THE ASPIRATION OF STOMACH CONTENTS INTO THE LUNGS DURING OBSTETRIC ANESTHESIA*

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IN MOST texts on pulmonary complications, aspiration of stomach contents into the lungs during general anesthesia is considered under the heading of postanesthetic pneumonia. Aspiration of infected material is said to produce atelectasis, pneumonia, and lung abscess.

A survey of New York Lying-In Hospital records of patients that aspirated gastric contents during obstetric anesthesia revealed the following different diagnoses: suffocation, massive atelectasis, partial atelectasis, disc atelectasis, pulmonary infarct, aspiration pneumonia, bronchopneumonia, lobar pneumonia, virus pneumonia, atypical pneumonia, tuberculous pneumonia, pulmonary tuberculosis, fungus infection, pulmonary metastasis, drowned lung, cardiac failure, pulmonary edema, and paroxysmal tachycardia. Obviously, a better understanding of this condition is wanting.

Present Study

There have been sixty-six instances of aspiration of stomach contents into the lungs in 44,016 pregnancies at the Lying-In Hospital from 1932 to 1945. The incidence of this complication is 0.15 per cent.

An analysis of the cases is presented and followed by experimental work to clarify the pathology of aspiration, and thereby gain insight into its diagnosis, prevention, and treatment.

Analysis of Cases

The significant data in the 66 cases are summarized in Table I.

The incidence of prolonged labor was somewhat higher than that of the total clinic population, which is 10 per cent.

Obstetric Reactions

Slightly more than half of the cases had operative intervention requiring relatively longer administration and greater depth of anesthesia than those delivered spontaneously. A mixture of gas, oxygen, and ether was employed in all instances.

Aspiration

Aspiration was recorded as having definitely occurred in the delivery room in 68 per cent. In 32 per cent this complication went unrecognized until later. The character of the aspirated material in the 45 recorded cases was liquid in 40 and solid in five.

*Read at a meeting of the New York Obstetrical Society, Dec. 11, 1945.

TABLE I. ANALYSIS OF 66 CASES OF ASPIRATION

Prolonged labor,	30 hours or over		9	or 14%
Type of delivery,	Normal spontaneous		29	44%
	Cesarean section		14	21%
	Operative other		23	35%
Anesthesia,	Gas, oxygen, ether		66	100%
Aspiration,	Recorded at delivery		45	68%
	solid	5		
	liquid	40		
	Subsequently diagnosed		21	32%
	Obstructive reaction		5	8%
	suffocation	3		
	massive collapse	2		
	Asthmatic-like reaction		61	92%
Cyanosis,	Recorded		55	83%
Tachycardia,	Pulse over 110 per minute		66	100%
Dyspnea,	Respirations over 30 per minute		66	100%
Chest pathology,	Diffuse		15	23%
	Right only		51	77%
	Left only		0	0%
Morbidity,	Febrile	20		30%
	chest	8		
	pneumonia	6		
	abscess	2		
	other	12		
Chemotherapy,	Sulfonamides		14	21%
	Penicillin	3		5%
	Both	2		3%
Deaths,	Immediate	2		3%
	Later	0		0%

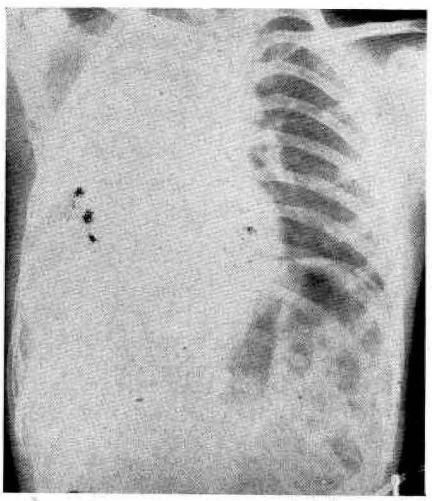


Fig. 1.—Massive collapse of right lung following obstruction by solid, undigested food. Note the mediastinal shift and homogeneous density over the collapsed area.

Obstructive reactions occurred in the five patients that aspirated solid material. Three of these had complete obstruction; two died of suffocation on the delivery table, whereas the third recovered after coughing up a large piece of meat. Two of the five patients had incomplete obstruction with massive atelectasis, and both recovered after coughing up the obstructing material. These patients exhibited the classical picture of massive collapse with cyanosis, tachycardia, dyspnea, evidence of mediastinal shift, and consolidation. Fig. 1 shows the typical chest plate in such a case. There is mediastinal shift and a homogeneous density over the collapsed area on the right side.

Asthmatic-like Reactions

A very different type of reaction was observed in the 40 patients that aspirated liquid material. For lack of any existing description, this type of reaction may best be likened to an acute asthmatic attack.

