

Electrocardiographic changes in elderly patients during endoscopic retrograde cholangiopancreatography

NG Kounis MD¹, GM Zavras MD², PJ Papadaki MD², SN Kouni BSc¹, M Batsolaki PhD¹,
GV Gouvelou-Deligianni SRN¹, C Markoglou MD², JA Goudevenos MD³, CN Mallioris MD¹,
C Kokkinis MD², K Kalokairinou MD², N Grapsas MD⁴, GN Kounis⁵, CM Koutsojannis PhD¹

NG Kounis, GM Zavras, PJ Papadaki, et al. Electrocardiographic changes in elderly patients during endoscopic retrograde cholangiopancreatography. *Can J Gastroenterol* 2003;17(9):539-544.

BACKGROUND: Cardiorespiratory complications may occur during gastrointestinal endoscopy, and elderly people seem to be more vulnerable to these complications during endoscopic procedures involving the manipulation of abdominal viscera.

OBJECTIVES: To determine the incidence of cardiac arrhythmias, changes in oxygen saturation, heart rate and blood pressure during endoscopic retrograde cholangiopancreatography (ERCP) via Holter monitoring in elderly patients older than 70 years of age.

METHODS: Holter monitoring and 12-lead electrocardiograms were performed in 30 elderly patients undergoing ERCP and in 30 control subjects undergoing routine chest, abdomen, bone and upper gastrointestinal small bowel follow-through studies. A computerized nontriggered template system was used to analyze the electrocardiograms qualitatively and quantitatively. Arrhythmias, cardiac axis, conduction defects, pauses, ST segment changes, ectopic beats, oxygen desaturation and changes in blood pressure and rate-pressure product were evaluated.

RESULTS: Increased heart rate, ST segment changes resulting from myocardial ischemia, oxygen desaturation and transient atrial and ventricular ectopic beats were frequent during ERCP compared with the control group. In one patient, transient left bundle branch block developed and this was attributed to pre-existing hypertension with cardiomegaly. One patient developed ventricular tachycardia and one other sinus bradycardia, but this was attributed to sick sinus syndrome.

CONCLUSIONS: Transient myocardial ischemia and various cardiac arrhythmias are frequent in elderly patients undergoing ERCP. Appropriate noninvasive monitoring seems to be justified during this procedure.

Key Words: Cardiac arrhythmias; Cholangiopancreatography; Elderly; Holter monitoring

Les modifications électrocardiographiques chez les patients âgés pendant une cholangiopancreatographie rétrograde endoscopique

HISTORIQUE : Des complications cardiorespiratoires peuvent se manifester pendant une endoscopie gastro-intestinale, et les personnes âgées semblent plus vulnérables à ces complications pendant les interventions endoscopiques qui entraînent une manipulation des viscères abdominaux.

OBJECTIFS : Déterminer l'incidence des arythmies cardiaques, les modifications de la saturation en oxygène, le rythme cardiaque et la tension artérielle pendant une cholangiopancreatographie rétrograde endoscopique (CPRE) par la méthode de Holter chez des patients âgés de plus de 70 ans.

MÉTHODOLOGIE : La méthode de Holter et des électrocardiogrammes à 12 dérivations ont été utilisés chez 30 patients âgés subissant une CPRE et chez 30 sujets témoins subissant un bilan systématique du thorax, de l'abdomen, des os et de la partie supérieure de l'intestin grêle. Un système informatisé de matrice non déclenché a permis d'analyser les électrocardiogrammes de manière qualitative et quantitative. Les arythmies, l'axe du cœur, les anomalies de conduction, les pauses, les modifications du segment ST, les extrasystoles, la désaturation en oxygène, les modifications de la tension artérielle et le produit de tension artérielle ont été évalués.

RÉSULTATS : Une augmentation du rythme cardiaque, des modifications du segment ST causées par une ischémie du myocarde, une désaturation en oxygène et des extrasystoles auriculaires et ventriculaires transitoires étaient fréquentes pendant la CPRE par rapport aux occurrences au sein du groupe témoin. Chez un patient, un bloc de branche gauche transitoire s'est développé, attribuable à une hypertension préexistante accompagnée d'une cardiomégalie. Un patient a développé une tachycardie ventriculaire et un autre, une bradycardie sinusale, mais celle-ci était causée par une maladie du sinus.

