Langenbecks Arch Surg (2008) 393:659–666
DOI 10.1007/s00423-008-0408-1

CONTROLLED PROSPECTIVE CLINICAL TRIALS

Focused versus conventional parathyroidectomy for primary hyperparathyroidism: a prospective, randomized, blinded trial

Algirdas Slepavicius · Virgilijus Beisa · Vinsas Janusonis · Kestutis Strupas

Received: 26 May 2008 / Accepted: 29 July 2008 / Published online: 15 August 2008

Abstract
Background For many years bilateral neck exploration (BNE) was the gold standard operation for primary hyperparathyroidism (pPHP). With advances in preoperative pathological gland localization and intraoperative parathyroid hormone (IPTH) monitoring, minimally invasive approaches have evolved. This study is aimed to compare BNE and focused parathyroidectomy (FP) in a prospective, randomized, blind trial.
Patients and methods Between 2005 and 2007, 48 patients with pPHP were enrolled in our study. Twenty three patients were randomized to the BNE group and 24 to the FP group. Patients in the FP group underwent preoperative localization studies. All parathyroidectomies were guided by intraoperative intact parathyroid hormone (IIPTH) monitoring. In the BNE group, neither IIPTH nor preoperative localization studies were performed.
Results All patients were cured by the primary operation. Overall, the operative time was similar in both groups. In the focused exploration (FE) group, compared to the BNE group, there was lower pain intensity at 4, 8, 16, 24, 36 and 48 h after surgery ($p<0.001$), lower consumption of analgesics ($p<0.001$), lower analgesia request rate ($p<0.001$), shorter scar length ($p<0.001$), higher cosmetic satisfaction rate 2 days, 1 month ($p<0.001$) and 6 months after surgery ($p<0.05$), but after 1 year cosmetic satisfaction rate became not significant ($p=0.38$). Focused exploration (FE) was more expensive ($p<0.05$). We did not find any difference in quality of life after 1 month and 6 months after surgery in both groups.
Conclusion Both methods of parathyroidectomy for PHP are safe and effective. Focused exploration (FE) has several advantages: lower postoperative pain, lower analgesic request rate, lower analgesic consumption, shorter scar length, better cosmetic satisfaction rate in a short time period.

Keywords Primary hyperparathyroidism · Conventional parathyroidectomy · Focused parathyroidectomy

Introduction

The traditional surgical approach for primary hyperparathyroidism involves bilateral neck exploration (BNE) and evaluation of all four glands. The high cure rate achieved with BNE (95-98%) and a morbidity of less than 1% makes this approach the gold standard for surgical cure of primary hyperparathyroidism (pHPT) [1, 2]. However, developments during the past decades, most notably preoperating imaging for gland localization and biochemical confirmation of surgical cure by means of intraoperative intact parathyroid hormone (IIPTH) assay, have made minimally invasive parathyroidectomy an alternative approach for the treatment of primary hyperparathyroidism. There is a considerable interest in less extensive parathyroid operations with reported good results [3, 4]. Less invasive procedures would be preferable if they accomplished the same excellent results with the same or a lower morbidity rate.

Best of Endocrine Surgery in Europe 2008.

A. Slepavicius (✉) · V. Janusonis
Klaipeda University Hospital,
Liepojos 41,
Klaipeda 92288, Lithuania
e-mail: algisle@gmail.com

V. Beisa · K. Strupas (✉)
Vilnius University Hospital Santariskiu Klinikos,
Santariskiu Str. 2,
Vilnius, Lithuania

Recently, there has been an increased interest in carrying out a focused parathyroidectomy (FP), using preoperative localization and IIPTH measurement. Although seemingly very promising, experience with this approach has not yet been shown to be applicable outside specialized endocrine surgical centers [5]. There has also been concern that these techniques may not detect multigland disease and may potentially increase the chance of developing disease recurrence [6, 7].

The purpose of this prospective, randomized, blinded trial is to compare conventional and focused parathyroidectomy for primary hyperparathyroidism. The primary end point was the cure rate. Secondary end points were postoperative pain intensity, analgesics consumption, time of surgery, cosmetic satisfaction, quality of life, and cost-effectiveness.

Materials and methods

Fifty seven patients were referred to the department of Abdominal and Endocrine Surgery of Klaipeda University Hospital and second department of Abdominal Surgery of Vilnius University Hospital "Santariskiu Klinikos", Vilnius, Lithuania, for the first surgery for pHPT between February 2005 to February 2008. The study was approved by the Bioethics Committee of Lithuania. Forty seven patients were included into the study.