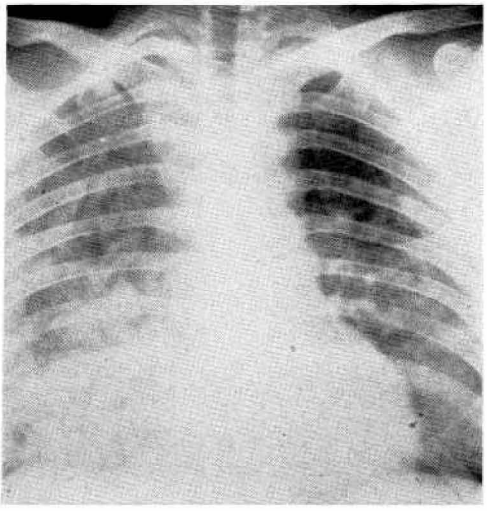


Fig. 2.—Scattered soft, mottled, confluent densities seen after aspiration of liquid gastric contents. Note the absence of any mediastinal shift.

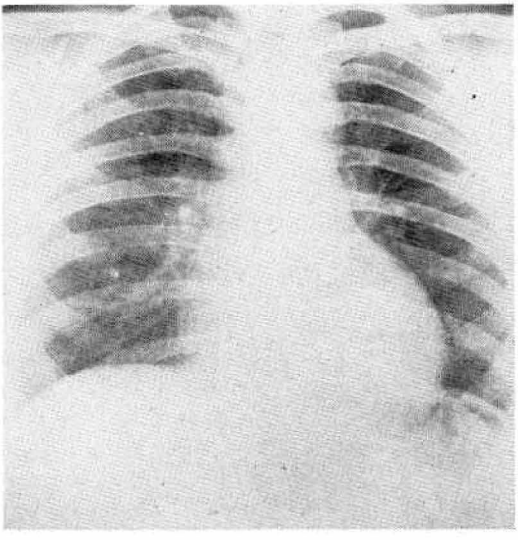


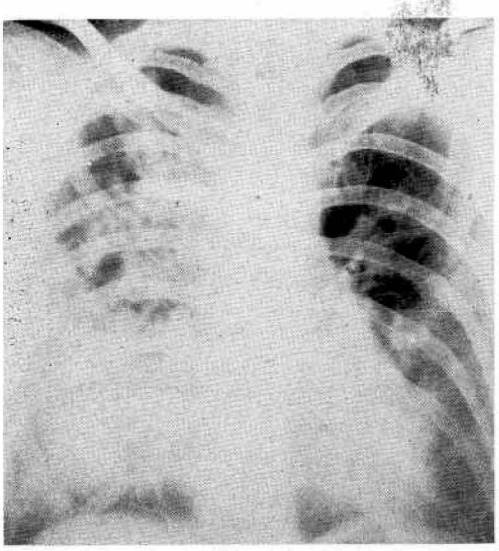
Fig. 3.—The same patient as in Fig. 2, ten days later.

Apparently liquid gastric contents were aspirated into the lungs, while the laryngeal reflexes were abolished during general anesthesia. The actual aspiration often escaped recognition. Cyanosis, tachycardia, and dyspnea developed as in the obstructive cases, but there was no massive atelectasis or mediastinal shift. Auscultation over the involved areas revealed numerous wheezes, râles,

and rhonchi. High pulse and respiratory rates were common, often reaching values of 160 and 40 respectively. Evidence of cardiac failure frequently appeared, and occasionally culminated in pulmonary edema.

The patients were critically ill during the acute episode, but there was gradual stabilization within twenty-four to thirty-six hours, and recovery was usually complete with an afebrile and uncomplicated course.

Early x-rays revealed irregular, soft, mottled densities in the involved areas, but no mediastinal shift. Subsequent films usually showed complete clearing within seven to ten days. These features are illustrated in Figs. 2, 3, 4, and 5.



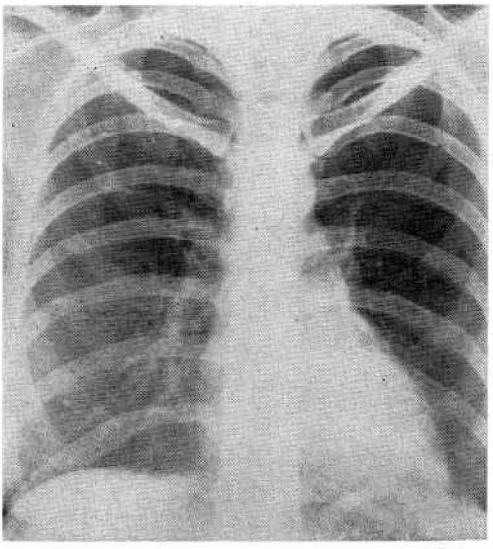


Fig. 4.—Another case after the aspiration of liquid gastric contents.
Fig. 5.—The same patient as in Fig. 4, seven days later.

