Iodinated Organic Compounds
As Contrast Media for Radiographic Diagnoses

VII. Visualization of Empyema CAVITIES with the Aid of Ethyl Iodophenylundecylate Emulsion

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Visualization of a group of eight empyema cavities has offered opportunities to test clinically the properties of the emulsion of ethyl iodophenylundecylate described in the preceding paper (1). As brought out in that paper, the emulsion has the property of coating and adhering to tissue surfaces to a rather high degree. This has led to a more perfect delineation of the cavities and of the response of the abscesses to chemotherapy and/or surgery.

The emulsion used was one containing 50 per cent of ethyl iodophenylundecylate, corresponding to an iodine content of 15 per cent. In every instance visualization was satisfactory both fluoroscopically and roentgenographically. After injection of the medium into each cavity, it was washed out by saline lavage. Relatively small amounts of the medium were required for visualization in each instance, and the injection and lavage were carried out with a minimum of discomfort to the patient.

In none of the cases was there evidence of toxic reactions of any sort.

ILLUSTRATIVE CASES

Eight empyema cavities were visualized with the aid of ethyl iodophenylundecylate emulsion. Of these, 7 were closed and 1 was open. Three of the cases are presented in some detail to illustrate the ease of use of the medium and the adequacy of the visualization.

Case I: J. F., a 52-year-old woman, had had repeated bilateral pleural effusions for a period of eighteen years. She was subjected to numerous examinations, including lipiodol bronchography. Several years prior to this admission, the fluid in the left pleural space became infected (Staphylococcus aureus and anaerobic streptococcus), and a chronic empyema resulted. The cavity was drained over a period of months, during which time it was visualized three times with lipiodol. Fifteen months after a left rib resection, the cavity failed to heal spontaneously, and in order to visualize it prior to thoracoplasty, about 20 c.c. of 50 per cent ethyl iodophenylundecylate emulsion were injected (Fig. 1). Following the examination, the emulsion was washed out with saline lavage. With the patient in the prone position it was possible to inject 63 c.c. of saline into the cavity. An injection of ethyl iodophenylundecylate emulsion eleven days postoperatively showed obliteration of the cavity but demonstrated a small draining sinus. The latter was healed completely ten days after discharge.

Comparison of the visualization achieved with the emulsion of ethyl iodophenylundecylate in this case with that obtained with the iodized oil was strikingly in favor of the emulsion. Small amounts of residual oil from the early examinations had been present in the tissues for some years, and these droplets interfered with an appraisal of whether small amounts of the emulsion remained after the examination. Apparently after each examination all the emulsion was removed by the saline lavage.

Case II: G. Q., a 64-year-old woman, had had pneumonia three times in the past. Although prior to this admission her local physician had been treating her with sulfamerazine, she was admitted

1 Accepted for publication in December 1946. Presented in part before the Radiological Society of North America at the Thirty-second Annual Meeting, Chicago, Ill., Dec. 1-6, 1946. This work was aided by a grant from the Research Laboratories of the Eastman Kodak Co., Rochester, N. Y.

2 Ethyl iodophenylundecylate emulsion is available for investigational purposes from Dr. H. Sidney Newcomer, E. R. Squibb & Sons, 745 Fifth Ave., New York 22, N. Y.
to the hospital because her condition was unimproved. On the day of her admission she was acutely ill and her disease continued to run an acute and toxic febrile course. At no time was a pneumococcus grown from the sputum, but *Streptococcus hemolyticus* was isolated from the fluid aspirated by thoracentesis. Treatment consisted in a combination of chemotherapy and thoracenteses. Following thoracentesis on the 33rd hospital day, ethyl iodophenylundecylate emulsion was injected through the needle into the empyema cavity to determine its size and to ascertain whether surgery was indicated at this time. On the following day a trocar was inserted and a catheter passed into the cavity. Within a few days after the catheter was inserted, the temperature returned to normal. A later visualization, on the 84th day, satisfactorily delineated a cavity much decreased in size. The patient was discharged from the hospital on her 107th day.