Patients from 18 to 90 years of age with diagnosis of primary hyperparathyroidism and having indications for surgical treatment, participated in the study after reading information letter and giving a written consent.

Criteria for exclusion from the study include family history of pHPT, relapse of primary hyperparathyroidism, previous neck surgery, patients with indications for partial or complete removal of thyroid gland, severe concomitant pathology, making surgical treatment impossible [patients of the fourth American Society of Anestesiology (ASA) risk class], patients that due to psychical disorders cannot evaluate adequately their health status, pregnancy and breastfeeding, patients with symptoms of hypercalcemic crisis, patients refusing to participate during the study.

Before surgery, patients with diagnosis of primary hyperparathyroidism determined clinically and with laboratory tests were divided into two groups using double randomization principle (with the help of envelopes and random variation row) in consultation-outpatient department of the hospitals (Fig. 1).

Conventional surgery group patients were those for which parathyroidectomy was performed with traditional Kocher incision and revision of all parathyroid glands. Localization examination before surgery was not carried out. IIPTH monitoring was not performed.

Focused parathyroidectomy group patients were those for which focused parathyroidectomy was performed. For those patients, preoperative localization studies before operation as well as intraoperative IPTH monitoring were performed.

Before surgery, all patients were consulted by ENT specialist concerning evaluation of vocal folds function. For patients of both groups, following blood tests were performed: general blood, electrolytes, creatinine, IPTH, alkaline phosphatase. Bone density was determined by DEXA method. For all patients, kidney echoscopy was performed. All patients answered to questions of A. Chan questionnaire to determine which PHP symptoms are prevailing [8].

Conversion from FP to traditional one was performed:

1. If during focused operation no adenoma is found on the side indicated by preoperative localization studies.
2. If post-excision IIPTH concentration does not decrease more than 50% in comparison with pre-incision.
3. If frozen-section examination does not confirm the presence of parathyroid gland.
4. If multiple disease of parathyroid glands is established during the operation.

If hyperplasia of parathyroid glands was found during the surgery, those patients were excluded from the study. This enabled to preserve both groups more homogeneous for subsequent analysis.

All operations were performed by two experienced endocrine surgeons (A.S. and V.B.), with the use of magnifying glasses (×3) and head lamp. All patients underwent parathyroidectomy under general anesthesia For FP we used a 2- to 2.5-cm transverse incision placed on the side of the abnormal gland, medial to the medial margin of the sternocleidomastoid muscle. The incision for presumed inferior gland was placed 2 cm above the clavicle, whereas that one for presumed superior gland was placed somewhat higher. The platysma was transected and the sternocleidomastoid muscle was retracted laterally to expose the strap muscles. These were retracted, exposing a space of thyroid and parathyroid glands. No attempts were made to visualize normal parathyroid glands.

The adequacy of resection was assessed with intraoperative rapid PTH measurements, using the Immulite 1000 Turbo intact PTH assay (Diagnostic Products Corporation). The blood for Turbo intact PTH levels were collected by venipuncture into ethylenediaminetetraacetic acid tubes from peripheral vein after intubation of patient (baseline) and 15 min after resection of the abnormal gland. We considered a decrease of at least 50% from the baseline at 15 min after gland resection as indicative of successful parathyroidectomy.

