

Techniques in Coloproctology

Official Journal of the:
Italian Society
of Colo-Rectal Surgery (SICCR)
Mediterranean Society
of Coloproctology (MSCP)
Israel Society of Colon
and Rectal Surgery (ISCRS)

EDITOR-IN-CHIEF

M. Pescatori

CO-EDITORS

F. Seow-Choen

S. D. Wexner

Spedizione in a. p. - 45 % - art. 2 comma 20/b legge 662/96 - Filiale di Milano

Online edition in SpringerLink - Medicine Online Library
<http://www.springerlink.com>
Indexed in Index Medicus
and EMBASE/Excerpta Medica

 Springer



1123-6337(200411)8:3;1-C

Printed on acid-free paper

P.J. Gupta

A comparative study between radiofrequency ablation with plication and Milligan-Morgan hemorrhoidectomy for grade III hemorrhoids

Received: 11 March 2004 / Accepted: 4 May 2004

Abstract Background Milligan-Morgan (MM) hemorrhoidectomy is the most favored treatment for prolapsed hemorrhoids. However, it may be associated with severe postoperative pain, long periods of convalescence and other complications. In alternative, I use a procedure of radiofrequency ablation and plication (RAP) of hemorrhoids. The present study compared the two procedures in terms of surgical parameters, postoperative pain and complications. **Patients and methods** A total of 60 patients with grade III hemorrhoids were randomized to undergo radiofrequency ablation and plication (31 patients) or MM hemorrhoidectomy (29 patients). The patients were followed up to 2 years. **Results** Duration of surgery was significantly longer in the MM group as was postoperative hospitalization ($p < 0.05$). Post-defecation pain and pain at rest were much less in the RAP group ($p < 0.05$). Wound healing period (17 vs. 38 days) and time to return to work (7 vs. 17 days) were the other significant findings favoring RAP procedure. Early complications occurred more frequently in MM group, but late complications like external skin tags (4 vs. 2 patients) were more common in RAP group. One asymptomatic recurrence was noted in RAP group. **Conclusions** Radiofrequency ablation and plication of hemorrhoids is associated with significantly less postoperative pain, shorter hospital stay and earlier return to normal activity. It can be considered as an alternative to the Milligan-Morgan hemorrhoidectomy.

Key words Hemorrhoids • Hemorrhoidectomy • Radiofrequency ablation • Plication

Introduction

Hemorrhoidectomy is considered to be as the best therapeutic treatment for advanced hemorrhoidal disease. The Milligan-Morgan operation [1] is still the most commonly performed procedure for such hemorrhoids. However, this surgery may be associated with long and painful postoperative course [2] and prolonged convalescence period with complications like hemorrhage, anal stenosis and recurrence.

In the background of cost containment and competition for better patient care, a definite trend is developing towards innovative simple treatments for hemorrhoids. In this attempt, a few alternative procedures including diathermy, laser hemorrhoidectomy and stapled hemorrhoidopexy have been introduced with the aims of minimizing pain, bleeding and postoperative complications. However, all these treatments involve some form of excisional therapy.

While excisional therapy should be used for critically advanced cases with accompanying complications, a nonexcisional method that can return the hemorrhoidal cushions to their normal size and position should be a rational choice. Infrared coagulation is one technique that results in immediate reduction of blood flow to the hemorrhoids followed by tethering of the mucosa to the underlying tissue, and subsequently induces healing by way of cicatrization. However, this technique is useful only in early grades of non-prolapsing hemorrhoids [3].

Radiofrequency coagulation of hemorrhoids is similar to infrared coagulation [4]. The principle of radiofrequency coagulation is that it ablates tissue by converting radiofrequency waves into heat. The alternating current passes down from an uninsulated electrode tip into the tissues to generate changes in the direction of ions within the tissue fluid. This creates ionic agitation and frictional heating. The tissue heating then drives extracellular and intracellular water out of the tissue, which results in the final destruction of the tissue by coagulative necrosis [5]. This phenomenon is called as cellular volatilization [6].