The visualization of the cavity on the 33rd day is shown in Figure 2. The delineation of the upper part of the cavity is inadequate, due to the use of too little medium. The patient was so acutely ill that it was inadvisable to repeat the examination with more of the contrast agent.

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**Fig. 1.** Case I. Visualization of a 63 c.c. open empyema cavity with 20 c.c. of ethyl iodo phenylundecylate emulsion, illustrating how the medium coats all parts of the cavity.

**Fig. 2.** Case II. Visualization of a closed empyema cavity by injection of ethyl iodo phenylundecylate emulsion. The presence of a coagulum of pus inhibits the distribution of the medium to some extent.
The roentgenogram shows that a considerable portion of the emulsion is collected about a coagulum of pus. It is possible that injection of saline might have given a more uniform distribution of opacity. In subsequent procedures the ethyl iodo-phenylundecylate emulsion was removed by saline lavage, and at the time of discharge the chest was free of shadows due to radiopaque medium.

Case III: E. K., a 20-month-old girl, was admitted because of abdominal pain following an upper respiratory infection of a week's duration. X-ray examination on the day of admission confirmed the
diagnosis of bronchopneumonia in the lower lobe of the left lung, and sulfadiazine therapy was started. By the third hospital day there was clinical and roentgenographic evidence of a left hydrothorax, and culture of fluid obtained by thoracentesis yielded Staphylococcus aureus hemolyticus. On the fifth hospital day the thoracentesis was repeated; Staphylococcus aureus hemolyticus was again isolated, and administration of penicillin was started, both intrathoracically and systemically. On the 15th day of the illness a trocar was inserted to permit drainage of the cavity. Following the insertion of a larger catheter on the 28th hospital day, the patient was somewhat improved and by the 35th day was having minimal drainage from the cavity. At that time about 10 c.c. of ethyl iodophenylundecylate emulsion were introduced through the catheter to outline the cavity and to ascertain whether further surgery was required. Since only a small cavity was outlined, it was felt that there was no indication for immediate surgery, but that the patient should be followed clinically and by repeated radiopaque visualization. The catheter was left in place and chemotherapy was continued. For the next twelve days the course was relatively afebrile and asymptomatic. Examination of the cavity with ethyl iodophenylundecylate emulsion was then repeated. The cavity was found to be considerably smaller, so the patient was discharged to her home on the 55th day, and was followed in the clinic thereafter.

The course of empyema thoracis in this patient is illustrated in detail in Figure 3, to show the value of the emulsion of ethyl iodophenylundecylate in following the obliteration of the cavity, and the completeness with which the medium may be removed by saline lavage.

**DISCUSSION**

Through the use of the emulsion of ethyl iodophenylundecylate the visualization of empyema cavities is much simpler and more complete than by conventional methods. After introduction either directly or through a drainage tube, the medium is distributed by the normal respiratory movements to all parts of the cavity. The presence of a coagulum of pus is a handicap, however, and the medium collects to a certain degree on the surface of the coagulum. This does not appear to interfere with the delineation of the extent of the cavity and from some aspects is helpful. When the examination has been completed, the medium may be removed almost completely by saline lavage and any small residuum appears to be absorbed in a few days.

Visualization of empyema cavities is usually conducted with iodized oils. Although the procedure is essentially simple, it is often difficult to obtain good distribution of the oil, and it is frequently hard to remove it all at the end of examination. In an attempt to improve on the use of
iodized oils, Gordon (2) in 1944 employed nebulized 35 per cent diodrast or skiodan-acacia mixtures in open empyema cavities. This procedure has the advantage that after the examination all the contrast medium is absorbed, but suffers from the disadvantage that no technic has been developed for its use in closed cavities.