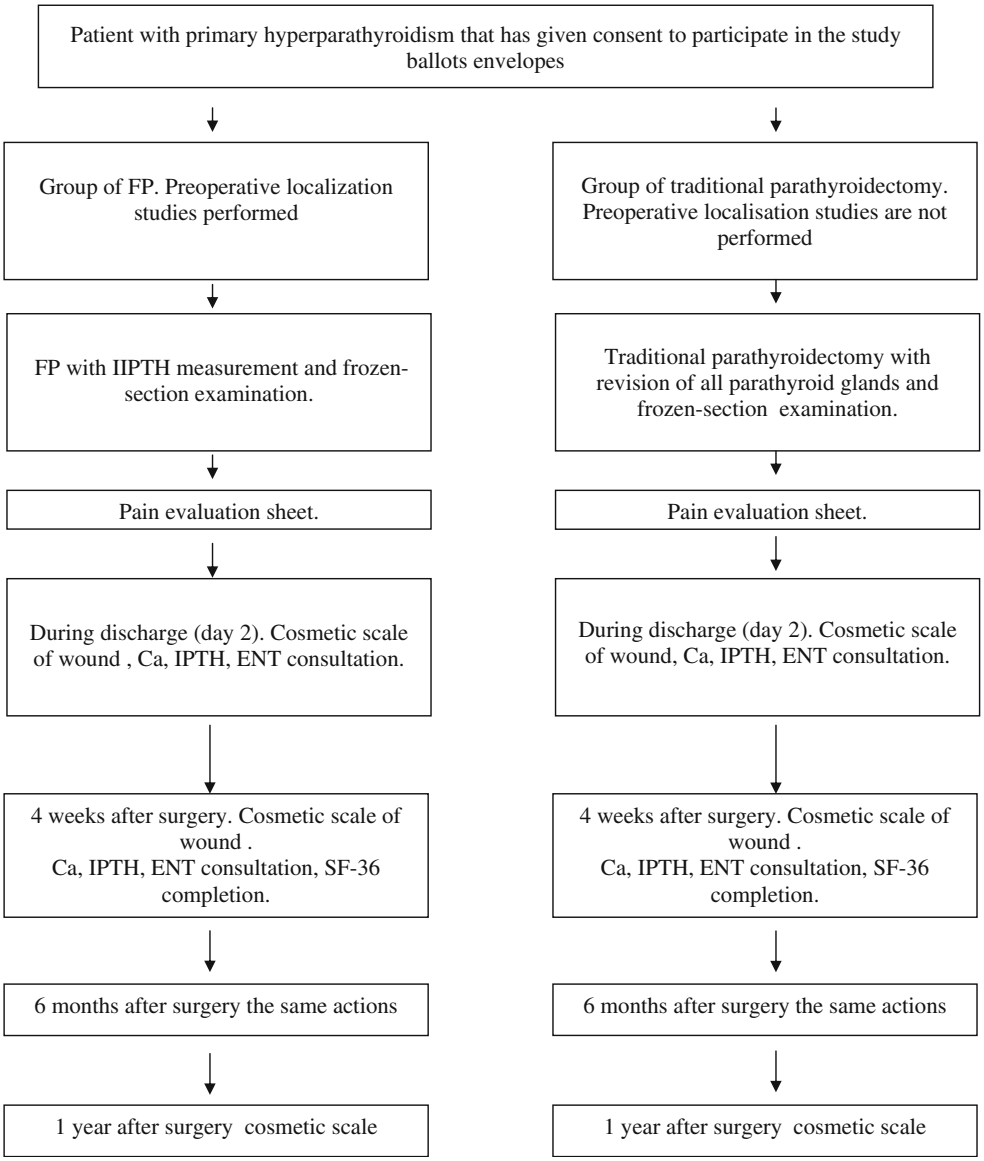

Fig. 1 Clinical study: comparison of traditional and focused parathyroidectomy for the treatment of primary hyperparathyroidism

For traditional group of patients surgery was performed through a 6- to 8-cm standard Kocher incision. Wound drainage was not used for both patients groups.

All patients were discharged 2 days after surgery.

The diagnosis of parathyroid adenoma and hyperplasia was established by conventional histological criteria [9], supported by gross morphology in both groups and by the intra-operative decrease of IIPTH concentration in the FP group.

Thyroid and parathyroid ultrasound examination was performed using ESAOTE MYLAB 50 echoscope. Linear sensor LA 523, frequency 13-4 MHz, was used.

Parathyroid scintigraphy was performed with 99m Tc99m-sestamibi for preoperative dual-phase sestamibi parathyroid scan of the neck and chest with planar images (Siemens, Germany).

A true-positive result was defined as a single abnormal focal accumulation or suspected adenoma on sestamibi or ultrasound (US) scanning that corresponded anatomically to a surgically proven parathyroid adenoma. On all FP patients, sestamibi scintigraphy and US were performed by the same radiologist with specific interest in parathyroid disease. In case when the radiologist was not able to localize the parathyroid adenoma, the blood from both internal jugular veins was taken for IIPTH measurement just after patient's intubation in the operating theatre. The side of incision was guided by the IIPTH level.

The following parameters were recorded during the surgery: operative time (time elapsed from adenoma detection, adenoma excision time after its detection, surgery time from "skin to skin", time until the results of the frozen-section analysis and IIPTH assay were available, extubation time), weight of adenoma, post-excision IIPTH level, frozen-section analysis, incidence of multiglandular disease, conversion rate.

For post-surgery follow-up, a special Visual Analogue Scale (VAS) form was completed. The intensity of pain was evaluated from 0 (pain is absent) to 100 (unbearable pain) points. Analgesia was obtained in all patients with the same time-scheduled protocol (4, 8, 16, 24, 36, and 48 h after surgery). According to anesthesia after surgery protocol, the first *Sol. Ketonal* (ketoprofenum, Sandosa) 2 ml (100 mg) dose was administered as intramuscular injection in the operation room before surgery, together with premedication. Additional dose of *Sol. Ketonal* 2 ml (100 mg) was injected into muscles, if patient was requiring to relieve pain.

