

# The efficacy and safety of argon plasma coagulation (APC) in the management of polyp remnants in stomach and colon

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## Abstract

**Purpose:** Endoscopic treatment of sessile and semipedunculated polyps remains controversial. Residual tissue remains frequently after endoscopic snare polypectomy. The aim of the study was to assess the outcome and safety of argon plasma coagulation (APC) in the management of gastric and colorectal polyp remnants after polypectomy, and to search for clinical parameters useful in predicting the efficacy of this technique.

**Material and methods:** This prospective study comprised 18 patients with gastric polyps and 29 with colonic polyps found in upper and lower GI endoscopy. Overall 22 gastric polyps and 58 colonic polyps have been detected. All those polyps were removed at colonoscopy with the diathermic snare and the polyp remnants were destroyed with APC using Argon Beamer source (Erbe, Germany). Follow-up endoscopies have been performed 1, 3 and 6 months after the treatment completion.

**Results:** Pathologic examination revealed 10 hyperplastic polyps and 12 tubular adenomas of the stomach. Effective destruction of polyp remnants was achieved in 20 (90.9%) gastric polyps in 16 (88.9%) patients. Significant positive correlation was demonstrated between the power output, APC sessions number and polyp location in the prepyloric part, its size and adenomatous content. Among colonic polyps there were: 17 hyperplastic, 26 tubular, 8 tubulo-villous, 4 villous adenomas and 3 inflammatory pseudopolyps. Effective destruction of remnant polyp tissue was obtained in 56 (96.4%) polyps in 27 (93.1%) patients. A significant positive correlation between the power output and the size, distal location and villous texture of the polyp has been demonstrated. No complications other than mild abdominal distention have been encountered.

**Conclusions:** APC is an effective and safe method in the management of polyp remnants in the stomach and colon. The application of higher electric power and numerous APC sessions are necessary to remove residues of large gastric polyps located in the prepyloric part and of with adenomatous content. In the case of colonic polyps the application of higher electric power should be recommended in case of large-sized lesions, located in rectum and of villous texture.

**Key words:** argon, plasma coagulation, polyp remnants, stomach, colon.

## Introduction

Gastrointestinal cancers belong to the most frequently occurring epithelial neoplasms in humans. Their treatment results remain unsatisfactory since in considerable number of cases the surgical treatment is being introduced in advanced cases. Therefore, optimal treatment of precancerous conditions is gaining the significant interest.

Gastric polyps include a number of lesions, among them non-neoplastic polyps, like: hyperplastic and hamartomatic, as well as neoplastic: tubular, tubulo-villous and villous adenomas [1]. Hyperplastic and adenomatous polyps belong to the most frequently occurring. The probability of malignant transformation of gastric adenoma depends on its histologic type, size, macroscopic appearance and the state of underlying mucosa [2]. The presence of adenoma increases the risk of carcinoma development not only within the polyp itself but also in other regions of the stomach [3]. Due to the risk of malignant transformation it is recommended to remove gastric polyps with endoscopic polypectomy [4].

It is widely accepted that nearly all colorectal cancers arise from benign neoplastic polyps [5]. Pathologic evaluations indicate that malignancy rarely occurs in tubular adenomas, and is more common in tubulo-villous and villous adenomas [5]. Based

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on the well-known adenocarcinoma sequence and the malignant potential of adenomas, complete removal of these lesions is indicated [6]. A recent study of postpolypectomy surveillance demonstrated a 66% reduction in colorectal cancer incidence with this procedure [7].

Most pedunculated adenomas can be excised endoscopically with diathermy snares. However, sessile adenomas are less well suited for snare resection.

The management of sessile polyps, small and very big, is the subject of much controversy. The removal of large or sessile lesions with "piecemeal" polypectomy is most frequently not radical and burdened with high risk of complications [8].

In the last decade, argon plasma coagulation (APC) has been introduced in endoscopic treatment of large polyps. This method has been known before and used for a long time in open surgery to control superficial, extensive bleedings from parenchymatous organs. Lack of electrode contact with coagulated tissue, no smoke production and no tissue carbonization contributed to the introduction of this technique to endoscopy in 1993 [9].

