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COMPUTED TOMOGRAPHY OF THE URINARY BLADDER USING THE OLIVE OIL-FILLED METHOD

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Staging of the urinary bladder neoplasms is based on precise demonstration of morphology of the tumor and surrounding structures including normal bladder wall. Computed tomography is recognized as an accurate non-invasive technique for evaluating urinary bladder tumors and its extravascular extensions on condition that the bladder is filled with appropriate contrast materials²⁻⁸. Although the gas filled method has been commonly used and it shows an appreciable diagnostic value^{2,4,5,7}, gas itself sometimes produces significant artifacts which mask the vesical wall and the extravascular structures. The authors proved the olive oil as a suitable contrast material for CT of the urinary bladder by experiment and clinical application. Our new method can demonstrate the intraluminal tumor, vesical wall and extravascular tumor extensions more precisely than the ordinary method using the gas or positive contrast materials.

MATERIALS AND METHODS

EMI 5005, 20 seconds body scanner was used for the scans.

For experimental study, a phantom was constructed by Mix DP¹⁾ to simulate the anatomical condition of urinary bladder. The construction and dimension of the phantom is shown in Fig. 1 and Table 1. Five sorts of contrast materials [gas, olive oil, water, 1% Angiografin (65% meglumine amidotrizoate) and 2% Angiografin] were tested by using this phantom. The phantom filled with each contrast material was scanned and all images were taken with window level+10 and window width 200 in EMI number. The diameter of the imitated tumor and the thickness of the imitated bladder wall were measured on CT imaged for each contrast material. Attenuation values of the contrast materials in the phantom were also measured.

For clinical study, a Foley catheter was

inserted into the bladder, and all residual urine was drained prior to scan. Thereafter up to 120 ml of olive oil was injected into the bladder with care of avoiding contamination of small air bubble. Olive oil is sterilized at 135°C for 15 minutes. The patients were generally scanned in supine position. After the detection of the tumor location, the patients were rotated to appropriate position to evaluate the characteristics of the tumor. Intravenous injection of small dose contrast material was sometimes used to examine the relation between tumor and ureters. Sixty-five patients of urinary bladder tumors were examined by this method.

RESULTS

Phantom Study: Measured values of imitated tumor size and bladder wall thickness are shown in Table 1 in relation to attenuation value for each contrast material. As shown in this Table, the air-filled

Table 1. Measurement of imitated tumor and bladder wall, and attenuation values of variable contrast materials in the phantom model.

Studied material	EMI number		Measurement	
	Mean	SD	Tumor size	Wall thickness
Air	-437.1	7.2	17mm	5mm
Olive oil	-50.1	4.8	20mm	7mm
Water	+2.9	3.9	19mm	7mm
1% Angiografin	+51.3	5.0	19mm	6mm
2% Angiografin	+92.3	4.4	18mm	6mm
Mix DP	+14.7	4.5	20mm*	7mm*

SD: Standard deviation. *: Actual size of phantom.

