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Assessment of relationship between colorectal cancer and parameters of tumour size

The incidence of colorectal cancer is the highest among tumours of the gastrointestinal tract and increases within human population. (9, 11). Early stages of colorectal cancer may occur three years before first clinical symptoms (5, 13). Computer tomography scanning is currently a routine test used in preoperative assessment of large bowel cancer to evaluate its stage of progression and therapy planning (1). Current computed tomography techniques may serve to screening strategies, progression assessment and diagnostics of postoperative recurrence in patients with colorectal cancer (8, 12). Prognosis for patients with colorectal cancer depends on the stage of progression at the moment of diagnosis. The extent of bowel wall thickening, invasion of perirectal fatty tissue, metastases to local lymph nodes and remote metastases are the main factors essentially influencing prognosis (6).

The aim of the studies is assessment of relationship between the stage of progression of colorectal cancer and parameters of tumour size.

MATERIAL AND METHODS

Material tested was taken from the group of 68 patients suffering from colorectal cancer: 27 women (39.7%) and 41 men (60.3%) at the age of 17 to 81 (62.3 on average). The largest group of tested patients i.e.: 41 persons (60.3%) were 50–70 years old. All of them were treated in 1st Clinic and the Department of Surgery, Medical University of Lublin and in the Department of Traumatology, Medical University of Lublin.

All patients had colonoscopy performed and material samples for histopathological tests were taken and diagnosed with cancer. CT scannings were performed in axial sections of 5 mm in thickness. Arial sections were supplemented with sagittal, frontal and sloping reconstructions as well as with irregular sections running along bowel loops.

Axial sections were performed before and after contrast medium enhancement. Doses of 60–150 ml i.e. 1–2 ml/kg body weight of the contrast medium were administered intravenously. Liver was tested by performing axial sections of 10 mm in thickness, after administration of the contrast medium. Scannings were performed with Somatom AR.T, Simens with Somaris software. Statistic analysis of tumour parameters, i.e. thickness and length of carcinous invasion and extent of narrowing in individual stages of cancer, was carried out.

Additionally, the relationship between factor (W), which is a product of the wall thickness, invasion length and tumour volume, and the progression stage was evaluated as well. The tumour volume was calculated by deducting the value of cylinder volume of colon internal diameter in the section of invasion from the volume of cylinder of invasion length and diameter including the internal bowel diameter.

RESULTS

The results of CT scanning of the tested material were classified according to the extended Duke classification as follows: Stage A – tumour confined to the wall or endophytic (14 cases – 20.6%); Stage B – tumour extended outside serous membrane into perirectal fatty tissue and/or invading proximal organs (17 cases – 25%); Stage C – stage B + enlargement of local nodes (21 cases – 30.9%); Stage D – remote metastases, especially to the liver and nodes of retroperitoneal space (16 cases – 23.5%).

Thickness of the bowel wall in place of carcinous invasion was equal to 7–50 mm (18.6 mm) and dependent on the stage of progression according to Duke: A – from 7 to 17 mm, 12.57 mm on average; B – from 7 to 35 mm, 17.7 mm on average; C – from 10 to 50 mm, 23.81 mm on average; D – from 10 to 30 mm, 20.88 mm on average.

Length of carcinous invasion was equal to 1–14 cm (6.29 on average) and dependent on the stage of progression according to Duke: A – from 1 to 10 cm, 3.89 cm on average; B – from 3 to 12 cm, 5.85 cm on average; C – from 4 to 14 cm, 7.81 cm on average; D – from 4 to 12 cm, 6.88 cm on average.

The extent of the narrowing was presented in per cent, for the small one 33%, medium – 50%, big – 75% and nearly total – 90%. The average value of the narrowing was 58.7%. For individual stages of the process progression the values were as follows: A – 47.14%, B – 54.06%, C – 67.38%, D – 66.18%. The results are presented in Table 1.