In APC the current is transmitted to the tissue through ionized, electrically inert argon gas. It comes to its ionization in high-frequency electric field created between the electrode of the applicator and the tissue. In the course of coagulation it does not come to vaporization ("vanishing") of tissue. The depth of coagulation is automatically limited by thin, insulating layer formed as a result of desiccation of tissue surface [10].

The clinical efficacy, safety and specific indications for APC have not been clearly established. In addition, the correlation between different clinical and APC technical parameters has not been studied yet.

The aim of the study was to evaluate the effectiveness of argon plasma coagulation in destroying remnants of gastric and colonic polyps after endoscopic polypectomy and to search for clinical parameters useful for predicting efficacy of this technique.

## Material and methods

This prospective investigation comprised 18 patients with gastric polyps aged 42-72 years (mean 57.7 years) and 29 patients with colonic polyps, aged 47-75 years (mean 59.5 years) treated in Gastroenterology Ward, Regional Hospital in Piotrków Trybunalski, Poland. Those lesions have been diagnosed at upper GI endoscopy and colonoscopy.

Among patients with gastric polyps there were 10 men and 8 women. Fourteen patients had one polyp each and four – two polyps each. Two polyps have been located in the cardia, eight in the body, six in prepyloric part and two – in the postresectional anastomosis area. Overall, APC has been applied in 22 polyps.

In the group of patients with colonic polyps there were 12 men and 17 women. In some of them multiple lesions have been found, therefore APC has been used overall in 58 colonic polyps. Nineteen patients had one polyp each, three – two polyps, four – three polyps, two – four polyps and one – thirteen polyps. The polyp location was the following: rectum – 33 polyps, sigmoid – 13, descending colon – 7, transverse colon – 1, ascending colon – 1 and caecum – 3.

For all the examined subjects individual protocols have been worked out containing the results of preliminary and follow-up clinical, endoscopic, histopathological and imaging data as well as the description of coagulation with argon beamer and its settings.

All polyps have been removed with diathermic snare and all the obtained material, fixed in 10% buffered formalin, was subjected to routine pathologic examination. On obtaining the result of pathologic examination (within 2-7 days), the patients were qualified for coagulation with argon beamer.

There following criteria of qualification for the removal of texture remnants of polyp after endoscopic polypectomy with APC have been established:

1. Sessile or semipedunculated polyp,
2. Diameter 8-20 mm,
3. No traits of severe dysplasia in pathologic examination.

The aim of argon plasma coagulation in the case of gastric and colonic polyps was the total destruction of polyp remnants. We arbitrarily assumed this method to be satisfactory, if this effect is obtained at least in 80% of cases.

Informed consent has been obtained from all patients, and the study protocol was approved by the local Ethical Committee at Medical University of Łódź, Poland.

Argon plasma coagulation was performed with the ERBE Argon Beamer source (Erbe, Germany) containing Erbotom ICC 200, Argon Beamer 2 and flexible applying catheter. After exposing the lesion at endoscopy and introducing the APC probe the procedure has been performed. In case of gastric polyps the power output was initially set at 50-80 W, in case of proximal colon lesions – at 40 W, and in distal colon – at 60-80 W. In case of visibly insufficient coagulation it has been increased gradually by 5 W up to 60 W – in the proximal colon, 80 W – in the stomach and 90 W – in the distal colon.

The APC sessions number ranged from 1 to 7 in one patient, with 2-4 days intervals, until total destruction of residual tissue has been achieved.

First follow-up endoscopy has been performed 2 days after coagulation and the next clinical and endoscopic examinations were carried out after 1, 3 and 6 months following the treatment completion. In each patient, video documentation of performed endoscopic procedures has been recorded in order to identify the sites after polypectomy and earlier coagulation.

Statistical analysis was performed using method of linear regression and Student's t-test for unpaired results. Determination coefficient ( $R^2$ ) and Durbin-Watson statistic value (DW) has been calculated. Differences were considered to be significant at  $p < 0.05$ .