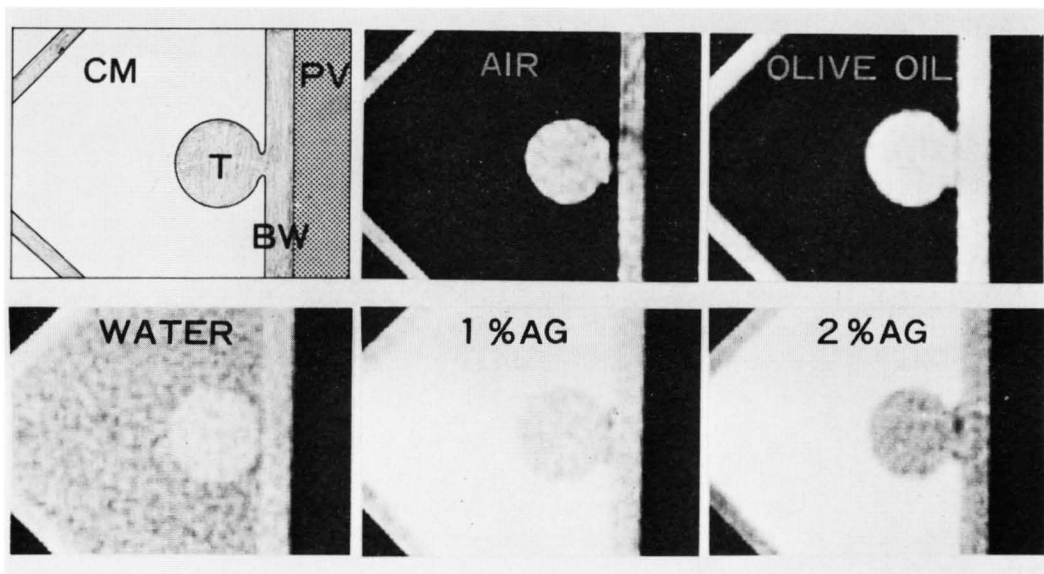


Fig. 1. Construction of bladder phantom and CT images for various contrast materials. All pictures were taken with WL+10, WW 200. Bladder wall (BW) and tumor (T) were made of Mix DP. Perivesical fat tissue (PV) was simulated by olive oil. CM=contrast material. AG=Angiografin.

phantom image is measured smaller than the actual size. The interface of air and Mix DP shifts to Mix DP side in 2 mm. The olive oil-filled phantom image is demonstrated as actual size. The water-filled phantom image is rather poor in contrast for demonstration of the tumor and wall. The 1% and 2% Angiografin phantom images are measured somewhat smaller than actual size.

Clinical Application:

1) Air and 2% Angiografin method: A polypoid tumor arising from the left

lateral wall is demonstrated on the interface of air and low density positive contrast material. The wall contracted to air and 2% Angiografin is not demonstrated as parallel layer of muscular density. The calcified lesion is hidden in the contrast material with this window level and width (Fig. 2).

2) Olive oil method: Bladder was filled with 100 ml of olive oil. CT demonstrated the left posterolateral wall with a mass invading perivesical fat layer and the irregular thickening of other part of the

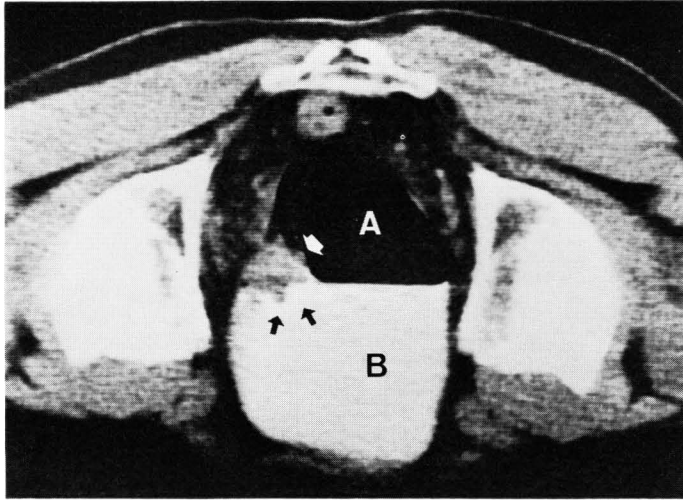


Fig. 2. Prone CT scan of a patient with polypoid tumor arising from left lateral wall of the urinary bladder. The bladder was filled with 60 ml of room air (A) and 70 ml of 2% Angiografin (B). Stage B1 tumor by Jewett's classification (white arrow). Calcified lesion in the tumor (black arrows).

