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Radiographic Findings and Hypotensive Reactions in Excretory Urography

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排泄性尿路造影における低血圧反応とその所見

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ルーチンの排泄性尿路造影（イオン性造影剤使用）において低血圧反応がみられた19症例でX線所見と低血圧の型との関係を調べた．9例で収縮期血圧が80mmHg以下にまで低下したが，残りの10例の収縮期血圧は80mmHg以下にまでは低下しなかった．収縮期血圧が80mmHg以上に保たれていた10例では排泄性尿路造影に著明な異常は認められなかった．

造影剤の静注の直後から収縮期血圧が急速に80mmHg以下に低下した2例ではpyelogramは淡い描出か描出されなかった．一方，造影剤の静注数分後に血圧が低下しはじめ，20分間以上収縮期血圧が80mmHg以下であった4例では，nephrogramは濃く，pyelogramは淡い描出か描出されなかった．収縮期血圧が80mmHg以下になっても，血圧低下の出現が遅かったり，また80mmHg以下が短時間であった3例では，排泄性尿路造影では著明な異常は認められなかった．

The radiographic findings and the hypotension patterns were reviewed in 19 patients having hypotensive reactions in routine excretory urography using ionic contrast medium. The lowest systolic blood pressure was above 80 mmHg in 10 patients while below 80 mmHg in remaining 9 patients. The urogram was unremarkable as long as the systolic blood pressure was preserved above 80 mmHg.

In 2 patients, whose systolic blood pressure decreased quickly beyond 80 mmHg immediately after injection of contrast medium, the pyelogram was faint or non-visualized. On the other hand, in 4 patients, whose systolic blood pressure decreased beyond 80 mmHg in several minutes after injection of contrast medium and remained under 80 mmHg for more than 20 minutes, the nephrogram was dense and the pyelogram was faint or non-visualized. Although systolic blood pressure decreased beyond 80 mmHg, the urogram was unremarkable in 3 patients. This was due to the delayed hypotension or the short duration of hypotension.

Introduction

Bilateral persistent dense nephrogram and faint or non-visualized pyelogram are often seen at severe contrast reactions in excretory urography (EU)[1)-3)]. However, these typical radiographic findings have not been discussed in conjunction with changes of blood pressure during the examination.

The hypotension patterns are characterized by the extent of hypotension[4)], the time of beginning of hypotension[3)], the progress of hypotension and the duration of hypotension[2)], therefore, the radiographic findings should vary with changes of these factors.

The purpose of this study is to show that the radiographic findings due to a hypotensive reaction are relevant to the above factors.

Materials and Methods

After confirmation of no adverse reactions by a test injection, 100 ml of contrast medium (diatrizoate; Urografin 60% or metrizoate; Isopaque 280) was injected intravenously within about 3 minutes.

We recorded systolic blood pressure using a device for monitoring blood pressure (Nippon Khorin Co.) during routine EU in 3002 patients (4832 studies) and found 19 patients having a hypotensive reaction (decrease more than 20% of the pre-injection systolic blood pressure lasting for more than 1 minute).

Films were obtained in low kilovoltage technique (60—75 KV) using a Bucky diaphragm and a medium-speed screen film system before (a scout abdomen) and after contrast medium injection (0 min film, 3 min film and 12 min film). Additional films were obtained when necessary.

The density of nephrogram or pyelogram was evaluated retrospectively on a 0 min film and a 12 min (or 30 min) film in 19 patients with hypotensive reactions. The density was graded "non-visualized", "faint", "normal", and "dense" by comparing the hepatic density.

The hypotension patterns were characterised by the extent of hypotension, the time from contrast medium injection to the beginning of hypotension, the time from contrast medium injection to systolic blood pressure 80 mmHg, and the duration of hypotension below 80 mmHg.

Results

The urogram or pyelogram was unremarkable in 10 patients, in which the systolic blood pressure never decreased beyond 80 mmHg after injection of contrast medium. Whereas, the density of nephrogram or pyelogram was varied in remaining 9 patients, in which the systolic blood pressure decreased beyond 80 mmHg (Table 1).

In 9 patients with severe hypotension (below 80 mmHg), a 0 min film showed "normal" nephrogram in 7 patients, "normal" pyelogram in 3 patients and "faint" or "non-visualized" pyelogram in 4 patients (no film was obtained in 2 patients). Whereas, a 12 min (or 30 min) film showed "normal" nephrogram in 6 patients and "dense" nephrogram in 3 patients, "normal" pyelogram in 3 patients and "faint" or "non-visualized" pyelogram in 6 patients.

After contrast medium injection, the blood pressure began to decrease within 2 min in 4 patients, at 4 to 7 minutes in 3 patients, and at 11 to 13 minutes in 2 patients, respectively. The time from contrat medium injection to systolic blood pressure below 80 mmHg was 3 to 5 minutes in 3 patients, 7 to 9 minutes in 4 patients, and 14 to 15 minutes in 2 patients, respectively. The duration of hypotension below 80 mmHg was 1 to 4 minutes in 2 patients, 9 to 15 minutes in 3 patients, and 21 to 24 minutes in 4 patients, respectively.

