ml). For the period of 12 months there were serum PTH values between zero and 693 pg/ml (average 103 pg/ml) and implant-related values between 8 and 9,582 pg/ml (average 1,324 pg/ml).

PTH values between limbs were significantly different in all groups.

In relation to the time of implant execution, in the analysis period the Group A obtained 21 records, Group B, 30 and Group C, 15.

In Group A, the variation of time was 30 to 60 minutes, averaging 44.0 minutes and median of 45 minutes. In Group B, the range was from 10 to 30 minutes, averaging 18.6 minutes and median 17.5 minutes. Group C presented

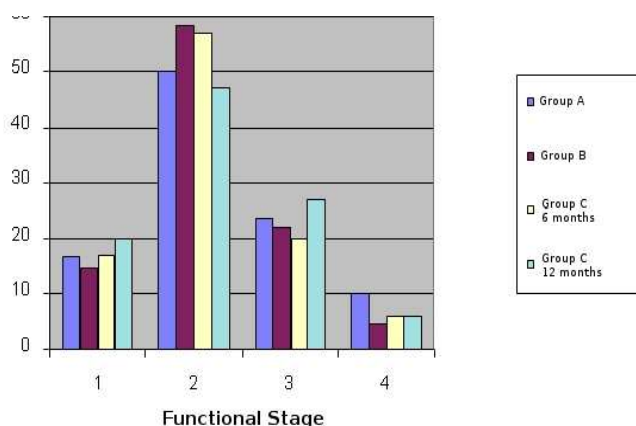


Figure 4 - Distribution of groups in relation to the functional state of implants.

Table 1 - Distribution of patients in relation to the functional state of the implant.

Funcional State	Group A	Group B	Group C	
	n = 30	n = 41	6 months - n = 30	12 months - n = 15
1	5 (16.6%)	6 (14.6%)	5 (17%)	3 (20%)
2	15 (50%)	24 (58.5%)	17 (57%)	7 (47%)
3	7 (23.3%)	9 (22%)	6 (20%)	4 (27%)
4	3 (10%)	2 (4.9%)	2 (6%)	1 (6%)

a range from 2 to 5 minutes, averaging 7.9 minutes and median of 7 minutes.

These averages were assessed through parametric test (*one way ANOVA*), with $p < 0.0001$.

In addition, we applied the Tukey multiple comparisons test to the implant time, with the following results: Group A vs group B: $p < 0.001$; group A vs group C: $p < 0.001$; and Group B vs group C: $p < 0.001$.

DISCUSSION

Most cases of hyperparathyroidism treated in Brazil are secondary to chronic renal failure^{10,11}. According to the Brazilian society of Nephrology, in 2007 73,605 patients were under chronic renal dialytic treatment in the country and the estimated figure for 2008 was 87,044 individuals¹².

The aim of the clinical treatment for hyperparathyroidism secondary to chronic kidney disease is to prevent progression to autonomy of the gland. Even under appropriate drug treatment, yet often autonomy takes place. Other therapeutic modalities were attempted, such as ethanol and calcitriol injection in the parathyroid tissue, but without satisfactory results¹³. The surgical treatment is indicated for significant portion of chronic kidney patients³ and, in recent years, there has been a noteworthy growth in the number of ¹⁰ parathyroidectomies.

Originally proposed by Wells in 1975⁴, total parathyroidectomy with immediate auto-implant in the upper limb soon gained the acceptance of the majority of surgeons. In Brazil, it is a procedure carried out in various services¹⁴⁻¹⁶.

The surgical technique, originally described as a site for each of the parathyroid fragments (20 in total), has been described as "tedious and tiresome"⁵.

Even having been previously proved that the technique of "Southern Cross" (with five sites) is faster than the original technique described by Wells⁴, there was no difference between the technical functionality of the implant^{8,9,17}. The study in question demonstrates that it is possible to further reduce the number of sites without changing the function of the implant.

It was shown that the auto-implant in a single site not only is faster than the implant in 20 sites ($p < 0.001$), but also than the technique of "Southern Cross" ($p < 0.001$). There was no significant difference between these groups regarding the functionality of the implant. Data from Group C on six and 12 months were presented because of the small difference between both those aspects evaluated and by the fact the six months subgroup had more cases ($n = 30$).

We therefore conclude that the patients undergoing total parathyroidectomy with immediate single-site auto-implant for secondary or tertiary hyperparathyroidism benefited from reduced surgical time and, consequently, lower anesthetic time, without presenting with alterations in the implant functionality.

R E S U M O

Objetivo: Avaliar o funcionamento e tempo cirúrgico do auto-implante de paratireóide em loja única comparando-o ao implante realizado em cinco e vinte lojas. **Métodos:** Pacientes submetidos à parotidectomia total com auto implante (Ptx-AI) por hiperparatireoidismo secundário e terciário foram avaliados em grupos de implantes em 20 lojas (A), cinco lojas (B) e loja única (C), em relação ao Estado Funcional (EF) do implante e ao tempo cirúrgico deste. Foram determinados quatro Estados Funcionais de acordo com o nível sistêmico de PTH: 1-abaixo do normal; 2-normal; 3- elevado não mais que três vezes; 4- elevado mais que três vezes.

Resultados: Foram submetidos a Ptx-AI 349 pacientes, por hiperparatireoidismo renal, entre 1994 a 2009. Para o estudo funcional foram elegíveis 101 pacientes com as seguintes observações: grupo A ($n=30$) - EF1 16,6%, EF2 50%, EF3 23,3% e EF4 10%; grupo B ($n=41$) - EF1 14,6%, EF2 58,5%, EF3 22% e EF4 4,9%; Grupo C ($n=30$) - EF1 17%, EF2 57%, EF3 20% e EF4 6% ($p=0,9$, χ^2). Porém no grupo C, o tempo cirúrgico médio do implante foi estatisticamente mais rápida (7,9 minutos) em relação à média em cinco lojas (18,6 minutos) e 20 lojas (44 minutos), em 66 pacientes avaliados ($p < 0,0001$, ANOVA). **Conclusão:** O auto-implante em loja única diminui o tempo cirúrgico sem alterar a funcionalidade do mesmo.

Descritores: Hiperparatireoidismo secundário. Paratireoidectomia. Transplante Autólogo.

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Received on: 03/02/2010

Accepted for publication: 05/04/2010

Conflict of interest: none

Funding source: none

How to cite this article:

Caliseo CT, Santos SRCL, Nascimento Jr. CP, Arap SS, Brandão LG, Montenegro FLM. Functional results of single-site parathyroid auto-implantation in the treatment of secondary hyperparathyroidism. *Rev Col Bras Cir*. [periódico na Internet] 2011; 38(2). Disponível em URL: <http://www.scielo.br/rcbc>

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