P.J. Gupta (✉)
Fine Morning Hospital and Research Center
Gupta Nursing Home
Laxminagar, Nagpur, India
E-mail: drpjg@yahoo.co.in

Plication or suturing of the anal cushions as a treatment of hemorrhoids has been practiced for many years. Farag [7] described a pile suture method using three interrupted sutures. Awojobi [8], while using Farag's pile suture technique, operated 25 patients with prolapsing hemorrhoids on an outpatient basis and achieved a 96% success rate. By a similar technique, Bhansali and Kale [9] operated patients with prolapsing hemorrhoids and claimed good results. Another series of 300 patients has been successfully operated by this method [10]. Pfenninger [11] advocated a method of 'pile stitch'. He used absorbable sutures, placing them above the dentate line to attach the anal cushion back to the internal sphincter. He claimed that the stitch obliterates the hemorrhoidal blood supply and reduces the bulk of the pile mass [11].

I experimented with a combination of two techniques [12], i.e. after ablating the hemorrhoidal tissue with radiofrequency, the tissue is plicated [13, 14]. This innovative approach was compared with the standard Milligan-Morgan hemorrhoidectomy, with particular attention to postoperative pain, time to return to work, and early and late complications.

Patients and methods

During a 1-year period from January 2001 to December 2001, 60 patients with symptomatic grade III hemorrhoids admitted for elective surgery were prospectively and randomly assigned to Milligan-Morgan (MM) hemorrhoidectomy or radiofrequency ablation followed by plication (RAP). Randomization was done using sealed envelopes. Patients having external piles, those previously operated for hemorrhoids, and patients taking anti-platelet medicines or having thrombosed hemorrhoids were excluded from the study.

All patients underwent a detailed clinical and anoscopic examination. Three patients having colonic symptoms such as increased frequency of stool, passage of mucus per rectum or abdominal pain underwent sigmoidoscopy to exclude more proximal disease. A dose of laxative (lactulose, 20 ml) was given the night before the procedure.

Informed consent was obtained from all the patients. The study was approved by the local ethics committee and was performed according to the Declaration of Helsinki. Patients were operated under a short general anesthesia or caudal block as per the preference of the anesthetist after evaluating the patient.

An intravenous dose of 1 g ceftriaxone sodium was given just before the commencement of the procedure. Both techniques were performed by the Author who has an experience of performing more than 300 procedures of both types.

Milligan-Morgan hemorrhoidectomy was performed by the standard method described in the literature [1].

Radiofrequency ablation and plication of hemorrhoids

An Ellman Dual Frequency 4 MHz radiofrequency generator (Ellman International, Oceanside, New York, USA) was used for

ablation of hemorrhoids. The unit has a handle to which different electrodes can be attached to meet the exact requirements of the procedure [15]. The amount of output power intensity to be delivered can be set to range between 1 and 100. A ball electrode was used.

The procedure was performed with the patient in lithotomy position. A two-finger gentle anal stretching (Lord's anal dilatation) relieved the sphincter spasm and helped minimize postoperative pain. This maneuver also helped reduce the size of the hemorrhoidal prolapse [16].

The three skin tags corresponding the three principle sites of hemorrhoids, namely those at the 3, 7 and 11 o'clock positions, were held with artery forceps and retracted to visualize the piles. Starting at the pedicle, the whole pile mass was coagulated by gradually rotating the ball electrode of the radiofrequency device over the hemorrhoid. The power of the radiosurgical unit was adjusted to shrink the tissues without creating a spark. The gradual change of hemorrhoids to dusky white color (blanching) indicated a satisfactory coagulation necrosis. Whenever associated secondary piles [17] were noticed, they also were simultaneously ablated.

All hemorrhoids were coagulated one after other with a precaution of leaving normal anal mucosa between the treated hemorrhoids. Care was taken to avoid charring of rectal mucosa or hemorrhoids. This precaution helped in avoiding undue fibrosis and anal narrowing, a complication often noticed after such procedures [18].

Following ablation, the whole pile mass was underrun with a 1-0 chromic catgut suture on a 45-mm needle (No. 4246, Ethicon, UK). This began from the most distal end of the pile at the anal verge and then advanced towards the pedicle with continuous locking sutures. The suture was locked and tied in the middle and a fresh suturing was undertaken until the final stitch reached just proximal to the pedicle of the pile mass. I preferred dealing with the hemorrhoid at 3 o'clock (left lateral) first, and then worked the piles at 7 o'clock and 11 o'clock.