CONCLUSIONS : L'ischémie myocardique transitoire et diverses arythmies cardiaques sont fréquentes chez les personnes âgées qui subissent une CPRE. Une surveillance non envahissante pertinente semble justifiée pendant cette intervention.

¹Section of Medical Sciences, School of Health, Patras Highest Institute of Education and Technology, Patras; ²Departments of Gastroenterology and Radiology, NIMTS and KAT General Hospitals, Athens; ³Department of Cardiology, Ioannina Medical School, Ioannina; ⁴Department of Cardiology, "Agios Andreos" General Hospital, Patras; ⁵Medical Student, Greece

Correspondence and reprints: Professor Nicholas G Kounis, MD, 7 Aratou Street, Queen Olga's Square, Patras 26221, Greece.

Telephone 000302610279549, fax 00302610279579, e-mail ngkounis@otenet.gr

Received for publication April 25, 2003. Accepted July 7, 2003

Manipulation of various body structures during routine or specific diagnostic and therapeutic techniques have been reported to be associated with cardiac arrhythmias and other cardiorespiratory complications. Such changes have occurred during tracheal suctioning (1), rectal examination (2), distention of the abdominal viscera (3), intravenous urography (4), coronary angiography (5), gastroscopy (6), sigmoidoscopy (7), barium enema (8) or small bowel enema (9). These events may be transient and not hazardous, but in some occasions they have been fatal (10-16). Gastrointestinal endoscopy is a modern and valuable procedure and consistently gives useful diagnostic and therapeutic results. Although cardiac arrhythmias and ST segment depression occur during gastrointestinal endoscopy even in younger patients (13,14), the elderly population is more prone to silent myocardial ischemia which manifests either as electrocardiographic ischemic changes or as disturbances of cardiac rhythm.

We previously have reported electrocardiographic changes in a middle-aged (17) and in elderly (9) populations during small bowel enema. However, there are no reports on any cardiac events during endoscopic retrograde cholangiopancreatography (ERCP) in elderly (greater than 70 years of age) patients, who seem to be more vulnerable to such procedures. Consequently, we have undertaken the following study to determine the incidence of any cardiac arrhythmia, changes in oxygen saturation, heart rate and blood pressure, and to identify those elderly patients at risk during the procedure.

SUBJECTS AND METHODS

Subjects

Thirty patients scheduled to undergo ERCP were recruited to the study and were monitored electrocardiographically with Holter tape recorders. Written informed consent was obtained for data correction and storage on magnetic media. The patients included 18 women and 12 men of mean age 73 years (SD 2, range 71 to 79 years). Their mean weight was 66.5 kg (SD 18.3, range 44 to 100). All current medications were continued to the time of the procedure. No oxygen was administered in the observation period. Premedication was not given until few minutes before ERCP. Diazepam and Buscopan (Boehringer Ingelheim, Canada) were given for sedation and duodenal relaxation. No opioids were given in the study period. Data were not available to the investigator, the endoscopist or the radiologist during the procedure. The clinical characteristics of the patients are outlined in Table 1.

Methods

After the usual skin preparation, modified V₂ and V₅ electrocardiographic leads were recorded on two channel Circadian Recorders (Circadian Inc, USA). The lead of most significance (V₅) was analyzed in detail. The positive electrode was placed in the V₅ position and the negative electrode was placed in the right infraclavicular fossa. Because the procedure was elective, electrocardiographic recording usually was initiated 4 h before the procedure and was continued during the examination and 4 h after it. All patients were advised to record in a diary any symptoms of palpitations, shortness of breath or chest pain. Immediately before ERCP, a 12-lead electrocardiogram and resting rhythm strip was available during Valsalva maneuver and during its recovery time. Continuous arterial blood pressure and oximetry monitoring data were recorded throughout the procedure. When it was necessary, arterial blood pressure also was measured by cuff sphygmo-