## Results

### Gastric polyps

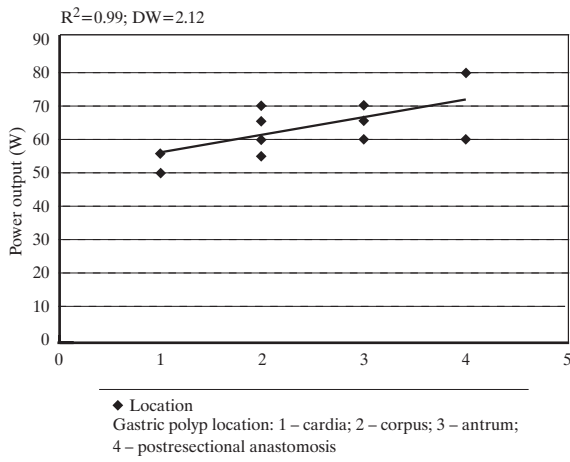
Pathologic examination revealed 10 hyperplastic polyps and 12 tubular gastric adenomas.

In all cases a partial polypectomy with diathermic snare has been performed and the residues have been destroyed with APC. The patients underwent 1 to 3 APC sessions (mean 2.5). The applied coagulation energy ranged from initial 50 W to 80

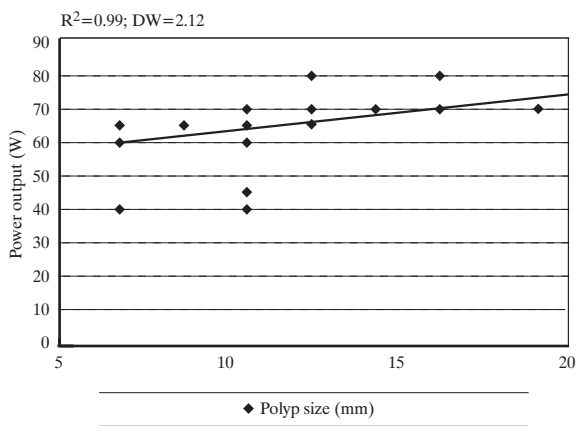
**Table 1.** Clinical data referring to APC procedure in gastric and colonic polyps

	Gastric polyps	Colonic polyps
Size of polyps	8-20 mm	8-20 mm
Number of sessions	1-3 (mean 2.5)	1-7 (mean 1.7)
Intervals between sessions	2 days	2-30 days
Applied energy	50-80 W	40-80 W
Complete treatment time	1-6 days	1 day-2 months
Follow-up complications	None	None
Effectiveness	20 polyps (90.91%)	56 polyps (96.55%)
Therapeutic failures	2 polyps (9.09%)	2 polyps (3.45%)