Table 1. Analyzed parameters of the investigated tumours in several stages of development

Feature	Duke's staging	n	Min.	Max.	Me median	M mean	SD	P-value
Length (cm)	A	14	1	10	3	3.89	2.40	a
	B	17	3	12	5	5.85	2.24	ab
	C	21	4	14	7	7.81	2.96	c
	D	16	4	12	6	6.88	2.28	bc
	total	68	1	14	6	6.29	2.28	-
Wall thickness (mm)	A	14	7	17	13.5	12.57	3.18	a
	B	17	7	35	16	17.71	6.25	b
	C	21	10	50	20	23.81	12.39	b
	D	16	10	30	20	20.88	6.87	b
	total	68	10	50	17	19.28	9.21	-
Narrowing extent (%)	A	14	33	90	33	47.14	23.58	a
	B	17	33	90	50	54.06	22.85	ab
	C	21	33	90	50	67.38	24.85	b
	D	16	33	90	75	66.19	21.33	b
	total	68	33	90	50	59.60	24.26	-
Product length x thickness (W)	A	14	1.0	12	4.5	5.24	3.57	a
	B	17	4.2	24	8.0	10.42	5.66	b
	C	21	6.0	48	13.7	19.30	13.69	c
	D	16	6.0	30	12.0	14.26	6.85	c
	total	68	1.0	48	10.25	12.98	10.19	-
Tumour volume (cm^3)	A	14	12.6	175.6	55.0	61.5	49.5	a
	B	17	48.8	263.8	108.5	129.7	70.2	b
	C	21	75.4	847.8	165.0	272.5	255.1	c
	D	16	37.7	423.9	150.0	182.1	115.7	bc
	total	68	12.6	847.8	109.2	172.0	173.9	

a, b, c – values that do not share common superscript letter in a column differ significantly for P-value < 0.05

The average length of the invaded bowel section was much smaller in stages A and B than in C and D, but it did not significantly differ in stages A and B, B and D and C and D. The average length of the invaded bowel section was significantly smaller in stage A in comparison to other groups, but it did not significantly differ in stages B, C and D. The average extent of narrowing of internal diameter of the invaded bowel section was significantly smaller in stage A than in C and D, but it did not differ significantly between stages A and B and stages B, C and D.

Factor (W), which is a product of length of the invaded bowel section and the wall thickness in the section of the widest invasion was the lowest for stage A and significantly different from others. The factor for stage B was significantly higher than for stage A, whereas significantly lower for both C and D stages. It did not significantly differ for stages C and D. The average tumour volume was significantly statistically the lowest in stage A. In stage B it was significantly higher than in stage A and lower than in stage C, whereas it was not significantly different from stage D. Average tumour volume in stage C was significantly higher than in stages A and B, but it was not significantly different from stage D.

Table 2. Tumour characteristics according on to Duke's staging

Volume (cm^3)	A		B		C		D		Total	
		%		%		%		%		%
< 75	12	75	3	18.8	0	0	1	6.2	16	100
%	85.7		17.6		0		6.2		23.5	
75–99	0	0	3	23.1	6	46.2	4	30.8	13	100
%	0		17.6		28.6		25		19.1	
100–199	2	9.1	7	31.8	8	36.4	5	22.7	22	100
%	14.3		41.2		38.1		31.3		32.4	
> 200	0	0	4	23.5	7	41.2	6	35.3	17	100
%	0		23.6		33.3		37.5		25	
Total	14		17		21		16		68	
Mean > 109.2	2	5.8	7	20.6	15	44.1	10	29.4	34	50
%	14.3		41.2		71.4		62.5		50	
Mean <109.2	12	35.3	10	29.4	6	17.6	6	17.7	34	50
%	85.7		58.8		28.6		37.5		50	

Table 2 presents the number of tumours in individual stages of advancement in four ranges of volume. In stage A 12 (85.7%) tumours had a volume below 75 cm^3, while volumes of 2 (14.3%) were in the range of 100–199 cm^3. In stage B there were 3 cases (17.6%) of small tumours of volume below 75 cm^3, volumes of 3 tumours (17.6%) were below the range of 100–199 cm^3, 7 (41.2%) in the range of 100–199 cm^3 and 4 (23.6%) above 200 cm^3. In stage C, volume of 6 (28.6%) the smallest tumours had volume in the range of 75–99 cm^3, 8 (38.1%) in the range of 100–199 cm^3 and 7 (33.3%) were bigger than 200 cm^3. In stage D one tumour had a volume below 75 cm^3, 4 (25%) in the range of 75–99cm^3, 5 (31.3%) in the range of 100–199cm^3 and 6 (37.5%) were bigger than 200 cm^3. There were 16 (23.5%) tumours of volume below 75 cm^3 and 13 (19.1%) in the range of 75–99 cm^3. Tumours of volume 100–199cm^3 were the most numerous – 22 cases (32.4%) and bigger than 200 cm^3 – 17 (25%). The volume of 109.2 cm^3 was the median. In stage A, the volume of 12 (85.7%) tumours was below and 2 (14.3%) above the median value. In stage B, respectively, 10 (58.8%) and 7 (41.2%), in C – 6 (28.6%) and 15 (71.4%). In stage D, volumes of 6 (37.5%) tumours were below,