TABLE 1
Clinical characteristics of 30 patients undergoing endoscopic retrograde cholangiopancreatography

Characteristics*	n (%)
Patients	30 (100)
Mean age (yrs)	73 (SD 2, range 71-79 yrs)
Men/Women	12 (40)/18 (60)
Current medications	
Angiotensin converting enzyme inhibitors	4 (13)
Angiotensin receptor blockers	3 (10)
Beta-blockers	2 (6.6)
Anticoagulants (Warfarin)	2 (6.6)
Sulfonylureas	3 (10)
Digoxin	1 (3.3)
Nitrates	3 (10)
Hydrochlorothiazide	1 (3.3)
Hypertension	8 (26.6)
History of heart failure	5 (16.6)
Diabetes mellitus	3 (10)
History of angina on effort	5 (16.6)
Previous myocardial infarction	3 (10)
Cardiomegaly on chest x-ray	3 (10)
Intraventricular septal hypertrophy on echocardiogram	6 (20)

*Some patients gave history of more than one condition

manometer in supine position. During analysis the rate-pressure product was calculated by microcomputer for each of one minute recording. Two channel qualitative and quantitative electrocardiographic analysis was performed by a computerized nontriggered template system. Particular attention was paid to arrhythmias of any kind, change in cardiac axis, conduction defects, pauses, ST segment changes and extrasystoles. The following definitions were used. Myocardial ischemia: a depression or elevation in ST segment of 0.1 mV or more from baseline measured at 60 ms from the j point; episodic hypoxemia: a sudden decrease in oxygen saturation of more than 4% from baseline (18); tachycardia: a heart rate above 100 beats/min; bradycardia: a heart rate below 50 beats/min; abnormal complexes: abnormal QRS-shaped complexes with a coupling interval of more than 80 % of the preceding RR interval; ventricular extrasystoles: abnormal QRS-shaped complexes with a coupling interval less than 80% of the preceding RR interval.

Control subjects

Thirty elderly age- and disease-matched patients not receiving any premedication, served as controls. They were undergoing chest, abdomen, bone or upper gastrointestinal small bowel follow-up studies and they had 8 h of electrocardiographic monitoring covering the period before, during and after the examination. The clinical characteristics of the control subjects are shown in Table 2.

Statistical analysis

Absolute differences in the number of arrhythmias, heart rate and oxygen saturation were compared between the hour of the examination and the closest hour when monitoring findings were most reliable, using Wilcoxon's paired *t*-test (statistical significance at $P < 0.05$). Differences in the prevalence of arrhythmias and ST segment changes between baseline periods and the procedure were assessed by χ^2 test.

TABLE 2
Clinical characteristics of 30 control subjects

Characteristics	n (%)
Patients	30 (100)
Mean age (years)	73 (SD 1.5, range 70 – 80 yrs)
Men/Women	15 (50)/15 (50)
Radiological procedure	
Chest	10 (34)
Plain abdomen	7 (23)
Bone	8 (27)
Barium swallow	5 (16)

RESULTS

Heart rate

Twenty nine patients (96%) had increased heart rate during and immediately after ERCP compared with the rate before the endoscopy ($P<0.05$), but the increased heart rate in the two patients receiving therapeutic β -blockers for ischemic heart disease and in the patient receiving digoxin was not statistically significant. However, the patients who underwent ERCP had a higher mean heart rate (98.3 beats/min; 95 % CI 92.1 to 103.3), than the control subjects (70.1 beats/min; 95 % CI 63.2 to 73.6); statistical significance at $P<0.05$ for patients and control subjects during and after the procedure (Figure 1). In 27 (90%) patients, sinus tachycardia developed with heart rate exceeding 100 beats/min. This tachycardia gradually subsided after the examination. In one (3%) patient, sinus bradycardia developed but this patient had suffered a previous myocardial infarction and had been diagnosed to have sick sinus syndrome.

