# Ventriculitis: Diagnosis With Technetium-99m DTPA

Michael J. Daly and Dennis D. Patton

*Arizona Health Sciences Center, Tucson, Arizona*

***Brain scintigraphy with technetium-99m DTPA can provide early detection of ventriculitis when results of lumbar puncture are misleading, as is shown in the following case report. Prompt diagnosis of ventriculitis is required for effective antimicrobial treatment.***

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Ventriculitis occurs as a life-threatening complication of meningitis and requires intraventricular instillation of antibiotics for resolution. The majority of cases are limited to the pediatric age group, especially neonates with meningomyelocele or infants with ventricular shunts for hydrocephalus (*1,2*). Suspicions are usually raised when there is a poor response of meningitis to conventional therapy. Diagnosis is most often confirmed by analysis of ventricular fluid, but in previous reports ventricular visualization during brain scanning with technetium-99m as pertechnetate has suggested the diagnosis before ventricular tap or postmortem examination (*3–6*).

The introduction of new brain-imaging agents, such as Tc-99m-labeled DTPA and glucoheptonate, combined with modern gamma cameras, has broadened the diagnostic potential of brain scintigraphy. In the following report, a Tc-99m-DTPA brain scan was the primary diagnostic tool that led to the diagnosis of ventriculitis and appropriate treatment.

## CASE REPORT

A newborn female Mexican developed respiratory distress with cyanosis immediately after delivery by Caesarean section. Before transfer, the infant reportedly had multiple cardiac arrests. On admission at 15 days of age she was awake and irritable, with a temperature of 36.6°C. A 1.5-cm wound at the left ankle, the site of a previous i.v. line, was draining pus, which grew *Klebsiella pneumoniae* on culture. CSF by lumbar puncture on admission revealed 21,000 WBCs/cu mm, 100% PMNs, glucose 70 mg/dl (normal 40–80), protein 980 mg/dl (normal 15–45); it also grew *Klebsiella* on culture. Intravenous chloramphenicol and gentamycin treatment was begun, and appropriate serum and CSF chloramphenicol and serum gentamycin levels were attained. By Day 3, CSF obtained by lumbar puncture was sterile, but because the patient showed only sluggish clinical improvement, a brain scan with Tc-99m DTPA (1 mCi i.v.) was obtained. There was ventricular visualization at 2 hr (Fig. 1). Ventricular tap revealed turbid fluid with 1,060 WBCs/cu mm, 99% PMNs, glucose 0 mg/dl, and protein 1,430 mg/dl; it grew *K. pneumoniae* on culture. Gentamycin was instilled through a ventricular reservoir for 12 days. Because a computerized tomographic scan at Day 22 showed moderately dilated ventricles, a ventriculo-peritoneal shunt was placed. Ventricular tap 1 day before discharge had 119 WBCs/cu mm, glucose 9 mg/dl, protein 300 mg/dl, and gave no growth on culture.

## DISCUSSION

The usefulness of brain scintigraphy in detecting inflammatory lesions, including ventriculitis, has been noted by Gilday (*4*). Although two adult patients in whom ventriculitis was visualized with pertechnetate have been described

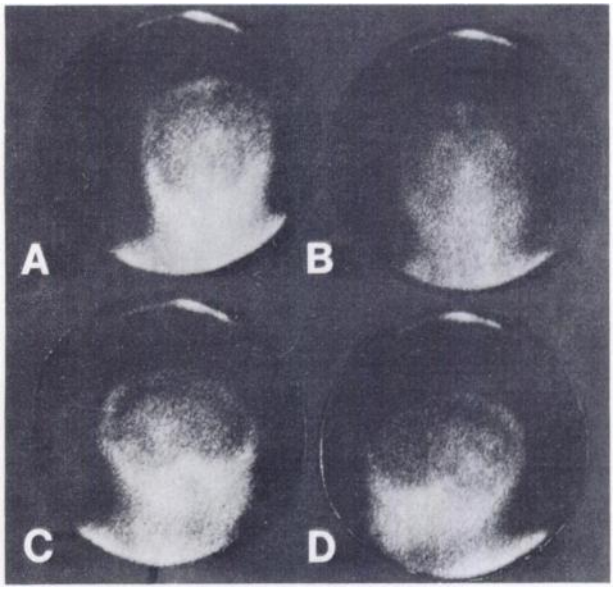


**Fig. 1. Technetium-99m DTPA brain scintigrams in patient with ventriculitis; most of ventricular system is seen. A = anterior; B = posterior; C = right lateral; D = left lateral.**

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For reprints contact: Michael J. Daly, Div. of Nuclear Medicine, Arizona Health Sciences Center, Tucson AZ 85724.

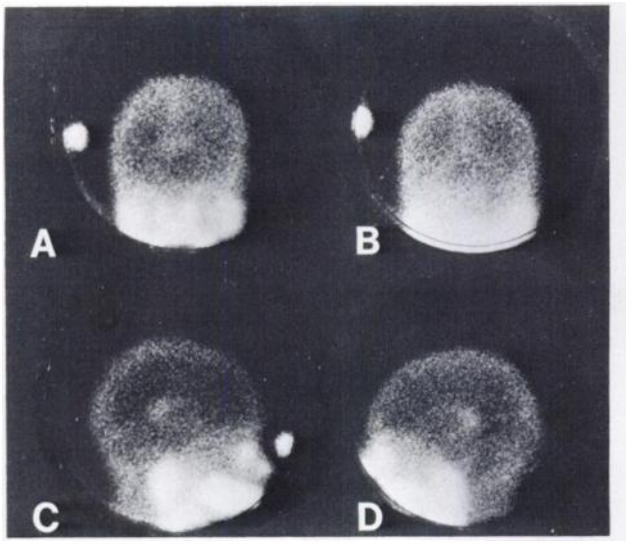


**FIG. 2.** Pertechnetate brain scintigrams in normal patient. No perchlorate was given (patient comatose). Choroid-plexus uptake is seen in lateral ventricles. A = anterior; B = posterior; C = right lateral; D = left lateral. A subsequent pertechnetate brain study with perchlorate block showed no choroid activity.