**Figure 1.** The relation of electric power output and gastric polyp location

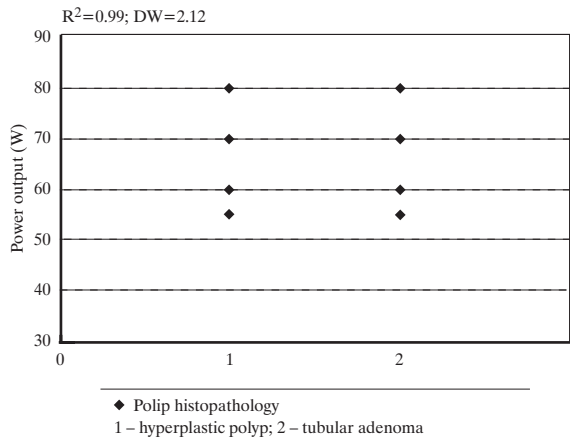


**Figure 2.** The correlation of electric power output and the gastric polyp size

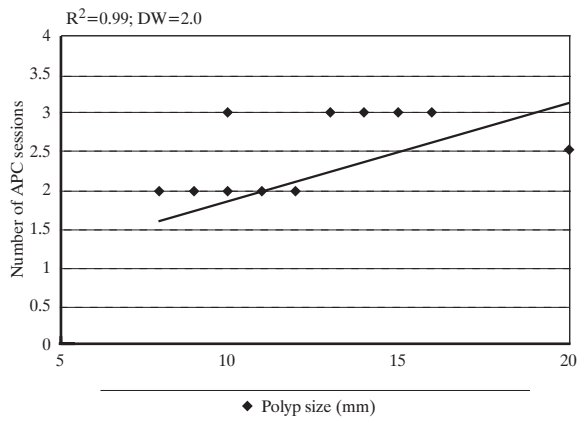


W. Four polyps' remnants have been destroyed in the course of one session, 12 – in two and 6 – in three sessions. In 20 polyps (90.9%) in 16 patients (88.9%) complete destruction of remnant tissue has been revealed at the second control gastroscopy, one month after APC treatment (Tab. 1). In this group, no recurrences have been noted until 3 years after the procedure. Therefore, the obtained results of APC application have been better than the intended 80%. In two cases the follow-up endoscopy

**Figure 3.** The correlation of electric power output and the gastric histopathology



**Figure 4.** The correlation between the number of APC sessions and the gastric polyp size



one month after APC completion, revealed the polyp recurrence. They were both hyperplastic polyps with the diameter of 8 mm and 10 mm, located in the postresectional anastomosis area.

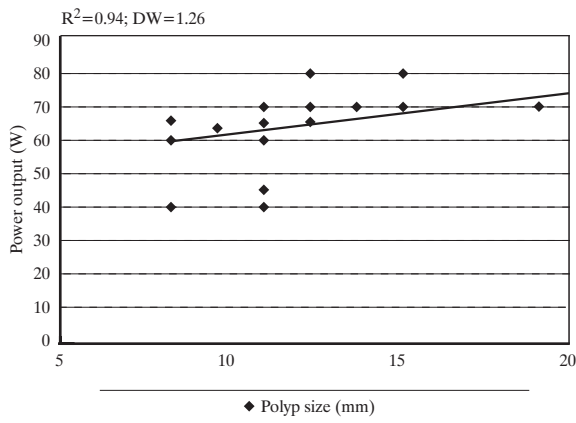
Significant positive correlation has been demonstrated between the final power output used and the location of the polyp in prepyloric part, its larger size and adenomatous morphology (in all cases:  $R^2=0.99$ ;  $DW=2.12$ ; Fig. 1, 2, 3). Significant positive correlation has also been found between the number of APC sessions and the size of polyp (Fig. 4;  $R^2=0.94$ ;  $DW=2.0$ ), adenomatous morphology ( $R^2=0.82$ ;  $DW=1.3$ ) and the location in prepyloric part of the stomach ( $R^2=0.84$ ;  $DW=0.82$ ).

In all patients in the course of APC procedure, a sensation of mild distension in epigastrium, disappearing after the withdrawal of air and argon from the stomach has been observed. No severe complications, such as perforation of the stomach wall have been encountered.

**Colonic polyps**

Among colonic polyps pathologic examination revealed: 17 hyperplastic polyps, 26 tubular adenomas, 8 tubulo-

Figure 5. The correlation of electric power output and the colonic polyp size



-villous adenomas, 4 villous adenomas and 3 inflammatory pseudopolyps. In all cases partial polypectomy with diathermic snare has been performed and the residue tissue destroyed with APC, which was carried out in 1-7 sessions (mean 1.7), in 2-4 days intervals. Power output of 40-50 W was applied for polyps located in caecum, 45-55 W – in ascending colon and 60-80 W for polyps of transverse, descending, sigmoid colon as well as the rectum (Tab. 1).

Complete destruction of the polyp remnants, observed also in all successive follow-up colonoscopies has been achieved in case of 56 polyps (96.4%) in 27 patients (93.1%). Among them, 39 polyps were destroyed in the course of one session, 8 – in two, 7 – in three, 2 – in four and 2 – in 7 sessions. In two patients with single villous polyps, despite initial successful remnants destruction, follow-up examination after 3 (in first case) and 6 months (in the second one) revealed single villous polyp in the postpolypectomy site.

Significant positive correlation has been demonstrated between the final power output used and the polyp size and its distal location within colon (in both cases:  $R^2=0.94$ ;  $DW=1.26$ ; Fig. 5, 6). In addition, the power output was the highest in case of villous adenomas, lower – in tubulo-villous and the lowest – in tubular adenomas and hyperplastic polyps (Fig. 7;  $R^2=0.94$ ;  $DW=1.26$ ).