Data collection and postoperative care

An independent observer, who was not from the operating team, recorded data concerning duration of surgery and amount of bleeding during the procedure. The quantity of bleeding was ascertained by weighing the swabs used for mopping the bleeding area.

In the postoperative course, all patients were given 30 ml lactulose in two divided doses for 4 weeks. One tablet of 500 mg ornidazole was given as an antibiotic for ten days. Pain was controlled with tablets containing 50 mg diclofenac sodium and 500 mg acetaminophen two-times daily on demand but never more than three per day, along with local application of 5% lidocaine ointment three-times daily. Pain was assessed using a visual analogue scale from 0 (no pain at all) to 10 (the worst pain ever experienced). Wound healing was observed by parting the buttocks of the patients in the MM group and by inserting a well-lubricated pediatric anoscope in RAP group.

Patients were discharged from the hospital only after one bowel movement had been achieved. Outpatient follow-up was carried out at 2, 4 and 6 weeks after the procedure to assess the duration of postoperative pain, time to return to work, wound healing and early complications like bleeding, urinary retention,

seepage and continence disorder. They were subsequently called after 24 months to note late complications like anal stenosis, recurrence of hemorrhoids and development of external skin tags. These findings were recorded by an independent observer, unaware of the kind of procedure performed.

Statistical analysis

The data were analyzed using Graphpad Software (Graphpad, San Diego, USA). Student's unpaired *t* test was used. A value of $p < 0.05$ was considered statistically significant.

Results

Of the 60 patients with symptomatic grade 3 hemorrhoids, 31 were randomized to radiofrequency ablation with plication (RAP) procedure and 29 were assigned to Milligan-Morgan (MM) hemorrhoidectomy. There was no significant difference in the patients' age and mean duration of disease between the two groups (Table 1).

The MM hemorrhoidectomy procedure took significantly longer time to perform than the RAP procedure: 28 vs. 7 min; $p < 0.05$ (Table 2). A mean of 74 seconds of

radiofrequency ablation was needed for each hemorrhoid. The volume of intra-operative bleeding was significantly higher in the MM group in comparison with the RAP group (64 vs. 11 ml). The amount of suture material required in RAP group was on an average 1.3 packs catgut per case, while a mean of 3.8 packs catgut was required in MM hemorrhoidectomy.

Patients who had undergone RAP had the first bowel movement earlier than patients who underwent MM hemorrhoidectomy (15 vs. 28 h, $p < 0.05$). This criterion determined the period of hospital stay, which was significantly less in patients operated by RAP method than that of the control group (17 vs. 30 h, $p < 0.05$). Serous discharge and anal pruritus were present in both groups, but the duration of discharge was longer in the RAP group (16 vs. 10 days, $p < 0.05$).

The duration and intensity of pain after defecation and at rest were greater in the MM group in comparison to RAP group (Fig. 1). Therefore, the analgesic requirement was significantly higher in patients from MM group (39 vs. 20 tablets, $p < 0.05$).

The time elapsing before returning to work or full activity was significantly shorter in RAP group (7 vs. 17 days, $p < 0.05$). The wounds healed in the patients from the RAP group with a mean period of 17 days, whereas the healing took a mean time of 38 days to complete in the MM group ($p < 0.05$).

Table 1 Patients' characteristics and perioperative and postoperative findings, by treatment group. Values are mean (SD)

	Radiofrequency ablation and plication (n=31)	Milligan-Morgan hemorrhoidectomy (n=29)	<i>p</i>
Age, years	39 (9)	41 (8)	NS
Disease duration, months	69 (11)	62 (13)	NS
Operative time, min	7 (1)	28 (5)	<0.05
Intra-operative bleeding, ml	11 (2)	64 (8)	<0.05
Suture material requirement, no. per case	1.3 (3)	3.8 (12)	<0.05
Time to first bowel movement, h	15 (31)	28 (2)	<0.05
Hospital stay, h	17 (4)	30 (3)	<0.05
Anal discharge, days	16 (2)	10 (2)	<0.05
Time to return to work, days	7 (2)	17 (3)	<0.05
Analgesic requirement, no. tablets	20 (3)	39 (2)	<0.05
Wound healing time, days	17 (4)	38 (8)	<0.05

NS, not significant

Table 2 Early and late complications after treatment for hemorrhoidal disease, by study group. Values are number (percentage) of patients