Cyanosis, Tachycardia, Dyspnea

Cyanosis, tachycardia, and dyspnea occurred in most cases, regardless of the type of aspiration.

Chest Pathology

The right lung was most commonly involved in both types of aspiration. Massive aspiration, however, readily involved both lungs.

Morbidity and Chemotherapy

The morbid group includes any patient with elevation of oral temperature to 38° C. (100.4° F.) during any two twenty-four-hour periods postpartum, exclusive of the first twenty-four hours following delivery. Thirty per cent of all cases were morbid, but less than half the morbidity was attributable to chest pathology. Many cases occurred before the use of sulfonamides and penicillin, so that relatively few received this type of chemotherapy, yet only six patients developed pneumonia. Two of the pneumonia cases followed the obstructive type of reaction, and four followed the asthmatic type. One of each of these groups went on to develop a lung abscess. Fortunately all these patients recovered. Infection must be regarded as a relatively infrequent but serious secondary complication.

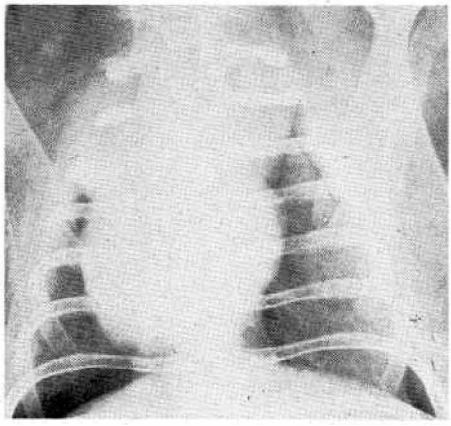
Mortality

The two deaths in the series were due to suffocation from complete obstruction by solid undigested food. Both patients had recently ingested a full meal; one eight hours previously, the other six hours previously. Autopsy obtained in the latter case revealed complete obstruction of the major respiratory passages by solid food particles.

None of the cases in the series suffered from pulmonary tuberculosis, primary organic heart disease, concurrent respiratory infection, or malignancy.

Experimental

A series of animal experiments were undertaken to determine the pathology of these two different aspiration syndromes. Anyone who has aspirated the slightest amount of fluid during a vomiting seizure will remember the intense irritation produced. It was thought pertinent to evaluate the role of hydrochloric acid.



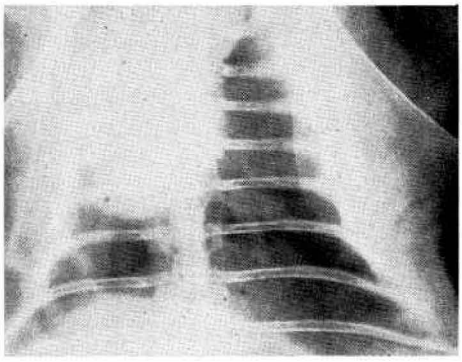


Fig. 6.—Chest film of normal rabbit.

Fig. 7.—Chest film of a rabbit after obstruction by solid undigested food. Note the mediastinal shift and homogeneous density over the collapsed area.

Various materials were introduced into the lungs of adult rabbits weighing between 5 and 6 kilograms. In some instances the material was introduced using a laryngoscope during sodium pentothal anesthesia, while in others the material was introduced directly into the trachea after preliminary tracheotomy.

The following substances were used: distilled water, normal saline, tenth normal hydrochloric acid, liquid vomitus, neutralized liquid vomitus, vomitus containing solid undigested food, and neutralized vomitus containing solid undigested food. All vomitus was obtained from parturient patients, none of whom suffered from achlorhydria. Such material was used in its acid state unless subsequently modified to a neutral pH, as previously indicated.

The experimental results may be summarized as follows. After aspiration of solid undigested food the picture is invariably that of obstruction as observed in the human. This is true regardless of whether acid or neutral material is used. Complete obstruction causes suffocation. Incomplete obstruction produces massive atelectasis. The chest film of a normal rabbit is shown in Fig. 6. Fig. 7 shows the picture with massive collapse following incomplete obstruction. Note the homogeneous density and mediastinal shift. Animals relieved of obstruction recover completely. The collapsed lung shows the typical

appearance of massive atelectasis. Practically all crepitation is gone, but otherwise the gross picture is not remarkable. There is no free fluid in the pleural or pericardial cavities. The heart and abdominal viscera are normal. The typical microscopic picture of atelectasis is seen in Fig. 8.