During the discharge of patients of both groups, on the second post-surgery day, Ca and IPTH examinations were performed and healing of surgical wound was evaluated. The evaluation of the patient of the healing of surgical wound was done according to the modified Hollander scale. Patients were also consulted by an Ear, Nose, Throat (ENT) specialist for the function of vocal folds. Patients with postoperative dysfunction were re-evaluated after 1 and 6 months. Cosmetic result was evaluated by numeric modified Hollander scale. This scale ranged from 0 to 7. The 0 means optimal result and 1–7 suboptimal result [10].

After 1 and 6 months, patients were examined repeatedly in the outpatient department. Ca and IPTH examinations were performed and ENT consultation was done for vocal folds function. Patients' surgical scar was evaluated according to the modified Hollander cosmetic scale. Patients of both groups completed SF-36 form. If blood tests indicated normocalcemia or hypocalcemia 6 months after surgery, a patient is completely recovered. Persisting primary hypoparathyroidism is diagnosed if hypercalcemia remains 6 months after surgery.

Calcium and vitamin D preparations after surgery were administered only in case of occurrence of symptoms of post-surgery hypocalcemia. Only patients with symptoms of postoperative hypocalcaemia proved by blood Ca examination below the lower limit were considered as complicated. According to the study protocol, asymptomatic biochemical hypocalcaemia was not considered as a complication, and any calcium supplementation was not given.

According to the study protocol, scar length was measured during the last out-patient consultation with a flexible tape 12 months after the surgery.

Statistics

Sample size was calculated during the planning of the study and during comparison of differences between traditional and focused surgery groups. Proportions were compared using *z*-score; for quantitative indices, averages of two independent groups were compared using Student's *t* criterion. For statistical significance of results, first-line level of significance was taken as α=0.05, and fixed second-line level β=0.20. For quantitative data, size of effect was changed from average (0.5) to large (0.8) (on the basis of pilot study). It was found that necessary sample size depending on the size of effect could be from 51 to 21 persons in each study group. For statistical significance of categorical indices (data of pathohistological examination of parathyroid gland and others), differences between traditional and focused surgery groups, depending on proportion size, the minimal number of cases in each group would be from six to 37 individuals in each group. To calculate the sample size, the program "GPower 3.0"(http://www.psycho.uni-duesseldorf.de/aap/projects/gpower/) was used.

Prior to statistical testing, each of the variables was tested for normality. Statistical comparison of the results was performed between the patient's groups: those who had traditional surgery and those who had focused parathyroidectomy operation. To determine the significance of the differences between the means (continuous measures) Student's *t* test was used. The nonparametric Mann–Whitney rank sum test was used in cases where the studied items had a nonnormal distribution. Results were presented as means (standard deviation) or medians (25–75 percentiles). The χ^2 test with a Yates correction or Fisher exact test and *z*-test was used for the comparison of proportions between groups. A value of $p<0.05$ was considered statistically significant. Computation was done using SPSS 12 statistical software.

Results

Among 57 pHPT patients referred for surgery, 47 were found eligible for the study. Forty seven patients, which, according to double random principle, were subdivided into two groups according to the surgery mode (traditional surgery or focused operation) were included into the study. Twenty four patients were enlisted into focused parathyroidectomy group, conventional surgery 23 patients. Preoperative biochemical data were similar between both groups (Table 1), as well as demographic data. All patients were symptomatic.

The sensitivity and of ultrasound examination and sestamibi scintigraphy were 81% vs. 82%, respectively, and positive predictive value 85% vs. 90%.When sestamibi scintigraphy and ultrasound examination did not show the side of adenoma, the blood from both internal jugular veins were investigated. Blood analysis for IIPTH taken from both internal jugular veins just before the operation correctly identified the side of adenoma in all four patients. The concordant results of preoperative sestamibi, US

Table 1 Patients preoperative studies

Indices	Surgery			Norm
	Traditional (N=23) Average (SD)	Focused (N=24) Average (SD)	p value	
Serum calcium, mmol/l	2.98 (0.22)	2.92 (0.17)	0.713	2.05–2.55
IPTH, ng/l	236.9 (90.5)	264.4 (161.8)	0.477	12–68
Serum alkaline phosphatase, U/l	128.3 (58.6)	147.5 (90.1)	0.394	40–150
Serum creatinine, μmol/l	78.3 (13.9)	78.7 (13.2)	0.913	53–97
T-score	−2.2 (1.8)	−2.4 (1.6)	0.821	± 1

SD-standard distribution

scanning and pre-incision IIPTH level from both internal jugular vein correctly identified the side of adenoma in all 21 patients with solitary adenoma (true-positive result).