Table 1　The urograms and the hypotension patterns

age & sex	urogram				time (min)		
	0 min film		12 min (or 30 min*) film		from contrast injection to decreasing BP	from contrast injection to BP 80 mmHg	duration of hypotension below 80 mmHg
	nephrogram	pyelogram	nephrogram	pyelogram			
87M	normal	non-visualized	normal	faint	1	3	9
54M	···	···	normal	faint	1	4	1
79M#	normal	faint	normal*	faint*	2	7	24
57F#	normal	non-visualized	dense*	non-visualized*	2	8	23
17F	normal	faint	dense*	non-visualized*	4	5	22
64F	···	···	dense	non-visualized	7	8	21
42F	normal	normal	normal	normal	7	9	4
20M	normal	normal	normal	normal	11	14	14
59F	normal	normal	normal	normal	13	15	15

no subjective or objective symptoms during EU

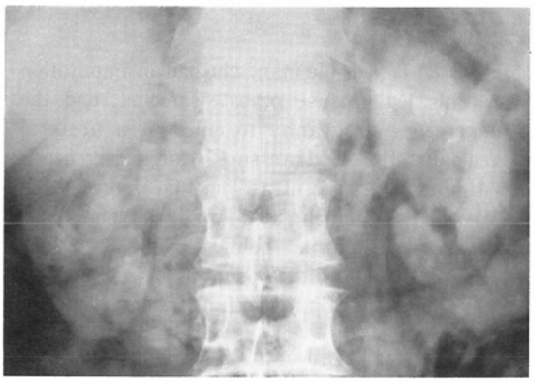

Fig. 1　A 87 year-old man with prostatic hypertrophy had the excretory urography to exclude a lower urinary tract obstruction. His blood pressure began to decrease immediately after contrast medium injection and progressed quickly to below 80 mmHg within 3 minutes. A 0 min film shows "normal" nephrogram and "non-visualized" pyelogram.

Discussion

Even if a hypotensive reaction occurs early, progresses quickly and lasts tedioulsy, the urogram is normal in density as long as systolic blood pressure is preserved above 80 mmHg. The glomerular capillary pressure is about 45 mmHg at systolic blood pressure being about 70 mmHg while the intra-plevic pressure is 45 mmHg[4]. Therefore, the glomerular filtration of contrast medium will decrease significantly when systolic blood pressure must be below 80 mmHg.

Fig. 2 A 17 year-old man, who had an amputation of his leg because of osteosarcoma, had the excretory urography to rule out a ureteral calculus. His blood pressure began to decrease at 4 minutes after contrast medium injection and reached 80 mmHg at 5 minutes. The blood pressure remained below 80 mmHg for 22 minutes. A 30 min film shows "dense" nephrogram, and "faint" pyelogram.

When systolic blood pressure decreaes quickly beyond 80 mmHg just after injection of contrast medium, both nephrogram and pyelogram are faint on a 0 min film because contrast medium is not enough in the glomeruli as well as in the plevo-calyceal spaces to produce the normal urogram density. The density of nephrogram or pyelogram on a 12 min (or 30 min) film is mainly controlled by the duration of hypotension below 80 mmHg. If the blood pressure will recover quickly from below 80 mmHg, the nephrogram or pyelogram will be normal in density.

When there are several minutes before systolic blood pressure decreases beyond 80 mmHg, the nephrogram is normal in density on a 0 min film because contrast medium exists sufficiently in the tubules. However, the pyelogram is faint or non-visualized on a 0 min film, because several minutes are necessary for contrast medium to pass through the convoluted tubules from the glomeruli to the pelvocalyceal system[3]. During this period, water is reabsorbed and contrast medium is concentrated in the tubules. Whereas, the density of nephrogram is dense on a 12 min (or 30 min) film due to the prolongation of hypotension below 80 mmHg because the glomerular filtration of contrast medium is superior to the excretion of contrast medium into the pervocalyceal spaces at blood pressure around 80 mmHg.

When blood pressure begins to decrease at over 10 minutes after injection of contrast medium, the urogram is normal in density on a 12 min film because contrast medium is normal in amount in the tubules

as well as in the pelvocalyceal spaces. In order to expect the abnormal urogram, films must be obtained during hypotension below 80 mmHg or shortly after recovered from hypotension below 80 mmHg[5].

The evaluation of the nephrogram density is more difficult than that of the pyelogram density since the density of nephrogram is influenced by the shape of kidney, KV and mA of the beam and the overlying tissue, besides contrast medium within the tubular spaces[3].

Hypotensive reactions to contrast medium occured during EU in 19 patients (19 examinations) of 3002 patients (4832 examinations). The treatment was performed for severe hypotension (below 80 mmHg) in 9 patients. The urogram was abnormal in 6 patients having severe hypotension. The subjective or objective symptoms to suggest a contrast reaction were present during the examinaiton in 4 patients of the above 6 patients. Consequently, 2 patients out of 9 patients with severe hypotension had the abnormal urogram to suggest a hypotensive reaction without any clinical symptoms. In these patiens, the typical radiographic findings gave us an initial suggestion of a contrast reaction during EU.

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