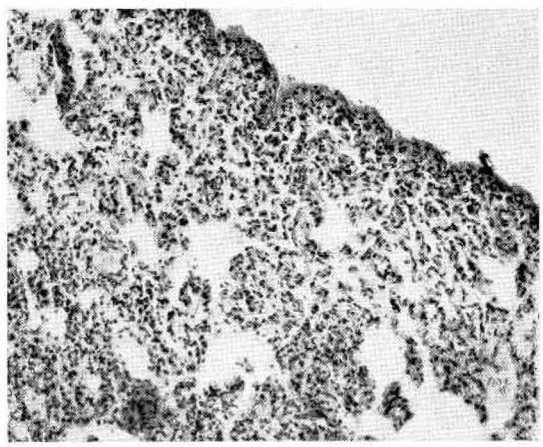
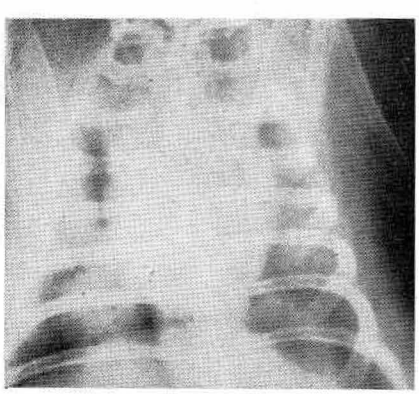


Fig. 8.—Section of a rabbit lung showing massive atelectasis.



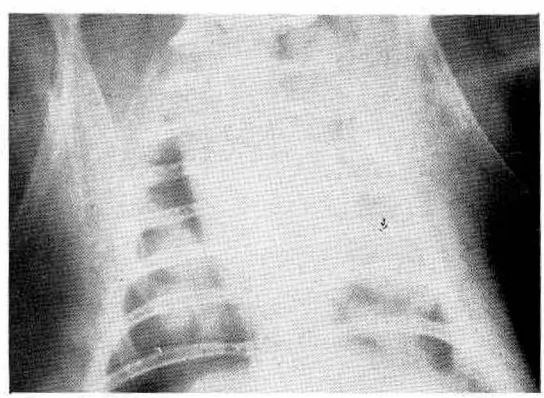


Fig. 9.—Chest film of a rabbit after aspiration of 20 c.c. of tenth normal hydrochloric acid. Note the soft, mottled, confluent densities and absence of any mediastinal shift.

Fig. 10.—Chest film of a rabbit after aspiration of 20 c.c. of unneutralized liquid gastric contents. Note the similarity to Fig. 9.

Following aspiration of liquid containing hydrochloric acid (tenth normal hydrochloric acid or unneutralized liquid vomitus) the animals develop a syndrome similar in many respects to that observed in the human following liquid aspiration. Cyanosis and labored respirations develop immediately, but death often ensues within minutes to hours, with a pink froth exuding from the respiratory passages in the terminal stages. X-rays reveal irregular, soft, mottled shadows without mediastinal shift. Fig. 9 shows the picture after aspiration of 20 c.c. of tenth normal hydrochloric acid, and Fig. 10 shows practically identical findings after aspiration of 20 c.c. of unneutralized liquid vomitus. The gross pathologic picture may be described as follows: The trachea is injected and filled with pink frothy material. The pleural cavities contain a

serosanguineous fluid. The visceral pleura is smooth with large subpleural hemorrhages, imparting a variegated color to the lungs, ranging from normal pink through all the shades of red to a rich dark purple. The darker areas are doughy in contrast to the pink areas which retain normal crepitation. The lungs are heavier than normal. Scatter emphysematous blebs are present. Fig.

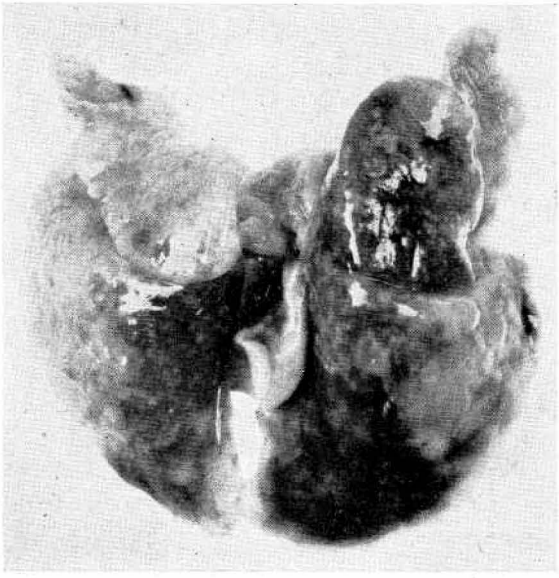


Fig. 11.—Lungs of a rabbit after aspiration of 20 c.c. of tenth normal hydrochloric acid. The darker areas are hemorrhagic and doughy.