and 10 (62.5%) above the median value. Tumours of volume 75 cm^3, were found mainly in stage A – 12 cases (75%), while in stage B there were 3 (18.8%) such cases and one (6.2%) in stage D. In the volume range of 75–99 cm^3 3 tumours (23.1%) were in stage B, 6 (46.2%) in stage C and 4 (30.8%) in stage D. In the volume range of 100–99 cm^3 2 tumours (9.1%) were in stage A, 7 (31.8%) in stage B, 8 (36.4%) in C and 5 (22.7%) in stage D. Four tumours (23.5%) had the volume bigger than 200cm^3 in stage B, 7 (41.2%) in stage C i 6 (35.3%) in stage D.

DISCUSSION

Currently, treatment of colorectal cancer involves various methods including local excision, radical resection, and multimodality therapy (15). The choice of appropriate therapy depends on the stage of progression, which is determined on the base of image scans such as CT, USG i MR (2). The use of supplementary MPR sagittal reconstructions, including estimation of fatty tissue and proximal organs invasion, increases sensitivity of CT test for assessment of the stage of local progression of tumour from 73% (axial sections only) to 83% (with MPR reconstructions) (4). CT scanning supplemented with MPR reconstructions enables accurate measurements of thickness of the invaded bowel wall as well as determination of the length of the invaded bowel section.

The results show that the relationship between the stage of tumour advancement concerns the local advancement whereas remote metastases are not correlated with tumour size. To diminish the stage of advancement of colorectal cancer, preoperative radio- and chemotherapy are used (3). Data of tumour volume may be taken into account while determining the radiation or chemotherapeutics dose. As the definite majority of tumours in stage A had the volume less than 75 cm^3, it can be assumed that for tumours of bigger volume, the probability of tumour limitation only to colon bowel wall is little.

Both the time of survival and recurrence risk are correlated with the stage of tumour advancement of the colon cancer. Five years long survival may be reached by 50% of patients. The time of survival in A, B, C and D stages may reach 81–85%, 64–78%, 27–32% and 5–14%, respectively (14). Modest increase of the fat tissue density nearby the tumour area as a symptom of an infiltration has a relatively poor diagnostic value and the differentiation of stages A and B is difficult (7). Due to significant differences of the volume and W factor between stages A and B, it is concluded that both these parameters may be used for assessment of tumour advancement of the colorectal cancer. The volume of the tumour is an important indicator for determination of the x-ray dosage in preoperative therapy. Furthermore, the tumour size is an important indicator for predicting the response of the tumour to the radiotheraphy. In the case of the tumour with the volume below 200 cm^3, totaly effective response of the tumour to preoperative radiotheraphy is possible (10).

CONCLUSIONS

Factor (W), which is a product of invasion parameters, i.e. its length and wall thickness and average volume of the tumour showed statistically essential differences in individual stages of advancement according to Duke's classification. The lowest values were found in stage A, higher, but lower than in stage C, in B. Values of factor W did not essentially differ in stages C and D and volumes did not essentially differ in stages C and D and B and D. The relationship between the volume of the tumour and colorectal cancer stage of progression concerns the local advancement whereas remote metastases are not correlated with tumour volume.