Cardiac rhythm

The electrocardiograms before the procedure showed no cardiac rhythm disturbances in 20 (67%) patients. However, two (7%) patients had pre-existing atrial fibrillation, five (16 %) patients had premature atrial complexes and three (10%) patients had premature ventricular complexes. During the procedure, premature atrial complexes appeared in 19 (63%) patients, premature ventricular complexes appeared in nine (30%) patients, a burst of supraventricular tachycardia developed in one (3%) patient, a short run of ventricular tachycardia appeared in one (3%) patient and transient left bundle branch block (LBBB) in one (3%) patient. The patient with the LBBB was hypertensive, had cardiomegaly in the chest radiograph and developed premature complexes. Significant differences were found upon comparing the absolute number of atrial and ventricular premature complexes during ERCP and the baseline period (Table 3). In comparing the arrhythmias appearing in the control group during chest, bone, abdomen and upper gastrointestinal small bowel follow-through with the baseline period, significant differences were not found. The number of patients in whom premature atrial complexes, sinus tachycardia and premature ventricular complexes developed during ERCP was significantly larger than the control group

The existence of normal or abnormal pre-ERCP electrocardiogram had little prognostic value in predicting the change of electrocardiographic changes developing during the procedure (Table 4). Of the 22 patients who had clinical, radiological and echocardiographic evidence of heart disease, unifocal ventric-

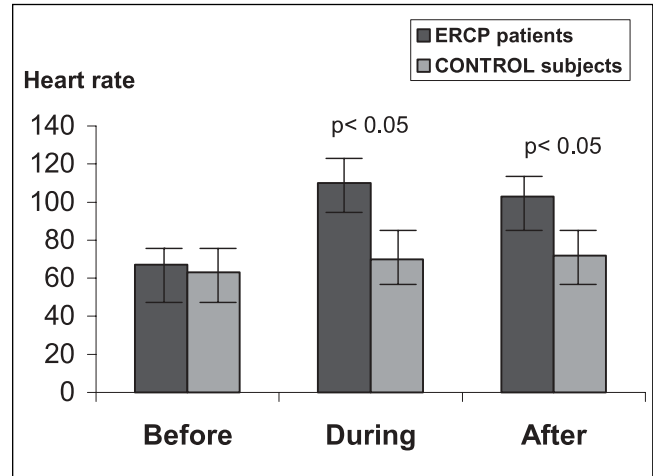


Figure 1 Heart rate (mean value, 95% CI) before, during and after procedure in 30 elderly patients undergoing ERCP and in 30 age- and disease-matched control patients.

TABLE 3
Arrhythmias during endoscopic retrograde cholangiopancreatography (ERCP) compared with the baseline period

Arrhythmias	Baseline		ERCP		P
	n (%)	95% CI	n (%)	95% CI	
Sinus tachycardia	0 (0)	NA	27 (90)	70–96	–
Sinus bradycardia	0 (0)	NA	1 (3.3)	1–22	–
Premature atrial complexes	5 (16.6)	3–25	19 (63.3)	45–95	<0.05
Supraventricular tachycardia	0 (0)	NA	1 (3.3)	1–20	–
Premature ventricular complexes	3 (10)	3–27	9 (10.2)	47–90	<0.05
Ventricular tachycardia	0 (0)	NA	1 (3.3)	NA	–

NA Not applicable

ular extrasystoles developed in eight, multifocal ventricular extrasystoles developed in three, atrial extrasystoles developed in six and sinus tachycardia in 20.

ST segment

ST segment changes (depression or elevation) during ERCP, in comparison with the baseline electrocardiogram, were considered as sign of myocardial ischemia. Sixteen (53%) patients developed ST segment changes (15 ST depression and one ST elevation) during the procedure. In all patients the changes were asymptomatic. In all instances the ST segment changes disappeared when the endoscope was withdrawn. There were no significant ST segment changes in the control group during chest, bone, abdomen and small bowel through studies.

Laboratory

In all patients oxygen saturation decreased during ERCP from a mean baseline 91.4% to a minimum of 78.6% ($P<0.05$). Saturation recovered to the baseline level 30 min after the study. Linear regression analysis was performed for arterial oxygen saturation and ST segment in 16 patients. A significant correlation was found between oxygen saturation and ST segment changes (Figure 2).