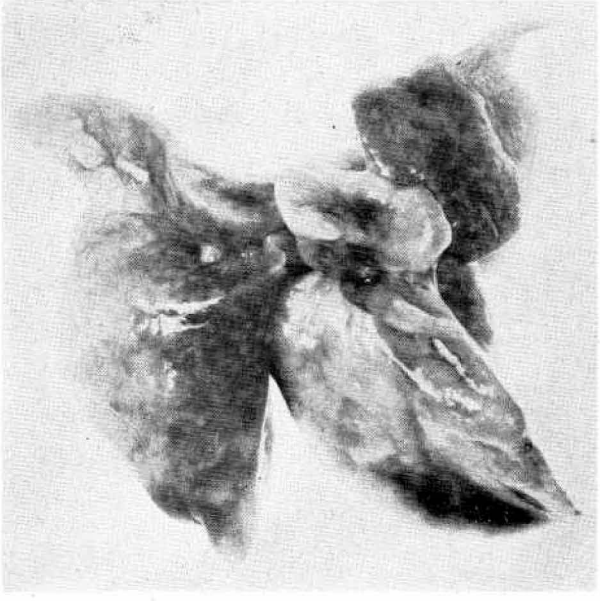


Fig. 12.—Lungs of a rabbit after aspiration of 20 c.c. of unneutralized liquid gastric contents. Note the similarity to Fig. 11.

11 shows the lungs after aspiration of 20 c.c. of tenth normal hydrochloric acid, and Fig. 12 shows a similar picture after aspiration of 20 c.c. of unneutralized liquid vomitus. On cut section the lungs exude a pink gelatinous material. The heart is dilated and shows small subpericardial hemorrhages. There is congestion of all the abdominal viscera.

Fig. 13.—Section of rabbit lungs after aspiration of 20 c.c. of tenth normal hydrochloric acid. Note the bronchiolar pattern with necrotic epithelium partly sloughed into the lumen, and the peribronchiolar congestion.

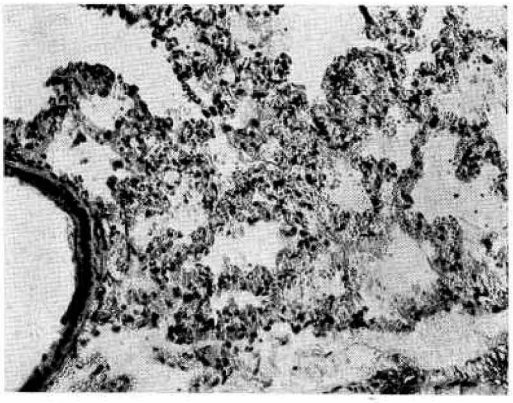
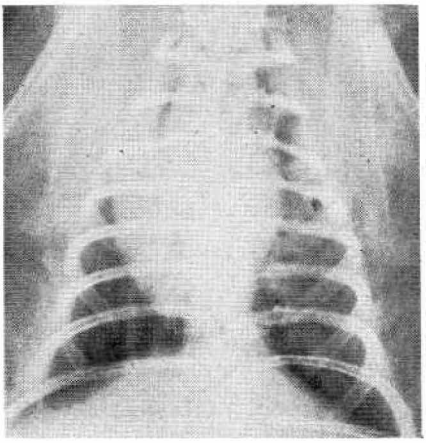


Fig. 14.—Section of rabbit lungs after aspiration of 20 c.c. of unneutralized liquid gastric contents. Note the character of the alveolar walls with pyknotic nuclei and the exudate within the alveoli.

The microscopic picture is also the same after aspiration of equal amounts of tenth normal hydrochloric acid or unneutralized liquid vomitus. The trachea and larger bronchi are congested, but the epithelium is intact. A wavy bronchiolar pattern is noted, indicative of muscular spasm. There is peribronchiolar hemorrhage and exudate with areas of surrounding emphysema. In places the bronchiolar epithelium is necrotic and sloughed into the lumen. The alveolar walls are hyaline with absent or pyknotic nuclei. Perivascular edema is marked. There is congestion and edema throughout. Figs. 13 and 14 demonstrate the above features.

Following aspiration of neutral liquid (distilled water, normal saline, or neutralized liquid vomitus) in equal quantities to the preceding series of acid experiments, the animals go through a brief phase of labored respirations and cyanosis, but within a few hours they are apparently back to normal, able to carry on rabbit activities uninhibited. There are no significant x-ray changes. Fig. 15 shows the chest film after aspiration of 20 c.c. of normal saline and Fig.