In the course of APC sessions, 16 patients (55.2%) complained of flatulence. No other symptoms or complications have been observed.

## Discussion

In the last 25 years endoscopic polypectomy has become the procedure of choice in pedunculated polyps of the digestive tract. However, no uniform standards of managing polyps of large sizes, non-pedunculated and situated in thin-walled organs have been established yet. Therefore a great interest is raised by new techniques which potentially could be useful in such cases.

In the presented study the complete destruction of 20 out of 22 gastric polyps (90.2% of the cases) has been achieved. Thus,

Figure 6. The correlation of electric power output and the colonic polyp location

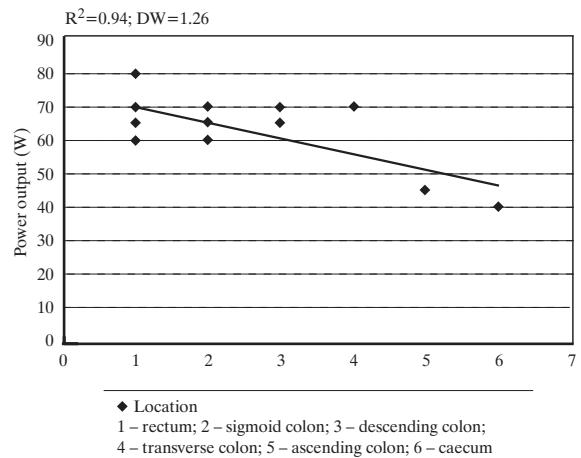
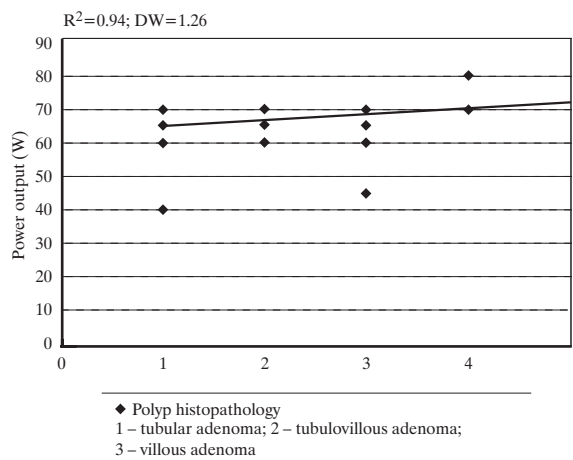


Figure 7. The correlation of electric power output and the colonic polyp histopathology



the efficacy of the presented method in eradication of residues after polypectomy of gastric polyps should be estimated as very high. APC treatment appeared to be ineffective for two hyperplastic polyps, of 8-10 mm diameter, located in the anastomosis area after partial gastrectomy. This should be explained with the increased mucosal proliferative activity, frequent development of atrophic gastritis, intestinal hyperplasia and metaplasia in this area [11].

In our study the final current power applied in APC depended on the size of gastric polyp and its histopathological parameters. Large adenomatous polyps required higher electric power than smaller, hyperplastic ones.

In addition, in case of large polyps confining to one treatment session was usually insufficient and more APC sessions were necessary. Up to now, to our knowledge, no similar analyses have been reported.

In the presented study argon plasma coagulation has been applied to eradicate 58 colonic polyps remnants after endoscopic polypectomy. Complete destruction of those remnants,

with no recurrences in the follow-up period up to 6 months, was achieved in as much as 56 (96.55%) of them. Therefore, those results should be considered as highly satisfying.