TABLE 4
Prevalences of PACs, ST, and PVCs during Holter monitoring of patients with ERCP and in control subjects

	Control Subjects (n)	ERCP Patients (n)	P
PACs	5	19	<0.05
ST	0	27	<0.05
PVCs	3	9	<0.05

ERCP Endoscopic retrograde cholangiopancreatography; PACs Premature atrial complexes; PVCs Premature ventricular complexes; ST Sinus tachycardia;

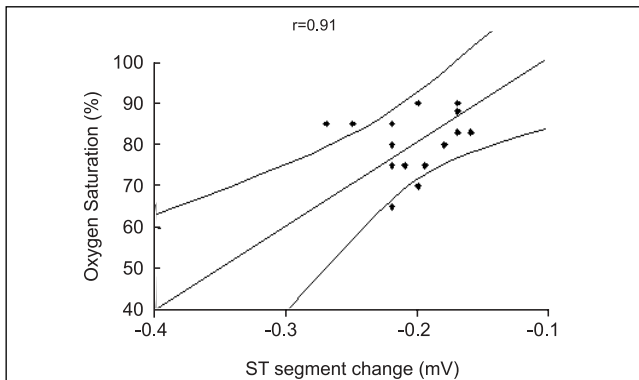


Figure 2) Linear regression shown significant correlation between oxygen saturation and ST segment depression. 95% confidence lines

DISCUSSION

The present study shows that arrhythmias of all kinds, conduction disturbances, electrocardiographic changes compatible with myocardial ischemia and oxygen desaturation are encountered in elderly patients undergoing ERCP. There are previous studies (18-20) using hemodynamic monitoring (heart rate, blood pressure, rate pressure product), pulse oxymetry and electrocardiographic monitoring during gastrointestinal endoscopic procedures which associate cardiac risk with changes observed in heart rate, asymptomatic arrhythmias, ST segment changes, oxygen desaturation and changes in blood pressure. Some studies (21,22) have suggested that patients with heart disease were at an increased risk during the above procedures. In one study (19) including 52 consecutive patients undergoing upper gastrointestinal endoscopy, arrhythmias during the procedure were common and tended to occur more frequently in the elderly and in persons with heart disease and chronic lung disease. In another study (23) patients with cardiac history, before esophageal dilation, were particularly prone to cardiorespiratory events. It was found that 90% of patients with pre-existing cardiac disease developed an event during the procedure.

Other studies (24-26) have shown that patients with increased age are particularly prone to low oxygen saturation, pain during the procedure and increased duration of the procedure.

The current study suggests also that electrocardiographic and laboratory changes during ERCP are frequent, especially in elderly patients with coexisting cardiac disease. These changes, however, seem to be asymptomatic. The abnormalities observed ranged from sinus tachycardia to innocent and transient atrial and ventricular premature beats as well as ST segment changes and oxygen desaturation. In one patient

asymptomatic supraventricular tachycardia and in another patient a burst of ventricular tachycardia developed but these two patients had ischemic heart disease. The patient who developed sinus bradycardia during ERCP had suffered a previous myocardial infarction and had been diagnosed as having sick sinus syndrome. All patients had diminished blood oxygen saturation and 16 developed ST segment changes compatible with ischemic heart disease.

The mechanisms by which the cardiorespiratory and electrocardiographic changes occur during ERCP remain speculative. During upper gastrointestinal endoscopy airway obstruction (24), gastric or salivary aspiration, direct pressure on the diaphragm (26), air insufflation (22) and stress and anxiety triggering catecholamine release may contribute (9,22,27,28). During ERCP several factors tend to increase sympathetic activity. Neural impulses from higher centers in the brain may be transient risk factors (29). The distension and collapse of hollow abdominal viscera during the procedure might be another factor accounting for the electrocardiographic abnormalities (19). Indeed, ERCP is a method with many applications especially for patients suspected to have biliary and pancreatic problems. However, it involves the insertion of a side-viewing duodenoscope through the oesophagus to the stomach, pylorus, duodenal bulb and papilla. This cannulation involves special manipulations, angulations, air insufflation and sometimes becomes unpleasant to the patient. It has been suggested that the removal of the insufflated air before the removal of the endoscope may lower the risk of cardiovascular problems (19). The use of a narrow diameter endoscope has been suggested to cause less hypoxia than the standard diameter endoscope (30,31). The increased load of the endoscopic examination on the cardiovascular function may be caused by psychological stress before and during examination (32) as well as by the physical effects of the anticholinergic drugs (33). Indeed, all of our patients were receiving, as premedication, diazepam and Buscopan.