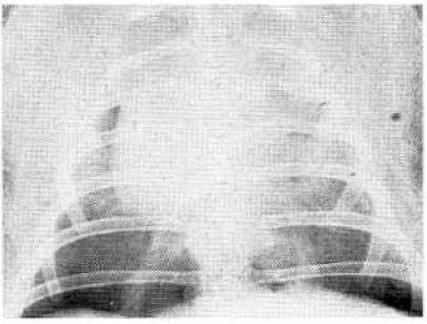


Fig. 15.—Chest film of a rabbit after aspiration of 20 c.c. of normal saline. There are no significant changes.

Fig. 16.—Chest film of a rabbit after aspiration of 20 c.c. of neutralized liquid gastric contents. There are no significant changes.

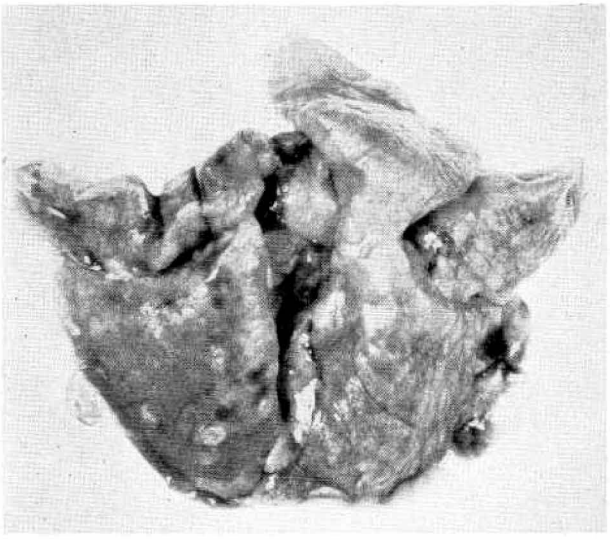


Fig. 17.—Lungs of a rabbit after aspiration of 20 c.c. of normal saline. Except for minute hemorrhagic areas, the lungs are not remarkable.

16 shows the film after aspiration of 20 c.c. of neutralized liquid vomitus. The gross pathologic changes are minimal. The trachea and larger bronchi are normal. There is no free fluid in the pleural or pericardial cavities. The lungs show minute scattered areas of atelectasis, but for the most part are crepitant throughout. Fig. 17 shows the lungs after aspiration of 20 c.c. of normal saline,

and Fig. 18 shows the lungs after aspiration of 20 c.c. of neutralized liquid vomitus. The cut surface of the lungs is normal. The heart and abdominal viscera are unremarkable.

The microscopic picture is not remarkable except for small patches of atelectasis and emphysema. There are no bronchiolar changes. Hemorrhage, congestion, edema, and exudate are absent. Fig. 19 shows a section from the lungs after aspiration of 20 c.c. of normal saline, and Fig. 20 shows a section following aspiration of 20 c.c. of neutralized liquid vomitus.

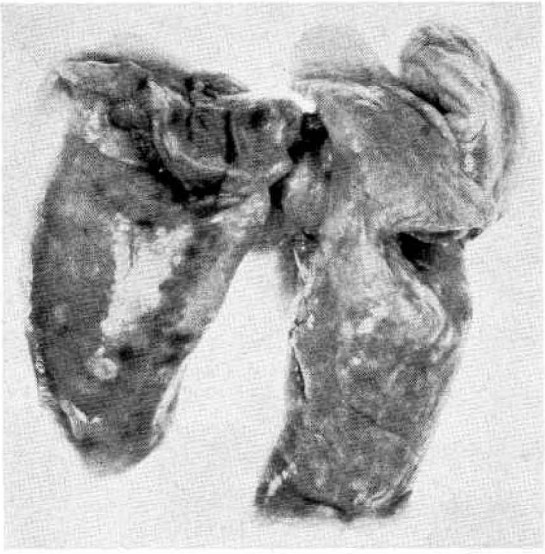
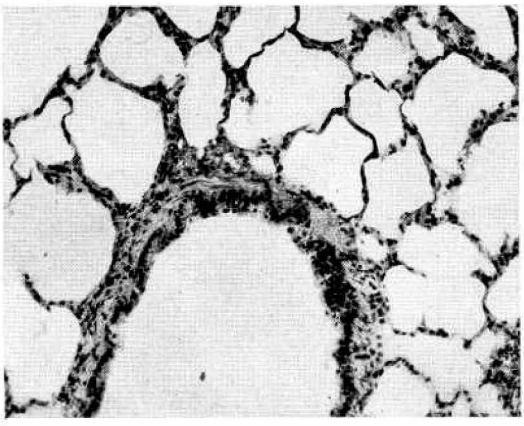


Fig. 18.—Lungs of a rabbit after aspiration of 20 c.c. of neutralized liquid gastric contents. Essentially the same as Fig. 17.