Grund, Storek, and Farin, as well used APC to remove residues of colonic adenomas. They subjected 13 patients to 19 sessions of APC, achieving in all cases the destruction of adenomas, enduring 1-72 months' of follow-up period [9]. Regula et al. used argon plasma coagulation to eradicate remnants of large sessile colorectal polyps after snare piecemeal polypectomy in 63 patients [12]. In follow-up examinations carried out in the mean period of 37 months after the treatment, recurrent adenomas has been found only in 14% patients. Similarly, Garcia et al., showed the successful APC ablation of colorectal polyp remnants in 90.9% of adenomas, with 20% recurrence rate during mean follow-up period of 16.3 months [13]. All of the recurrent polyps have been located in the rectum, which corresponds with our observation on the need of using higher power output for distal colon polyps. In the randomized study, even in patients after complete endoscopic snare resection of large adenomas, APC significantly reduced adenoma recurrence [14]. However, Zlatanovic et al., applying APC in a similar case in 30 patients observed recurrences of polyp in as many as 50% of the cases during five and a half months' follow-up period [15]. The fact that in this study almost all polyps treated with APC were tubulo-villous adenomas might explain this high number of recurrences. In the presented study, the follow-up examinations carried out 3 and 12 months after the last APC session, only in 2 cases (3.45%) showed a polyp recurrence, which in both cases were villous adenomas.

On the other hand, Wahab et al. used APC to destroy residues of villous adenomas in 28 patients, achieving recovery in as many as 100% during 3-18 months' follow-up period [16]. Good results presented by these authors are most probably related to the high number of performed sessions (10-13) and longer treatment (up to 13 months). However, it should be emphasized that both, our own results and the reports of many other authors show the high clinical aggressiveness of adenomas with villous content. Growth kinetics studies revealed the increased proliferative activity and the extension of proliferative zone in villous adenomas, compared to tubular and tubulo-villous adenomas [17]. High number of recurrences of villous polyps in the same place has also been observed after surgical polyp removal [18]. It has been proven that patients with the history of villous adenomas are at increased risk for advanced adenoma and colorectal cancer at follow-up and are therefore recommended to undergo colonoscopy 3 years after their polypectomy, compared to 5 years for tubular adenomas [19]. It seems, that those observations indicate, the need for more careful monitoring and management of villous lesions, compared to other adenomas.

Another important clinical problem is polypectomy safety in case of their location in thin walled organs, as caecum and ascending colon, where the risk of perforation is high. The application of laser thermoablation in this case may increase the risk of perforation, and furthermore it is difficult, considering the necessity to immobilize the endoscope which precludes any changes in its position during the procedure [20]. The use of APC seems to be an advantageous solution in these cases because on principle it is a method of definite coagulation of

shallow depth and the application of low electric power is the additional protection against perforation. In the presented study 5 polyps of caecum and ascending colon were subjected to APC with no further complications.

In the presented study no serious complications following APC have been observed. Similarly, in the comprehensive work summing up 1606 cases of APC application for various indications, Grund and Farin indicated the high safety profile of this procedure [21]. In the study comprising 697 subjects, only in 0.31% of them the perforation occurred. Intestinal wall emphysema has been observed in 0.5% patients and mortality – in 0.14%. Other authors confirm particularly rare occurrence of complications with the use of this method [13,14,22]. It should also be emphasized that in the course of APC therapy practically does not exist a risk of bleeding from gastrointestinal tract, which is confirmed by our experiences. This method has already gained an unquestioned position in the treatment of bleedings from alimentary tract angiodysplasia, where it is being recommended as “the gold standard”, as well as in the course of radiation-induced intestinal injury.

To sum up, it should be stated that argon plasma coagulation is an extremely effective and safe method of removing remnants after endoscopic polypectomy performed in the gastric and colonic lumen. The application of higher electric power and numerous APC sessions are necessary to remove residues of large gastric polyps located in the prepyloric part and with adenomatous content. In case of colonic polyps the application of higher electric power should be recommended in case of large-sized lesions, located in rectum and with villous content.