Complication	RAP group (n=31)	MM group (n=29)
Urinary retention	1 (3.2)	3 (10.3)
Bleeding	0 (0)	1 (3.4)
Incontinence to flatus	2 (6.5)	4 (13.8)
External tags	4 (12.9)	2 (6.9)
Recurrence	1 (3.2)	0 (0)
Anal stenosis	0 (0)	1 (3.4)

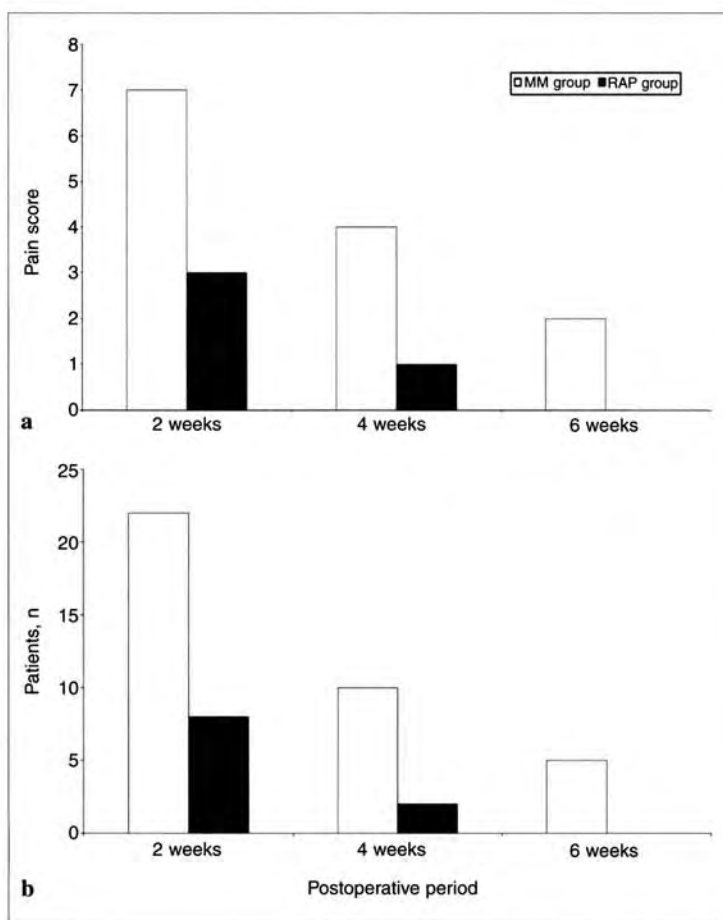


Fig. 1a, b Postoperative pain in patients treated for grade III hemorrhoids, by treatment group. Pain was scored on a visual analog scale (VAS) in which 0 is no pain and 10 is maximum pain. **a** Pain score after defecation. **b** Number of patients reporting any pain (VAS score ≥ 1) at rest

During anoscopic examination at the 4-week follow-up, the hemorrhoidal mass in patients of RAP group looked shrunken and segmented. At the 24-month follow-up, the pile mass was replaced by fibrous bands.

Acute urinary retention developed in four patients in the immediate postoperative period (Table 2). Out of these four patients, three were from the MM group and one from the RAP group. All of them required catheterization once. None of them had this complaint again. A patient from the MM group needed readmission in the hospital due to secondary bleeding in the second postoperative week. He, however, responded to conservative treatment using local compression and haemostatic therapy. While no patients in either group complained of incontinence of feces, 4 patients from MM group and 2 patients from RAP group had incontinence for flatus for about 3 weeks after the procedure. At the 24-month follow-up, 4 patients from the RAP group developed external skin tags. Similar tags were seen in 2 patients from the MM group. One patient from the RAP group was found to have hemorrhoids during anoscopic examination at the 2-year follow-up. He, however, had no complaints. He was prescribed laxatives and was instructed not to strain at stool. No such recurrence was found in the MM group. One patient from the MM group developed narrowing of the anal canal. The

digital anal examination was painful. He was subjected to regular anal dilatation and was prescribed a bulk-forming laxative.

Discussion

Radiofrequency ablation is a widely used technique in the fields of ophthalmology, otorhinolaryngology [19], and cosmetic and reconstructive surgery. It is now becoming a procedure of choice for ablation of hepatic tumors [20]. It is also being used for various proctological procedures [21].