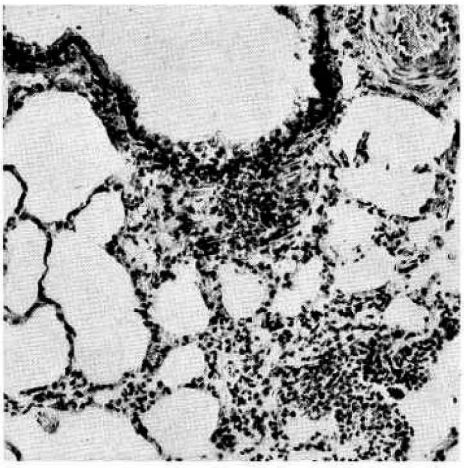


Fig. 19.—Section of rabbit lungs after aspiration of 20 c.c. of normal saline. There is slight emphysema, but otherwise the section is unremarkable.

Fig. 20.—Section of rabbit lungs after aspiration of 20 c.c. of neutralized liquid gastric contents. There is a small area of atelectasis.

Discussion

The gastric emptying time is often prolonged during labor. This applies to liquid as well as solid stomach contents. At delivery it is not uncommon for a patient to vomit food ingested twenty-four to forty-eight hours previously. As much as a liter of clear to dark green fluid has been recovered from a single patient.

Aspiration of vomitus may occur while the laryngeal reflexes are abolished during general anesthesia. Bronchial configuration favors right-sided aspiration, but massive aspiration readily involves both lung fields. Liquid material is more commonly aspirated than solid. The consistency and dimensions of solid food probably interfere with its aspiration.

This study reveals that two entirely different syndromes may follow aspiration. Aspiration of solid food usually produces the well-known picture of laryngeal or bronchial obstruction. Complete obstruction produces suffocation. Incomplete obstruction produces massive atelectasis with the classical picture of cyanosis, tachycardia, dyspnea, mediastinal shift, and signs of consolidation over the collapsed area. X-rays reveal a homogeneous density in the affected area and varying degrees of mediastinal shift. The pathology of atelectasis is well described in all textbooks dealing with the subject.

Obstruction should be promptly relieved either indirectly by external stimulation with encouragement of coughing, or directly with the aid of suction and endoscopic removal.

The value of sulfonamides and penicillin for this type of aspiration is questionable. Although the process is not primarily infectious, the seriousness of secondary pneumonia and lung abscess may make such chemotherapy worthwhile as a prophylactic measure.

Aspiration of liquid material produces an asthmatic-like syndrome with distinct clinical, roentgenologic, and pathologic features. Apparently this syndrome has escaped recognition, for to the author's knowledge it has not been previously described. There is cyanosis, tachycardia, and dyspnea, but no mediastinal shift or massive atelectasis. Wheezes, râles, and ronchi are heard over the affected portions of the lungs.

X-rays reveal irregular, soft, mottled densities without mediastinal shift. The picture has been misinterpreted as bronchopneumonia, tuberculosis, fungus infection, and even metastasis.

Progressive cardiac embarrassment and pulmonary edema may supervene, regardless of the previous normal condition of the heart. Here the diagnosis has been confused with primary cardiac failure.

The animal experiments indicate that hydrochloric acid is responsible for the changes described. The acid produces a bronchiolar spasm and a peribronchiolar congestive and exudative reaction interfering with normal intrapulmonary circulation to the extent that cardiac failure may develop.

The irritative action of hydrochloric acid on the respiratory tract has been previously studied by Winternitz,[1] specifically in reference to the action of chlorine and phosgene in war gas poisoning, but any relation to the pathology of aspiration appears to have been overlooked. The changes following aspira-

tion of tenth normal hydrochloric acid and unneutralized liquid gastric contents are similar to those following gassing with chlorine and phosgene, but there is less necrosis after aspiration, probably because of smaller concentration of the irritant.

Therapy in this type of aspiration should be directed against the bronchiolar spasm and cardiac embarrassment. Oxygen, atropine, adrenaline, and aminophylline will accomplish these objectives. Should evidence of cardiac failure develop, rapid intravenous digitalization is indicated. The circulatory burden may be further relieved by the application of tourniquets to the extremities to produce the effect of a bloodless phlebotomy.

The dramatic relief reported[2, 3] in the treatment of acute asthma by stellate ganglion block suggests that this procedure may be of value. The fundamental neurophysiology of stellate ganglion block is not clear, but the technique of performing the block is relatively simple. So far it has not been tried in the treatment of this type of aspiration.