In 21 patients from the FP group, IIPTH monitoring showed more then 50% decline. The solitary parathyroid gland adenoma was confirmed by pathohistological examination in all 21 patients. In three FP group patients, IIPTH level 15 min after resection of enlarged parathyroid gland did not drop more than 50% from the baseline. Operations were converted to conventional and hyperplasia of all parathyroid glands was found. Three and a half glands were resected. From 23 patients operated by conventional method, two patients had primary hyperplasia. Histopathological examination confirmed the clinical diagnosis of primary hyperplasia. In the follow-up, all these patients were normocalcemic.

The weight of the adenoma was similar in both groups: 2.1 (1.62) g in conventional group and 2.22 (1.85) g in FP group (p=0.73).

The perioperative data for the two groups of patients are summarized in Table 2. The time elapsed from adenoma detection was lower in the FP group (p<0.001), adenoma excision time after its detection was shorter in the FP group (p<0.001), surgery time from "skin to skin" was shorter in the FP group (p<0.001), but time for anesthesia (till extubation) was similar in both groups (p=0.318). Waiting for IIPTH examination prolonged FP for almost 30 min.

Postoperative pain evaluated by visual analog scale at 4,8,16,24,36, and 48 hours showed what patients from conventional group experienced significantly higher pain than patients from the FP group (p<0.001). Four patients from FP group did not require any analgesics in the postoperative period.

Statistically significant differences between groups according to the need of analgesics and their use after operation were found. In the FP group, pain had to be relieved for 22 (3.2) h after surgery, and in the conventional group 42 (6) h (p<0.001). After FP patients were taking twice less ketonal in comparison with patients who underwent conventional parathyroidectomy (p<0.001).

Notwithstanding different surgery methods, convalescence of patients was rather similar. Patients from the focused surgery group were recovering slightly more smoothly, but difference was insignificant. Four patients from the conventional group (19%) and two patients from the FP group (9.6%) sustained postoperative symptomatic hypocalcemia (p=0.27). Thirty days after surgery, hypocalcaemia was detected for only one female patient of traditional operation group; in focused surgery group, not a single case of hypocalcemia was found. Six months after operation, all patients in both groups were eucalcemic.

Six months after the surgery, increased IPTH in combination with normal calcium levels persisted for seven patients of both groups, and it was 33.3%.

Table 2 Comparison of surgery indices

Surgery index	Surgery		p value
	Traditional (N=21) Average (SD)	Focused (N=21) Average (SD)	
Time elapsed from adenoma detection, min	48 (20)	20 (8)	<0.001
Adenoma excision time after its detection	4 (1.2)	8 (4.2)	<0.001
Surgery time "from skin to skin"	64 (14)	36 (3.8)	<0.001
Surgery time till results of frozen-section examination (25 min)	72 (8.2)	48 (8.4)	<0.001
Surgery time till IIPTH examination results (30 min)	–	76 (2.1)	
Anesthesia time (till extubation)	84 (6.2)	82 (6.6)	0.318

SD standard distribution

Vocal cord palsy occurred in two patients: one each from both groups. Palsy disappeared in both patients during 1 month after surgery.

It was determined that during the traditional operation, median scar length was 8 cm (QS=4.2 cm), and, in case of focused surgery, 1.9 cm (QS=0.6 cm). Difference of scar length was statistically significant ($p<0.001$).

Quality of life according the SF-36 questionnaire 1 and 6 months after surgery did not reveal any differences between the groups.

Cosmetic satisfaction assessed by the modified Hollander scale at 2 days, 1 month ($p<0.001$) and 6 months ($p<0.05$) postoperatively was significantly higher in the FP group versus conventional group patients. In both groups, cosmetic satisfaction tended to increase with time. This difference became nonsignificant between both groups 1 year after the surgery ($p=0.38$; Fig. 2).

Average expenditure for one patient of traditional surgery group was 1166 EU, focused surgery group—1428 EU. FP was statistically significantly more expensive than conventional parathyroidectomy ($p<0.05$).The main differences in charges between the groups are shown in Table 3.

Table 3 Cost differences in two groups (in EU)

Method of surgery	Conventional (*n*-21)	Focused (*n*-21)
Ultrasonography	0	210 (10)
Sestamibi scintigraphy	0	630 (30)
Preoperative IIPTH from int. jugular vein	0	64 (14)
Pre-incision IIPTH	0	294 (14)
Post-excision IIPTH	0	292 (14)
Analgetics	78	35
Hypocalcemia treatment	50.8	4

Cost of one test is indicated in brackets.