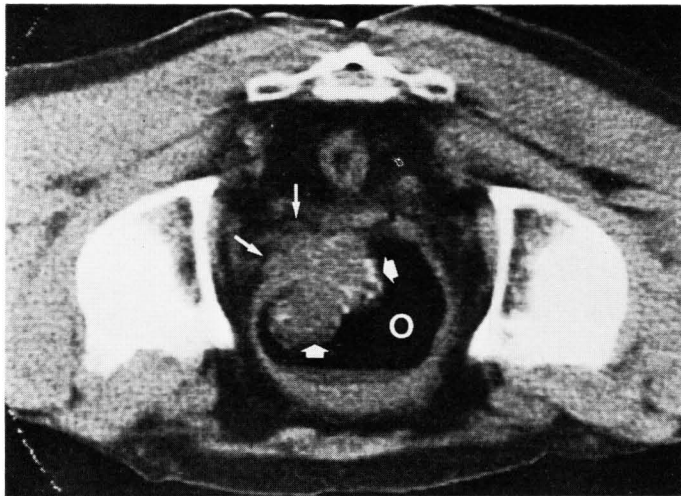


Fig. 3. Prone CT scan of olive oil (O) filled bladder. Stage C polypoid tumor (short arrows) arises from left posterior lateral wall. Extravesical extension (long arrows) is demonstrated.

vesical wall. Precise demonstration of tumor characteristics and surrounding structures can be obtained by this method (Fig. 3).

No infectious or allergic complications by instilled olive oil were found among sixty-five patients.

DISCUSSION

Although many investigators have indi-

cated that CT examination of the pelvic organs is valuable in clinical practice, only a few reports^{2,4,5,8)} discussed the utility of CT for urinary bladder neoplasms. In fact, the tumors limited to the bladder wall is not sufficiently outlined by the ordinary pelvic CT. For the precise clinical staging of bladder tumors which contributes to determine the treatment modality, some contrast materials are

required. It is wellknown that CT measurement value of a small-sized material is not always accurate due to the edge response and partial volume phenomenon^{9,10}). Further the wall thickness of urinary bladder which contains about 100 ml of urine is less than 3 mm in normal state. For these reasons, high contrast materials are not necessarily adequate for CT presentation of the bladder. The methods using these ones are difficult to delineate the tumor, vesical wall and perivesical organs in the same CT film image. Consequently, low density positive contrast materials are suitable for this purpose, but it is difficult to keep its density and homogeneity for continuous urine efflux from ureters. The olive oil-filled method solves all these problems, and distinguishes the vesical wall from a tumor easier than the low density positive contrast materials.

Computed tomography of the urinary bladder using olive oil-filled method is one of the excellent procedures among the radiological examinations to detect the intraluminal tumor and extravesical tumor extensions simultaneously^{5,6,8}). It is our impression that this method may be essential to determine the preoperative stage of the bladder neoplasms.

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和文抄録

オリーブ油注入法による膀胱 CT scan

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Computed Tomography (CT) による膀胱癌の診断は、非侵襲的な診断法であり、膀胱周囲臓器との関係を観察できるのみならず、腫瘍の形態、膀胱の性状の変化などを知りうることから、これによる術前診断が期待されている。しかし、膀胱造影剤として、従来用いられてきた空気、低濃度陽性造影剤では、必ずしも腫瘍形態を満足に描出することができず、また造影剤による artifact により、診断が困難になることが多く、種々の研究努力がなされているが、いまだ解決に至っていない。今回、われわれは、滅菌オリーブ油を膀胱内造影剤として用いることにより、腫瘍の膀胱内部分の行態、正常膀胱壁、および腫瘍の壁外浸潤を正確にとらえることを、実験的に確め、臨床に応用した。実験には、膀胱ファントムを作製し、造影剤とし

て、空気、オリーブ油、生食、1%アンギオグラフィン、2%アンギオグラフィンを用い、検討を行なったが、CT 膀胱造影剤として、オリーブ油が最適であると結論した。臨床的には、検査前にバルーンカテーテルを挿入、排尿を完全に行ない、空気の混入を避けながらオリーブ油100から120 cc を注入の後、カテーテルを抜去し、仰臥位にてスキャンを行った。つぎに腫瘍の位置により、患者の体位変換をおこない、再びスキャンをおこなって、腫瘍の正確な描出を試みた。現在までに、65例に滅菌オリーブ油注入による CT 膀胱スキャンを行なったが、副作用は全く認めず、この方法は膀胱癌の術前診断として高く評価されると考える。