Compared to traditional electrocautery and diathermy, the radiofrequency electrode during its application remains cold [22]. This is possible because of the use of high frequency current (4 MHz), as compared to the 0.5–1.5 MHz current used in electrocautery [23].

While true cautery, which is widely used for hemorrhoidectomies, causes damage similar to third-degree burns, the tissue damage that occurs in radiofrequency technique is superficial and comparable to that which occurs with lasers [24]. Histologically, the tissue damage from radiofrequency surgery is actually less than that of the conventional scalpel and is equal to that of the cold scalpel

[25]. While CO₂ and Nd:YAG lasers have been proposed as scalpel and coagulator for hemorrhoidectomy, the treatment cost is high and the method does not have any significant advantage over conventional hemorrhoidectomy [26].

The history of ablating the hemorrhoids is old. Hippocrates suggested burning hemorrhoids [27]. Infrared heat coagulation [28], bipolar diathermy destruction (Bicap) [29], CO₂ or Nd:YAG laser coagulation [26, 30], direct current probe (Ultroid) [31] and coagulation by heater probe [32] are other techniques used in the heat destruction of hemorrhoids. In another study, hemorrhoidectomy using a radiofrequency bistury had been used with good success [33].

Several parameters related to surgery, postoperative events and complications were measured to compare the two procedures in the present study. They have distinctly shown that RAP is superior to MM technique. The mean time taken to perform RAP was one-fourth that needed for the MM procedure. The volume of bleeding during the RAP procedure was negligible compared to the MM procedure. Radiofrequency ablation results in frictional heating, causing thermal coagulation and protein denaturation of the hemorrhoidal mass [34]. Thus, the procedure of RAP is virtually bloodless. While an average of 3.8 packs catgut sutures was needed for each case of MM hemorrhoidectomy, the patients operated by RAP technique required only 1.3 packs on average. Radiofrequency ablation seals the sensory nerve endings and the leaking lymphatics [35]. Because of the low level of tissue destruction and controlled direction of the radiofrequency waves, the postoperative pain was appreciably less. While MM technique involves removal of some sphincter tissue, which causes postoperative anal spasm and increased post-defecation discomfort, no such interference is needed in RAP technique. The reduction in pain did help in the early bowel movements. As there were no external anal wounds created by RAP, the pain at rest was significantly less. The mean hospital stay for patients in RAP group was 17 h. This was possible due to less postoperative pain, early bowel evacuation and minimal discomfort in bowel movements. The patients operated by RAP technique were able to return to their duties earlier than the patients operated by conventional method.

None of the patients in either study group had fecal incontinence. Inadequate control to hold flatus was reported by 13.8% of patients in MM group, and by 6.5% of patients operated by RAP. This difference may be explained by the minimal manipulation of the sphincter muscles required under the RAP procedure. The wounds in patients operated by RAP healed earlier than those in the MM group. This can be attributed to the fact that radiofrequency waves cause negligible damage to the normal tissues while ablating the offending tissues, and thus helps in early repair of the wound [36]. The longer duration of discharge per anus in the RAP group was probably due to sloughing of the hem-

orrhoidal mass after coagulation. The commonest reason for narrowing of the anal canal is inadvertent removal of the anoderm, which produces fibrosis and cicatrization of the anal canal. As RAP does not cause any injury to the anoderm, there was no incidence of anal stenosis; however, there was one such case in MM group. The development of external skin tags after RAP was probably due to development of perianal thrombosis caused by obstruction of venous return from the external hemorrhoidal plexus following plication of the hemorrhoids. After resolution of the thrombosis, the elongated skin persisted as skin tags.

One of the patients in RAP group developed internal hemorrhoids after 2 years. This could be due either to an incomplete ablation of the hemorrhoid mass or a premature dissolution of the suture used for plication of the pile.

The ablation and plication procedure achieves three major goals, which are needed to tackle advanced hemorrhoidal disease: (1) it helps fix the hemorrhoidal cushions to the underlying internal sphincter, (2) it reduces hemorrhoidal prolapse, and (3) it minimizes the hemorrhoidal blood flow [12]. For associated secondary hemorrhoids, radiofrequency coagulation is a useful tool.