Since the advent of sulfa drugs and penicillin, empyema cavities are seen less frequently, and the treatment has become far more satisfactory. When a cavity does form, however, it is desirable to visualize it completely and to follow the course of corrective measures. As Blades (3) has emphasized, the cavity cannot be considered cured until it has been obliterated.

SUMMARY

The delineation of empyema cavities through the use of ethyl iodophenylundecylate emulsion has been described in detail. The medium is easily injected, distributes itself without posturing of the patient, and is readily removed by saline lavage. Where a coagulum of pus is not present, the medium distributes itself on the walls of the cavity so that double contrast studies are obtained.

REFERENCES


DISCUSSION

Sydney F. Thomas, M.D. (Palo Alto, Calif.): These papers are quite revealing. Mucosal studies of the trachea are something we haven’t seen before and to which we are going to have to pay more attention. Mucosal studies of the urinary tract are also going to call for greater attention, because, while air contrast pyelograms have been used, they are not exactly satisfactory in the presence of non-opaque stones. This new medium should find some usefulness there.

The spreading and coating qualities of the medium are its main advantages, but another thing about it is remarkable to me is that in one or two of Dr. Strain’s cases it was completely gone at the time of the patient’s discharge from the hospital. In other words, it doesn’t stay in the alveoli like lipiodol and confuse one’s view of the chest for months.

If anyone would raise the objection that there is a possibility of the emulsion getting into the blood vessels, Dr. Strain has already stated that they have given this material intravenously with no significant toxicity and with no electrocardiographic changes; therefore probably no embolism.

We started attacking this problem in about 1942. We did it in a little different way but were not as successful in getting a uniform emulsion with a particle size as small as Dr. Strain has produced. We had no new medium, and we used lipiodol, emulsified it, and gave it intravenously. We are interested in hepatosplenography, but there is one other use that should be mentioned—placentography. I believe we are eventually going to be able to visualize the placenta—a reticulo-endothelial organ, like the spleen and liver. There should be many other uses for this method other than those which have been mentioned here. As far as sinus tracts are concerned, I think this really is a step ahead.

William H. Strain, Ph.D. (closing): I shall close by supplementing my earlier remarks a bit. We have used the emulsions for cholangiograms a number of times, and have done two hysterosalpingograms with it, I believe. Dr. Golden became interested in the medium, and at his suggestion a supply was sent to Dr. C. L. Buxton at Presbyterian Hospital in New York City. There the medium was used in some eight or nine cases for the visualization of the fallopian tubes. At Presbyterian the examination is called uterotubography, an expression which I prefer. In each case Dr. Buxton reported a fair amount of reaction, but we obtained no adverse comments from the patients examined at Strong Memorial by Dr. George Heckel. In our cases the tubes were not patent, and I understand from a telephone conversation with Dr. Buxton that in all his cases the tubes were patent. Obviously the medium requires much further clinical study, and those of you who are interested may obtain some from Dr. H. S. Newcomer of E. R. Squibb & Sons.

I suspect that for some time the emulsion will be rather difficult to get. The preparation is dependent on the supply of ethyl iodophenylundecylate (pantopaque), and this in turn is dependent on the availability of undecylenic acid. As I understand the commercial situation, the supply of this acid is currently short, due to lack of adequate stocks of castor oil and the competitive use of undecylenic acid in preparations for the treatment of athlete’s foot.
SUMARIO

El Yodafenilundecilato de Etilo en la Visualización de las Cavidades Empiématicas

Mediante la inyección de una emulsión de yodafenilundecilato de etilo (véase el trabajo anterior) se obtuvo la visualización roentgenoscópica y roentgenográfica de las cavidades empíématicas. El medio se inyecta fácilmente, se esparce sin que haya que cambiar la posición del enfermo y se extrae fácilmente por medio del lavado con solución salina. Si no hay coágulo de pus presente, el medio se reparte por las paredes de la cavidad, de modo que se logran estudios de doble contraste. Tres de los 8 casos en que se utilizó el procedimiento son descritos.