Buscopan increases heart rate because it has anticholinergic properties. Premedication with anticholinergic drugs tends to shift the balance of the autonomous nervous system towards sympathetic dominance which increases the cardiac work and heart rate. It has been suggested that patients with cardiac disease, anticholinergic drugs may increase the risk of cardiac complications during endoscopic examination and they should be avoided in such patients (33). These authors state that withholding anticholinergic premedication does not seriously affect the endoscopic examination (33). To confirm whether psychological stress could alter the cardiac vulnerability, the investigators (33) compared the heart rate in patients who had never undergone endoscopy with those who had. They found that the heart rate increased during endoscopy, but did not increase significantly in those who had previous endoscopy, indicating that psychological factors play an important role in the electrocardiographic changes during endoscopy. Neural inhibition of the diaphragm by viscerosomatic reflexes due to esophageal and gastric distention has been thought to be another possibility (34-36). Additionally an increase in vagal activity as a result of gastrointestinal manipulation may induce vasospasm and reduce coronary blood flow with consequent bronchospasm, ventilation-perfusion mismatch, hypoxia and blood desaturation (36). These effects may be potentiated by benzodiazepines given as premedication sedatives (37). However endoscopy without sedation also causes significant

reduction in oxygen saturation after introduction of the endoscope (38,39).

The present study is the only one in the literature to monitor elderly patients, greater than 70 years of age during ERCP. Elderly patients might be more vulnerable to hypoxemia. Hypoxaemia is a documented consequence (40) of endoscopic manipulations and has been attributed to hypoventilation secondary to sedative medication, partial obstruction by the endoscopy and possible ventilation-perfusion mismatch caused by autonomic disturbance. In all our patients the oxygen saturation decreased during the procedure and this was correlated with ST segment deviation and arrhythmias. Twenty nine of our patients (96%) developed also sinus tachycardia with heart rate above 100 beats/min. However, while all of our patients developed hypoxaemia and 29 sinus tachycardia, only 16 patients developed ST segment changes. Therefore, it seems that the ST segment changes of the 16 patients were related to both hypoxaemia and sinus tachycardia. It has been suggested (41) that the development of myocardial ischemia during ERCP, manifesting an ST segment deviation, is related to increase cardiac oxygen demand caused by tachycardia rather than decreased oxygen supply caused by hypoxaemia. Our data cannot support this suggestion. We did not use beta-blockade in order to reduce the tachycardia in our patients because this was

not the aim of this study. Beta-blockers reduce heart rate, increase cardiac diastolic filling and improve blood oxygen supply to myocardium. Therefore, beta-blockers have been used to prevent tachycardia during endoscopy. Metoprolol is a beta-blocker which has been used in a double blind randomized controlled trial during ERCP (41) in peripheral vascular surgery (42) and after cardiac operations (43), with positive effect on myocardial oxygen supply and incidence of myocardial ischemia. Beta-blockers have also a strong anxiolytic effect comparable with benzodiazepines but without concurrent sedation (44).

CONCLUSIONS

We believe that the encountered electrocardiographic abnormalities and myocardial ischemia during ERCP in elderly patients, are common and usually transient. Clinical evidence of prior heart disease seems to be predisposing factor for these abnormalities. The procedure requires careful evaluation of the risks especially in the elderly people with preexisting cardiac disease. A careful history especially of the cardiovascular system should be obtained in all patients. Non invasive monitoring during the procedure and appropriate clinical observation by the cardiologist, endoscopist and radiologist will result in safer examination and seems to be justified.