While procedures such as diathermy and stapled hemorrhoidectomy are associated with a late complication of rectal stricture in 4%–5% of patients [37], none of the patients in this study had this complaint. Six patients in this study had skin tag formation. This complication has also been reported after diathermy hemorrhoidectomy [38].

Compared to electrocautery or laser ablation, there is little or no heat generated at the surgical site during radiofrequency ablation. This allows the surgeon to work in direct proximity to the functional tissues that need to be preserved, such as the intervening normal rectal mucosa and the underlying anal sphincter [39].

No special equipment is required to perform radiofrequency ablation and plication besides the radiofrequency unit. The procedure is cost effective, as no disposables are needed and the cost to run the instrument is negligible. The procedure can be conveniently performed in any routine surgical set-up [13].

In recommending this hybrid technique, a question may be asked as to whether radiofrequency ablation or suture plication is the key component of the procedure. In addition, is the radiofrequency treatment necessary at all? In my opinion, while plication controls prolapse of hemorrhoids, radiofrequency ablation decreases bleeding during the procedure and fixes the hemorrhoidal mass to the anal wall [14]. The combined procedure minimizes the lacunae in a single procedure while doubly ensuring a complete control of the hemorrhoidal disease.

Another objection that could be raised regards the 2-finger anal stretch before commencing RAP. The concern regarding disruption of anal sphincter following this maneuver is certainly well founded, but this gentle stretch did not cause permanent incontinence in any of the patients.

In conclusion, the study shows that the combined procedure of radiofrequency ablation and plication of hemorrhoids offers several advantages over the Milligan-Morgan hemorrhoidectomy. The procedure is quick to perform, easy to learn and bloodless in nature. It is economical in the sense that the durations of procedure and hospital stay are short, and the patients return to daily activities earlier. It is appreciably less painful in the postoperative course.