REFERENCES

1. Balthazar E. J. et al.: Carcinoma of the colon: detection and preoperative staging by CT. AJR Am. J. Roentgenol., 150, 301, 1988.
2. Bipat S. et al.: Rectal cancer: local staging and assessment of lymph node involvement with endoluminal US, CT, and MR imaging – a meta-analysis. Radiology, 232, 773, 2004.
3. Chen E. T. et al.: Downstaging of advanced rectal cancer following combined preoperative chemotherapy and high dose radiation. Int. J. Radiat. Oncol. Biol. Phys., 30, 169, 1994.
4. Filippone A. et al.: Preoperative T and N staging of colorectal cancer: accuracy of contrast-enhanced multi-detector row CT colonography – initial experience. Radiology, 231, 83, 2004.
5. Freeny P. et al.: Colorectal carcinoma evaluation with CT: Preoperative staging and detection of postoperative recurrence. Radiology, 158, 347, 1986.
6. Gazelle G. S. et al.: Staging of colon carcinoma using water enema CT. J. Comput. Assist. Tomogr., 19, 87, 1995.
7. Kelvin F., Gardiner R.: Clinical Imaging of the Colon and Rectum. Raven Press. New York 1987.
8. Krupski W.: Wykorzystanie współczesnych technik tomografii komputerowej w diagnostyce raków prostniczo-esiczych. Ph. D. Thesis, Lublin 1999.
9. Moss A.: Imaging of colorectal carcinoma. Radiology, 170, 308, 1989.
10. Myerson R. J. et al.: A phase I/II trial of three-dimensional planned concurrent boost radiotherapy and protected venous infusion of 5–FU chemotherapy for locally advanced rectal carcinoma. Int. J. Radiat. Oncol. Biol. Phys., 50, 1299, 2001.
11. Pema P. et al.: CT vs. MRJ in diagnosis of recurrent rectosigmoid carcinoma. J. Comput. Assist. Tomogr., 18, 256, 1994.
12. Potter J., Slattery M.: Colon cancer: A review of the epidemiology. Epidemiol. Rev., 15, 499, 1993.
13. Rex D. et al.: Relative sensitivity of colonoscopy and barium enema for detection of colorectal cancer in clinical practice. Gastroenterology, 112, 17, 1997.
14. Thoeni R.: Colorectal cancer: Cross-sectional imaging for staging of primary tumour and detection of local recurrence. AJR, 156, 909, 1991.
15. Zaheer S. et al.: Surgical treatment of adenocarcinoma of the rectum. Ann. Surg., 227, 800, 1998.

SUMMARY

Computer tomography is currently a routine test used in preoperative assessment of large bowel cancer to evaluate the stage of progression and therapy planning. The aim of the study is the assessment of the relationship between the stage of progression of colorectal cancer and parameters of tumour size. Material tested was taken from the group of 68 patients at the age of 17–81 suffering from colorectal tumour. Statistic analysis of tumour parameters, i.e. thickness and length of carcinous invasion and the extent of the narrowing in individual stages of cancer, was carried out. Additionally, dependence of factor (W), which is a product of the wall thickness, length of invasion and tumour volume on the progression stage of cancer was evaluated. The relationship between the progression stage of colorectal cancer and length, thickness of invasion and extent of the internal diameter narrowing was stated. Factor W showed significant differences in individual stages of advancement according to Duke's classification. The relationship between the volume of the tumour and colorectal cancer stage of progression concerns the local advancement whereas remote metastases are not correlated with the tumour volume.

Ocena zależności stopnia zaawansowania raka prostniczo-esiczego i parametrów wielkości guza

Obecnie TK jest rutynowo stosowana w przedoperacyjnej ocenie raka jelita grubego w celu określania stopnia zaawansowania i planowania terapii. Celem pracy jest ocena zależności pomiędzy stopniem zaawansowania raka prostniczo-esiczego a parametrami wielkości guza. Materiał stanowi grupa kolejnych 68 chorych z rakiem prostniczo-esiczym w wieku od 17 do 81 lat. Przeprowadzono analizę statystyczną parametrów guza, tj. grubości i długości nacieku oraz stopnia przewężenia w poszczególnych stadiach zaawansowania raka. Dodatkowo oceniono zależność współczynnika (W) będącego iloczynem grubości ściany i długości nacieku oraz objętości guza od stopnia zaawansowania. Stwierdzono, że istnieją zależności pomiędzy stopniem zaawansowania raka prostniczo-esiczego a długością i grubością ściany nacieku nowotworowego oraz stopniem przewężenia światła. Współczynnik W wykazywał istotne statystycznie różnice w poszczególnych stadiach zaawansowania wg klasyfikacji Dukes. Zależności pomiędzy objętością guza a stopniem zaawansowania raka prostniczo-esiczego dotyczą miejscowego zaawansowania, natomiast występowanie przerzutów odległych nie jest skorelowane z objętością guza.