REFERENCES

- Shim C, Fine N, Fernandez R, Williams MB. Cardiac arrhythmias resulting from tracheal suctioning. *Ann Intern Med* 1969;71:1149-53.
- Earnest DL, Fretcher GF. Danger of rectal examination in the patients with acute myocardial infarction: Fact or fiction? *N Engl J Med* 1969;281:238-41.
- Skjennald A, Samset JH. Duodeno-jejunal intubation in the examination of the small intestine. *Clin Radiol* 1980;31:221-4.
- Stadelnik R, Davies R, Vera Z, Hilliard G, DaSilva O. Ventricular tachycardia during intravenous urography. *JAMA* 1974;229:686-7.
- Coskey RL, Magidson O. Electrocardiographic response to selective coronary arteriography. *Br Heart J* 1967;29:512-9.
- Schuman BM, Gale H. Electrocardiographic changes associated with gastroscopy. *Bull Gastroint Endosc* 1969;8:10-3.
- Fletcher RL, Earnest DL, Shuford WF. Electrocardiographic changes during routine sigmoidoscopy. *Arch Intern Med* 1968;122:483-6.
- Higgins CB, Roeske WR, Karminer JS, O'Rourke R, Berk RN. Predictive factors and mechanism of arrhythmias and myocardial ischemic changes in elderly patients during barium enema. *Br J Radiol* 1976;49:1023-7.
- Zavras GM, Papadaki PJ, Kounis NG, et al. Electrocardiographic changes in elderly patients during small bowel enema. *Invest Radiol* 1996;5:256-60.
- Katz D, Selesnick S. Cardiac arrest during gastroscopy. *Gastroenterology* 1967;33:650-4.
- Palmer ED, Wirts CW. Survey of gastroscopic and esophagoscopy accidents. *JAMA* 1957;164:2012-5.
- Daneshmend TK, Bell GD, Logan RFA. Sedation for upper gastrointestinal endoscopy: results of a nationwide survey. *Gut* 1991;32:12-5.
- Arrowsmith JB, Gartsman B, Fleisher DE, Benjamin SB. Results of the American Society for Gastrointestinal endoscopy. U.S. Food and Drug Administration collaborative study on complication rates and drug use during gastrointestinal endoscopy. *Gastrointest Endosc* 1991;37:421-7.
- Okazaki Y, Takemoto T. [A report of a case of cardiac arrest soon after gastroscopic examination.] *Gastroenterol Endosc* 1977;19:123-9 (Japanese).
- Blakeborough A, Sheridan MB, Chapman AH. Complications of barium enema examinations: A survey of UK Consultant Radiologists 1992 to 1994. *Clin Radiol* 1997;52:142-8.
- Yantis PL. Lavage-induced cardiac asystole. *Gastrointest Endosc* 1984; 30:17. (Lett)
- Kelekis D, Papadaki PJ, Zavras GM, Kounis NG, Vassiliou P, Fezoulidis IB. EKG-Veränderungen während der Enteroklyse. *Röntgenpraxis* 1993;46:108-10.
- Tremper KK, Barker SJ. Pulse oximetry. *Anesthesiology* 1989;70:98-108.
- Mathew PK, Ona FV, Dameski K, Wallace WA. Arrhythmias during upper gastrointestinal endoscopy. *Angiology* 1979;11:834-40.
- Wilcox CM, Faibicher M, Wenger NK. Prevalence of silent myocardial ischemia and arrhythmias in patients with coronary heart disease undergoing gastrointestinal tract endoscopic procedures. *Arch Intern Med* 1993;153:2325-30.
- Murray AW, Morran CG, Kenny G, Macfarlane P, Anderson JR. Examination of cardiorespiratory changes during upper gastrointestinal endoscopy. *Anaesthesia* 1991;46:181-4.
- Steffes CP, Sugawa C, Wilson RF, Hayward SR. Oxygen saturation monitoring during endoscopy. *Surg Endosc* 1990;4:175-8.
- Thompson AM, Park KGM, Kerr F, Munro A. Safety of fiberoptic endoscopy: Analysis of cardiorespiratory events. *Br J Surg* 1992;79:1046-9.
- Barkin JS, Krieger B, Blinder M, Bosch-Blinder L, Goldberg RI, Phillips RS. Oxygen desaturation and changes in breathing pattern in patients undergoing colonoscopy and gastroscopy. *Gastrointest Endosc* 1989;35:526-30.
- Dark DS, Campbell DR, Wesselius LJ. Arterial oxygen desaturation during gastrointestinal endoscopy. *Am J Gastroenterol* 1990;85:1317-21.
- Patel NM. Paroxysmal ventricular complexes during coloscopy. *Gastrointest Endosc* 1986;32:234.
- Marsh WH, Bronner MH, Yantis PL, Kilgore JW, Rickoff MI. Ventricular ectopy associated with peroral colonic lavage. *Gastrointest Endosc* 1986;32:259-63.
- Lown B, Verner RL. Neuroactivity and nentricular fibrillation. *N Engl J Med* 1976;294:1165-70.
- Hoffman BF. Autonomic control of cardiac rhythm. *Bull N Y Acad Med* 1967;43:1087-96.
- Rozen P, Fireman Z, Gilat T. Arterial oxygen tension changes in elderly patients undergoing upper gastrointestinal endoscopy II. Influence of the narcotic premedication and endoscope diameter. *Scand J Gastroenterol* 1981;16:299-303.
- Rozen P, Fireman Z, Gilat T. The causes of hypoxemia in elderly patients during endoscopy. *Gastrointest Endosc* 1982;28:243-6.
- Davidson T, Levine M, Meyerowitz R. Ventricular fibrillation during