Discussion

In recent years, the trend toward less invasive surgery has been accepted and required by patients and physicians in management of many disorders. This has included treatment of pPHP in which new adjuncts have allowed surgeons more accurate diagnosis, better preoperative localization of pathological glands, and intraoperative quantitative assurance as to when all hypersecreting glands have been removed. Utilization of these adjuncts has resulted in minimal invasive parathyroidectomy (MIP). A number of different MIP surgical techniques have subsequently evolved, which gain popularity worldwide. It is quite difficult to evaluate the new minimally invasive techniques. The conventional BNE is a very successful operation for pPHP. The more successful a standard treatment, the more difficult is to prove a particular new method to be superior [11, 12].

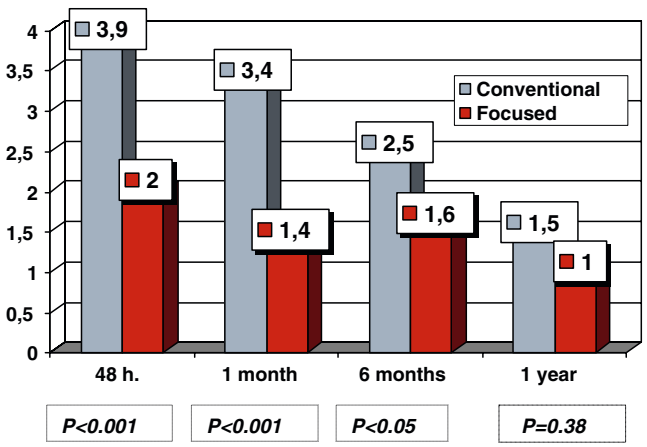

Fig. 2 Patients satisfaction regarding the cosmetic results scored with 0 to 7 scale (according to the modified Hollander scale)

In our study, we compared BNE and focused parathyroidectomy. FP is the current method of choice of the majority of members of the International Association of Endocrine surgeons that favor the MIP [11].

Several large series using this technique have been published. Most of these are from specialized centers and have reported results that are comparable well with those of BNE. A retrospective cohort study from Yale comparing 255 FP to 401 BNE demonstrated no significant difference in surgical success (99% versus 97%) or complication rates (1.2% versus 3%). There are several other similar studies [4, 12]. Most of these studies suggest that the FP is safe and has some advantages (less postoperative hypocalcaemia, shorter operating time, early discharge and perhaps better cosmesis and less postoperative pain).

In the surgery of pPHP, only five randomized controlled trials are published [13–16]. Only two of them compared FP with BNE. In one of these studies, FP under local anesthesia was compared to BNE under general anesthesia. The results showed that patients undergoing FP under local anesthesia had a shorter operating time and less hypocalcaemia with no difference in cure rate [14] (Table 4). In the second, scan-directed FP was compared with BNE and found no difference in cure rate between the two groups of patients [15].

If one accepts that any parathyroidectomy that involves a conventional Kocher-type cervicotomy is a conventional access procedure, then it follows that the term “minimal invasive parathyroidectomy” is the umbrella term that should apply to all procedures that aim to achieve parathyroid excision with less access [11]. Unilateral neck exploration for PHP has been proposed as a MIP by

Table 4 Postoperative follow-up of cure rate, complications, measuring postoperative pain by visual analog score (VAS), analgesia request, analgetics consumption, scar length, and total cost analysis

	Conventional (*n*-21)	Focused (*n*-21)	*p* value
Success rate (%)	100	100	1.0
Transient hypocalcemia (no)	4	2	0.27
Temporary RLN palsy (no)	1	1	1.0
Pain at 4 h (VAS)	42 (30)	20 (5)	<0.001
Pain at 8 h (VAS)	40 (25)	10 (13)	<0.001
Pain at 16 h (VAS)	30 (25)	10 (10)	<0.001
Pain at 24 h (VAS)	30 (16)	5 (10)	<0.001
Pain at 36 h (VAS)	20 (5)	0 (8)	<0.001
Pain at 48 h (VAS)	10 (10)	0 (5)	<0.001
Analgesia request 48 h	42 (6)	22 (3.2)	<0.001
Analgesic consumption 48 h (g)	0.44 (0.15)	0.20 (0.08)	<0.001
Adenoma weight (g)	2.1 (1.62)	2.22 (1.85)	0.73
Scar length (cm.)	8 (4.2)	1.9 (0.6)	<0.001
Total charges (EU)	1166	1428	<0.05

number of authors [13, 17–19]. Others think that to perform a unilateral exploration through a standard neck incision—it is not a MIP. The point at which the procedure becomes a minimal-access operation presumably is best defined by the length of the incision. The suggestion has therefore been made that the designation MIP be adopted only when the incision is less than 2.5 cm [20, 21]. Several different techniques of MIP are in use. Which operation has more advantages should be shown in randomized controlled trials.