References

1. Milligan ETC, Morgan CN, Jones LE, Officer R (1937) Surgical anatomy of the anal canal and operative treatment of haemorrhoids. *Lancet* 2:1119–1124
2. Mikuni N, Oya M, Komatsu J, Yamana T (2002) A prospective randomized comparison between an open hemorrhoidectomy and a semi-closed (semi-open) hemorrhoidectomy. *Surg Today* 32:40–47
3. Nevah El (1993) The outpatient management of internal hemorrhoids by infrared coagulation. *Rev Med Panama* 18:166–170
4. Gupta PJ (2002) Novel technique: radiofrequency coagulation – a treatment alternative for early-stage hemorrhoids. *Med Gen Med* 4:1–9
5. Huang SK (1991) Advances in applications of radiofrequency current to catheter ablation therapy. *Pacing Clin Electrophysiol* 14:28–42
6. Goldberg SN, Gazelle GS (2001) Radiofrequency tissue ablation: physical principles and techniques for increasing coagulation necrosis. *Hepatogastroenterology* 48:359–367
7. Farag AE (1978) Pile suture: a new technique for the treatment of hemorrhoids. *Br J Surg* 65:293–295
8. Awojobi OA (1983) Modified pile suture in the outpatient treatment of hemorrhoids. A preliminary report. *Dis Colon Rectum* 26:95–97
9. Bhansali A, Kale PC (1982) Plication of hemorrhoids. *Indian J Surg* 49:78–80
10. Patnaik SP, Mangual R (1996) Plication: a new method of treating piles without knife. *Antiseptic* 93:206–209
11. Pfenninger JL (1997) Modern treatments for internal haemorrhoids. *BMJ* 314:1211–1212
12. Gupta PJ (2003) Radiofrequency ablation and plication of hemorrhoids. *Tech Coloproctol* 7:45–50
13. Gupta PJ (2002) Plication of hemorrhoids after radiofrequency ablation. An alternative to hemorrhoidectomy. *Ann Saudi Med* 22:267–268
14. Gupta PJ (2003) Radioablation of advanced grades of hemorrhoids with radiofrequency. *Curr Surg* 60:447–453
15. Goldberg SN, Gazelle GS, Dawson SL, Rittman WJ, Mueller PR, Rosenthal DI (1995) Tissue ablation with radiofrequency: effect of probe size, gauge, duration and temperature on lesion volume. *Acad Radiol* 2:399–404
16. Khalil KH, O'Bichere A, Sellu D (2000) Randomized clinical trial of sutured versus stapled closed hemorrhoidectomy. *Br J Surg* 87:1352–1355
17. Morinaga K, Hasuda K, Ikeda T (1995) A novel therapy for internal hemorrhoids. Ligation of the hemorrhoidal artery with a newly devised instrument (Moricorn) in conjunction with a Doppler flow meter. *Am J Gastroenterol* 90:610–613
18. Milito G, Cortese F, Anselmo A, Casciani U (1995) Treatment of hemorrhoidal peduncles with diathermy probe. *Ann Ital Chir* 66:801–803
19. Wedman J, Miljeteig H (2002) Treatment of simple snoring using radio waves for coagulation of uvula and soft palate: a day-case surgery procedure. *Laryngoscope* 112:1256–1259
20. Weber JC, Navarra G, Jiao LR, Nicholls JP, Jensen SL, Habib NA (2002) New technique for liver resection using heat coagulative necrosis. *Ann Surg* 236:560–563
21. Gupta PJ (2003) Sphincterotomy with radio frequency surgery: a new treatment technique of fissure in ano and associated pathologies. *Rom J Gastroenterol* 12:37–40
22. Pfenninger JL, DeWitt DE (1994) Radio frequency surgery. In: Pfenninger JL, Fowler GC (eds) *Procedures for primary care physicians*. Mosby, St. Louis, pp 91–101
23. Saidi MH, Setzler FD Jr, Saddler RK, Farhart SA, Akright BD (1994) Comparison of office loop electrosurgical conization and cold knife conization. *J Am Assoc Gynecol Laparosc* 1:135–139
24. Valinsky MS, Hettinger DF, Gennett PM (1990) Treatment of verrucae via radio wave surgery. *J Am Podiatr Med Assoc* 80:482–488
25. Hettinger DF (1997) Soft tissue surgery using radiowave techniques. *J Am Podiatr Med Assoc* 87:131–135
26. Tajana A, Chiurazzi D, De Lorenzi I (1995) Infrared photocoagulation, cryosurgery and laser surgery in hemorrhoidal disease. *Ann Ital Chir* 66:775–782
27. Hughes E, Cuthbertson A, Killinbach K (1983) In: *Colorectal surgery*. Churchill Livingstone, London, pp 178–202
28. Leicester RJ, Nicholls RJ, Mann CV (1981) Infra red coagulation: a new treatment for hemorrhoids. *Dis Colon Rectum* 24:602–605
29. Smith LE (1987) Hemorrhoids. A review of current techniques and management. *Gastroenterol Clin North Am* 16:79–91
30. Leff EL (1992) Hemorrhoidectomy: laser versus non-laser outpatient surgical experience. *Dis Colon Rectum* 35:743–746
31. Norman DA, Newton R, Nicholas GV (1989) Direct current electrotherapy of internal hemorrhoids: an effective, safe, and painless outpatient approach. *Am J Gastroenterol* 84:482–487
32. Jensen DM, Jutabha R, Machicado GA et al (1997) Prospective randomized comparative study of bipolar electrocoagulation versus heater probe for treatment of chronically bleeding internal hemorrhoids. *Gastrointest Endosc* 46:435–443
33. Filingeri V, Casciani CU (1997) Submucosal hemorrhoidectomy with a radiofrequency bistoury. *Minerva Chir* 52:1255–1259
34. Scudamore CH, Lee SI, Patterson EJ et al (1999) Radiofrequency ablation followed by resection of malignant liver tumors. *Am J Surg* 177:411–417
35. Hussain SA, Hussain S (1988) Incisions with knife or diathermy and postoperative pain. *Br J Surg* 75:1179–1180
36. Kainz C, Tempfer C, Sliutz G, Breitenacker G, Reinhaller A (1996) Radio surgery in the management of cervical intraepithelial neoplasia. *J Reprod Med* 41:409–414
37. Fazio VW (2000) Early promise of stapling technique for hemorrhoidectomy. *Lancet*. 355:768–769
38. Rowsell M, Bello M, Hemingway DM (2000) Circumferential mucosectomy (stapled hemorrhoidectomy) versus conventional hemorrhoidectomy: randomized controlled trial. *Lancet* 355:779–781
39. Brown JS (1994) Radiosurgery. In: *Minor surgery. A text and atlas*, 4th edn. Arnold, London, pp 324–325