(*5,6*), other reports have included only pediatric cases, especially those who require or have received neurosurgical intervention (*3,4*). Timely diagnosis of ventriculitis is important because adequate treatment requires antibiotic concentrations 10–60 times those usually achieved in the serum, and this can be attained only by direct instillation (*1,2*).

Brain scintigraphy with pertechnetate has a number of disadvantages. Choroid-plexus uptake, variable in different patients, could be mistaken for ventriculitis, given the typical C shape and location in the lateral ventricle of the plexus (Fig. 2). It may also be mistaken for an anatomic lesion. To avoid this potential confusion, a "blocking" dose of perchlorate must be given. Although perchlorate administration is not usually difficult in adults, semi-comatose infants with meningitis may require nasogastric tube placement. Additionally, for optimal lesion visualization, imaging with pertechnetate must be delayed 2–4 hr to promote high lesion-to-background ratios (*7*).

Technetium-DTPA, a chelate, is excreted rapidly through the glomeruli. Unlike pertechnetate, it is not known to be actively concentrated in any organ (*8*). Thus, perchlorate blocking is unnecessary. Recent studies have shown the superiority of Tc-DTPA images compared with those of pertechnetate obtained at the same time after injection (*9,10*). No previous reports have shown Tc-DTPA localization in the ventricles with CNS infections, although rupture of an intracerebral hematoma into the ventricles with visualization on brain scan has been noted (*11*). Although pertechnetate was found in the ventricular fluid of one of Fulmer's cases (*3*), whether Tc-DTPA was actually in the ventricular fluid or simply in the ependymal membranes is not known in the present case. Given the passive movement of DTPA elsewhere in the body, passage into the membranes or ventricular cavity may be entirely due to the higher permeability of the periventricular region in infants with inflammatory disease.

The insensitivity of bacteriologic culture of CSF fluid obtained by lumbar puncture in the diagnosis of ventriculitis was demonstrated in our patient on Day 3, and contrasts with the obviously abnormal Tc-99m-DTPA brain scan performed at about the same time. Computerized axial tomography was not done until 3 wk after admission, a time delay preventing a valid comparison with the radionuclide scan.

## CONCLUSION

Clinical suspicion is the most important factor in the diagnosis of ventriculitis. Compared with brain scintigraphy, the major diagnostic test most relied upon—lumbar puncture—may be relatively insensitive. Although the mechanism of entry in ventriculitis of infants is not well explained for either pertechnetate or Tc-DTPA, ventricular visualization in infants with CNS infections is of clinical significance, for if the diagnosis is confirmed it indicates the need for more invasive sampling and direct intraventricular instillation of antibiotics. If pertechnetate is used, awareness of ventricular anatomy is necessary to distinguish between choroid plexus and ventricular activity. Technetium-DTPA eliminates any possibility of confusion.

## REFERENCES

*1.* SALMON JH: Ventriculitis complicating meningitis. *Am J Dis Child* 124: 35–40, 1972

*2.* LORBER J, KALHAN SC, MAHGREFTE B: Treatment of ventriculitis with gentamycin and cloxacillin in infants born with spina bifida. *Arch Dis Child* 45: 178–185, 1970

*3.* FULMER LR, SFAKIANAKIS GN: Cerebral ventricle visualization during brain scanning with $^{99m}$Tc-pertechnetate. *J Nucl Med* 15: 202–204, 1974

*4.* GILDAY DL: Various radionuclide patterns of cerebral inflammation in infants and children. *Roentgenol* 120: 247–253, 1974

*5.* DELAND FH, WAGNER HN JR: *Atlas of Nuclear Medicine*, vol 1. Philadelphia, WB Saunders, 1969, p 48

*6.* LEE HK: Unilateral pyogenic ventriculitis. *J Nucl Med* 18: 403, 1977

*7.* RAMSEY RG, QUINN JL III: Comparison of accuracy between initial and delayed $^{99m}$Tc-pertechnetate brain scans. *J Nucl Med* 13: 131–134, 1972

*8.* HAUSER W, ATKINS HL, NELSON KG, et al: Technetium-99m DTPA: A new radiopharmaceutical for brain and kidney scanning. *Radiology* 94: 679–684, 1970

*9.* AKERMAN M, DE TOVAR G, CHORNY DB: Comparative study of technetium-99m gluconate and four other technetium complexes (pertechnetate, DTPA, citrate, and bleomycin) in the diagnosis of metastatic brain tumors. *J Nucl Med* 18: 630–631, 1977 (abst)

*10.* SAKIMURA IT, WAXMAN AD, SIEMSEN JK: Comparison of delayed 99m technetium DTPA and pertechnetate camera brain images. *J Nucl Med* 16: 564–565, 1975 (abst)

*11.* SILVER L, SHAM R, KLEIN HA: Cerebral hematoma with intraventricular bleeding. *J Nucl Med* 15: 639–640, 1974