One criticism of the minimally invasive surgical approach is that it requires careful case selection, being applicable to only a small subset of patients [22]. And even the last few randomized prospective trials were conducted on scan-preselective patients [14–17]. Only in one of these trials, patients were included regardless of the results of preoperative localization studies [13]. Several case-control studies were published in which patients were included regardless of the results of the preoperative localization studies as well [12, 24, 25].

The presentation of pHPT in Western countries (up to 80% are asymptomatic) and developing countries is different. Developing countries where pHPT presents with "old fashioned" symptoms mimic the past Western experience [26, 27]. All patients referred to surgery in our study were symptomatic. It was not the result of selection of the patients. It is the result that the multi-channel screening tests are not yet available in our country widely. All patients were sent for surgery not by family physicians, but by rheumatologists (they treat osteoporosis in Lithuania), psychiatrists, and urologists. As a result, hypercalcemia and the weight of removed adenomas were higher in comparison with other studies from Western countries [13–17].

The etiology of pHPT in our trial was similar to the results of the last metaanalysis [26]: adenoma (89.4%), hyperplasia (10,7%).

The sensitivity for sestamibi scanning and high-resolution real-time ultrasonography of 82% and 81% concurs with the results of the last published systemic review [26]. It mostly depends on experience and dedication of the radiologist. The accuracy level given above is for a single radiologist with a specific interest in parathyroid disease. The data from other trials support this statement [27].

Surgeon experience plays a role in the success of FP. Our results suggest that even if preoperative localization is not perfectly accurate in predicting the exact location of the adenoma, FP is still possible as long as the gland is localized on the correct side of the neck. Moving the wound's hooks upward and downward facilitate examination of the upper and lower glands on the same side of the neck.

The FP group patients experienced higher cosmetic satisfaction with the scar. Cosmetic satisfaction assessed by the modified Hollander scale at 2 days, 1 month ($p<0.001$) and 6 months ($p<0.05$) postoperatively was significantly higher in the FP group versus the conventional group patients. This difference became nonsignificant between both groups 1 year after surgery ($p=0.38$).

Cosmesis after parathyroidectomy was studied only in two trials [16, 23]. However, evaluation of the scar was done only after 1 month [16], and after 6 months [23]. According to the general rules of plastic surgery, the final evaluation of the scar should be performed only after 1 year after the surgery [28].

Health care administration and costs in different countries are very different. That is why it is extremely difficult to calculate and compare per-procedure costs for Lithuanian patients with other countries' health care systems pre-procedure costs. In our study, we found that charges for FP are higher than in conventional group patients ($p<0.05$).

Conclusions

Both operations are safe. Not a single patient had intra-surgery complications. During early post-surgery period, hypocalcemia occurred in four patients from the conventional group and two patients from the FP group; the difference was not significant ($p=0.27$).

The duration of focused operation was shorter, although statistically insignificantly ($p=0.318$). Adenoma was detected more rapidly for patients of focused surgery group ($p=0.001$). IIPTH test prolonged focused parathyroidectomy by 30 min.

Post-surgery pain was statistically significantly more pronounced in the group of traditional surgery ($p=0.001$). Need of analgesics was significantly lower for patients from focused surgery group ($p=0.001$). From a cosmetic point of view, 6 months after surgery, patients preferred scar from focused parathyroidectomy than from traditional surgery. However, 1 year after surgery cosmetic results became similar ($p=0.38$).

Life quality evaluation according to SF-36 questionnaire revealed that there were no statistically significant differences between the study groups 1 and 6 months after surgery.

Focused surgery in Lithuania is more expensive than traditional parathyroidectomy ($p<0.05$).