- colonoscopy: Case report and review of the literature. *Am J Gastroenterol* 1985;80:690-3.
33. Segawa K, Nakazawa S, Yamao K, et al. Cardiac response to upper gastrointestinal endoscopy. *Am J Gastroenterol* 1989;84:13-6.
 34. Rosenberg J, Hansen BJ. Possible role of autonomic afferents in treatment of postoperative hiccups. *Lancet* 1989;2:873.
 35. De Troyer A, Rosso J. Reflex inhibition, of the diaphragm by esophageal afferents. *Neurosci Lett* 1982;30:43-6.
 36. Vawter M, Rutz R, Alaama A, Aronow WS, Dagradi AE. Electrocardiographic monitoring during colonoscopy. *Am J Gastroenterol* 1974;63:155-7.
 37. Macrae FA, Tank G, Williams CB. Toward safer colonoscopy: A report on the complications of 5000 diagnostic or therapeutic colonoscopies. *Gut* 1983;24:376-83.
 38. Pecora AA, Chiesa JC, Alloy AM, Santoro J, Lazarus B. The effect of upper gastrointestinal endoscopy on arterial O₂ tension in smokers and nonsmokers with and without premedication. *Gastrointest Endosc* 1984;30:284-8.
 39. Whorwell PJ, Smith CL, Foster KJ. Arterial blood gas tensions during upper gastrointestinal endoscopy. *Gut* 1976;17:797-800.
 40. Rosenberg J, Jorgensen CN, Rasmussen V, Vibits H, Hansen PE. Hypoxaemia and myocardium ischaemia during and after endoscopic cholangiopancreatography: Call for further papers. *Scand J Gastroenterol* 1992;27:717-20.
 41. Rosenberg J, Overgaard H, Andersen M, Rasmussen V, Schultze S. Double blind randomized controlled trial of effect of metoprolol on cholangiopancreatography. *Br Med J* 1996;313:258-61.
 42. Pasternak PF, Grossi EA, Baumann FG, Riles TS, Lamparello PJ, Giagnola G. Beta blockade to decrease silent myocardial ishcemia during peripheral vascular surgery. *Am J Surg* 1989;158:113-6.
 43. Wesslen O, Hallhagen S, Ekroch R, Jangerbung R, Joachimsson PO, Nordgren L. High-dose intravenous β -blockade in patients early after cardiac operations: Negative inotropism versus myocardial oxygen economy. *J Thorac Cardiovasc Surg* 1992;104:1672-8.
 44. Jakobsen CJ, Blom L, Brondbjerg M, Lenler-Petersen P. Effect of metoprolol and diazepam on pre-operative anxiety. *Anaesthesia* 1990;45:40-3.
-



Hindawi
Submit your manuscripts at
<http://www.hindawi.com>