## References

1. Snover D. Benign epithelial polyps of stomach. *Pathol Ann*, 1985; 20: 303-29.
2. Papa A, Cammarota G, Tursi A, Montalto M, Cuomo L, Certo M, Fedeli G, Gesbarrini G. Histologic types and surveillance of gastric polyps: A seven year clinico-pathological study. *Hepato-Gastroenterology*, 1998; 45: 579-82.
3. Nakamura T, Nakano G. Histopathological classification and malignant change in gastric polyps. *Am J Clin Path*, 1992; 58: 434-44.
4. Stolte M. Clinical consequences of endoscopic diagnosis of gastric polyps. *Endoscopy*, 1995; 1: 32-7.
5. Fenoglio-Preiser CM, Hutter RV. Colorectal polyps: pathologic diagnosis and clinical significance. *Cancer J Clin*, 1985; 35: 322-44.
6. Muto T, Bussey HJR, Morson BC. The evolution of cancer of the colon and rectum. *Cancer*, 1975; 36: 2251-70.
7. Citarda F, Tomaselli G, Capocaccia R, Barcherini S, Crespi M, TIMS Group. Efficacy in standard clinical practice of colonoscopic polypectomy in reducing colorectal cancer incidence. *Gut*, 2001; 48: 812-5.
8. Cohen LB, Wayne JD. Treatment of colonic polyps: practical considerations. *Clin Gastroenterol*, 1986; 15: 359-76.
9. Grund KE, Storek D, Farin G. Endoscopic argon plasma coagulation (APC). First clinical experiences in flexible endoscopy. *End Surg*, 1994; 2: 42-6.
10. Farin G, Grund KE. Technology of argon plasma coagulation with particular regard to endoscopic applications. *End Surg*, 1994; 2: 71-7.
11. Wanebo HJ, Kennedy B, Chmiel J, Steale G, Winchester D, Osteen R. Cancer of the stomach: a patient care study by American College of Surgeons. *Ann Surg*, 1993; 218: 583-92.
12. Regula J, Wrońska E, Polkowski M, Nasierowska-Guttmejer A, Pachelewski J, Rupinski M, Butruk E. Argon plasma coagulation (APC) after piecemeal polypectomy for sessile colorectal adenomas: long term follow-up. *Endoscopy*, 2003; 35(3): 212-8.
13. Garcia A, Nunez O, Gonzalez-Asanza C, Parera A, Menchen L, Ripoll C, Sement C, Cos E, Menchen P. Safety and efficacy of argon

plasma coagulator ablation therapy for flat colorectal adenomas. *Rev Esp Enferm Dig*, 2004; 96(5): 315-21.

14. Brooker JC, Saunders BP, Shah SG, Williams CB. Treatment with argon plasma coagulation reduces recurrence after piecemeal resection of large sessile colonic polyps: a randomized trial and recommendations. *Gastrointestinal Endosc*, 2002; 55(3): 371-5.

15. Zlatanich J, Waye J, Kim P, Baiocco PJ, Gleim GW. Large sessile colonic adenomas: use of argon plasma coagulator to supplement piecemeal polypectomy. *Gastrointest Endosc*, 1999; 49: 731-5.

16. Wahab PJ, Mulder J, den Hartog G, Thies E. Argon plasma coagulation in flexible gastrointestinal endoscopy: pilot experiences. *Endoscopy*, 1997; 29: 176-81.

17. Yang HB, Hsu PI, Chan Sh. Growth kinetics of colorectal adenoma-carcinoma sequence: an immunohistochemical study of proliferating cell nuclear antigen expression. *Hum Pathol*, 1996, 27(10): 1071-6.

18. Muto T, Ishikawa K, Kino I, Nakamura K, Sugano H. Com-

parative histologic study of the large intestine in Japan and England with special reference to malignant potential. *Dis Colon Rectum*, 1977; 20: 11-6.

19. Winawer S, Fletcher R, Rex D, Bond J, Burt R, Ferruci J, Ganiets T, Levin T, Woolf S, Johnson D, Kirk L, Litin S, Simmanq C, Gastrointestinal Consortium Panel. Colorectal cancer screening and surveillance: clinical guidelines and rationale – update based on new evidence. *Gastroenterology*, 2003; 124: 544-60.

20. Conio M, Carolo-Bosc FX, Filiberti R. Endoscopic Nd: YAG laser therapy for villous adenomas of the right colon. *Gastrointest Endosc*, 1999; 49: 504-8.

21. Grund KE, Zindel C, Farin G. Argonplasmakoagulation in der flexiblen Endoskopie. *Dtsch Med Wschr*, 1997; 122: 432-8.

22. Heindorff H, Wøjdemann M, Bisgaard T, Svendsen LB. Endoscopic palliation of inoperable cancer of the oesophagus or cardia by argon electrocoagulation. *Scan J Gastroenterol*, 1998; 33(1): 21-3.