References

1. Van Heerden J, Grant C (1991) Surgical treatment of primary hyperparathyroidism: an institutional perspective. World J Surg 15:688–692
2. Debridge L, Younes N, Guinea A et al (1998) Surgery for primary hyperparathyroidism 1962–1996: indications and outcome. Med J Aust 168:153–156
3. Burkey SH, Snyder WH, Nwariaku F, Watumull L, Mathews D (2003) Directed parathyroidectomy: feasibility and performance in 100 consecutive patients with primary hyperparathyroidism. Arch Surg 138:604–609
4. Udelsman R, Donovan PI, Sokoll LJ (2000) One hundred consecutive minimally invasive parathyroid explorations. Ann Surg 232:331–339
5. Irvin GL, Carneiro DM, Solorzano CC (2004) Progress in the operative management of sporadic primary hyperparathyroidism over 34 years. Ann Surg 239:704–711
6. Hudai G, Morita E, Perier ND et al (2003) Differing histologic findings after bilateral and focused parathyroidectomy. J Am Coll Surg 196:535–540
7. Clerici T, Brandle M, Lange J et al (2004) Impact of intraoperative parathyroid hormone monitoring on the prediction of multiglandular disease. World J Surg 28:187–192
8. Chan AK, Duch QY, Katz MH, Siperstein AE, Clarc OH (1995) Clinical manifestation of primary hyperparathyroidism before and after parathyroidectomy. Ann Surg 222:402–414
9. Delellis RA (1993) Tumors of the parathyroid gland. In: Atlas of tumor Pathology, 3rd series, fascicle 6. Washington, DC, Armed Forces Institute of Pathology, p 1
10. Hollander JE, Singer AJ (1999) Laceration management. Ann Emerg Med 34:356–365
11. Palazzo F, Delbridge L (2004) Minimal access/ minimally invasive parathyroidectomy for primary hyperparathyroidism. Surg Clin N Am 84:718–731
12. Dillovou ED, Cohn HE (2003) Minimally invasive parathyroidectomy:101 consecutive cases from a single surgeon. J Am Coll Surg 197:1–7
13. Bergenfelz A, Lindblom P, Tibblin S, Westerdahl J (2002) Unilateral versus bilateral neck exploration for primary hyperparathyroidism: a prospective randomized controlled trial. Ann Surg 263:543–551
14. Bergenfelz A, Kanngiesser V, Zielke A, Nies C, Rothmund M (2005) Conventional bilateral cervical exploration versus open minimally invasive parathyroidectomy under local anaesthesia for primary hyperparathyroidism. Br J Surg 92:190–197
15. Russell CF, Dolan SJ, Lair JD (2006) Randomized clinical trial comparing scan-directed unilateral versus bilateral cervical exploration for primary hyperparathyroidism due to solitary adenoma. Br J Surg 93:418–421
16. Miccoli P, Berti P, Materazzi G, Massi M, Pinoce A, Minuto MN (1999) Results of video-assisted parathyroidectomy: a prospective randomized study. Surgery 126:1117–1121
17. Lucas RJ, Weish RJ, Glover JL (1990) Unilateral neck exploration for primary hyperparathyroidism. Arch Surg 125:982–985
18. Robertson GSM, Jonson PR, Bolia A et al (1996) Long term results of unilateral neck exploration for preoperatively localized nonfamilial parathyroid adenomas. Am J Surg 176:311–314
19. Worsey JM, Carty SE, Watson CG (1993) Success of unilateral neck exploration for sporadic primary hyperparathyroidism. Surgery 114:1024–1030
20. Brunaud L, Zarnegar R, Wada N, Clarc OH, Duh QY (2003) Incision length for standard thyroidectomy and parathyroidectomy. When is it minimally invasive? Arch Surg 138:1140–1143
21. Henry J (2006) Minimally invasive surgery of the thyroid and parathyroid glands. Br J Surg 93:1–2
22. Perrier ND, Ituarte PH, Morita E, Hamill T, Duch QY et al (2002) Parathyroid surgery: separating promise from reality. J Clin Endocrinol Metab 87:1024–1029
23. Barczynski M, Cichon S, Konturek A, Cichon W (2006) Minimally invasive video-assisted parathyroidectomy versus open minimally invasive parathyroidectomy for a solitary parathyroid adenoma: a prospective, randomized, blinded trial. World J Surg 30:721–731
24. Gurnell EM, Thomas SK, McFarlane I, Munday I et al (2004) Focused parathyroid surgery with intraoperative parathyroid hormone measurement as a day-case procedure. Br J Surg 91:78–82
25. Slepavicius A, Navickas A (2005) Minimaliai invazine adenomektomija su intraoperaciniu parathormono matavimu gydant pirmini hiperparatiroidizma. Sveik Mokslai 15:22–24
26. Ruda J, Hollenbeak C, Stack B (2005) A systematic review of the diagnosis and treatment of primary hyperparathyroidism from 1995 to 2003. Otolaryngol Head and Neck Surg 132:359–372
27. Vogel M, Lucas R, Craco P, Broadlie T, Hopkins W (1998) Unilateral parathyroid exploration. Am Surgeon 64:693–697
28. Robinson J, Hange W, Sengelman R, Siegel O (2005) Surgery of the skin. Elsevier Mosby, USA, pp 23–78