The bronchoscope would appear to be of little value in this condition, for the pathologic process is beyond reach, and endoscopy may only increase the existent spasm and dangers of secondary infection.

The majority of patients have an afebrile recovery with complete clearing of the chest in seven to ten days. The pathologic process is primarily irritative and not infectious, but sulfonamides and penicillin may be of value in preventing secondary infection due to concurrent aspiration of nasopharyngeal flora.

It is conceivable that both solid and liquid aspiration may occur simultaneously, in which instance both the obstructive and asthmatic pictures would be found. In the present series this situation has not been encountered. Presumably the presence of any solid material so alters the consistency of the gastric contents that little material reaches the bronchioles.

It is important to appreciate that both types of aspiration are preventable. The delayed emptying time of the stomach during labor has already been discussed. The necessity of feeding the parturient has been overemphasized. Misinformed friends and relatives often urge the patient to ingest a heavy meal early in labor before going to the hospital. This food is supposed to provide strength for parturition. It is obviously dangerous to give any solid food during labor and it would be judicious to explain this to the patient during the prenatal course.

The dangers of fluid aspiration have been overlooked, for it is common hospital practice to urge water, tea, and fruit juices throughout the first stage of labor. It has already been pointed out that copious amounts of liquid may be retained in the stomach and that aspiration of liquid occurs much more frequently than aspiration of solid material.

It is common surgical practice to withhold all feeding for twelve hours or longer before any elective operation. This procedure plus the delayed emptying time of the stomach during labor probably account for aspiration being less of a surgical than an obstetric hazard. While it is true that the parturient expends considerably greater energy than the preoperative patient, it is unlikely that any serious harm would result from withholding all oral feeding for the

average duration of labor. Should fluid and caloric balance be disturbed in the event of prolonged labor, parenteral therapy is available.

Even if oral feedings were withheld during labor, it is possible that the stomach might still elaborate and retain sufficient hydrochloric acid to produce a serious aspiration hazard. This danger could be readily avoided by emptying the stomach prior to the administration of a general anesthesia. The time-honored finger in the throat method is always available, but the oral administration of a warm alkaline solution would in all probability produce the same desired effect and further obviate the dangers of residual hydrochloric acid being aspirated from the nasopharynx.

The anesthetic problem deserves special consideration. A new and inexperienced intern is frequently assigned to give obstetric anesthesia. Wider use of local anesthesia would eliminate the dangers of incompetently administered general anesthesia. Too often an active patient is rushed into the delivery room and a general anesthetic started with an opaque mask fastened over the face before information is obtained regarding the condition of the heart, lungs, or stomach. Examination of the heart and lungs is recorded on most labor sheets. The time of ingestion of the previous meal should also be recorded. This would draw attention to the possibility of a full stomach.

Once retching occurs, it is dangerous to force the anesthetic if the stomach has not been emptied. The mask should be removed, vomiting encouraged, and followed by thorough cleansing of the mouth and nasopharynx. Opaque masks are undesirable as vomitus may be concealed. It may also escape recognition if the anesthetist's attention is focused on the obstetric proceedings at the other end of the table. The anesthetist should remain with the patient until the laryngeal reflexes have returned.

Suction, laryngoscopic, and bronchoscopic equipment should be readily available in the delivery room, together with personnel trained in its use. The delivery table should be adjustable for Trendelenburg position.

Summary

Sixty-six cases of aspiration of stomach contents into the lungs during obstetric anesthesia are analyzed. The incidence of this complication is 0.15 per cent in 44,016 pregnancies at the New York Lying-In Hospital from 1932 to 1945.

Two distinct aspiration syndromes are described. The clinical, roentgenologic, and pathologic features of each are reproduced in the rabbit, and inferences drawn regarding diagnosis, prevention, and treatment.

Conclusions

1. Gastric retention of solid and liquid material is prolonged during labor.

2. Aspiration of vomitus into the lungs may occur while the laryngeal reflexes are abolished during general anesthesia.

3. Bronchial configuration favors right-sided aspiration. Massive aspiration, however, readily involves both lungs.

4. Liquid material is more frequently aspirated than solid.

5. Aspiration of solid material usually produces the classical picture of laryngeal or bronchial obstruction.

6. Aspiration of liquid produces an apparently hitherto unrecognized asthmatic-like syndrome with distinct clinical, roentgenologic, and pathologic features. This syndrome is due to the irritative action of gastric hydrochloric acid, which produces bronchiolar spasm and a peribronchiolar exudative and congestive reaction.

7. Aspiration of stomach contents into the lungs is preventable. The dangers of this complication as an obstetric hazard may be avoided by: (a) withholding oral feeding during labor and substituting parenteral administration where necessary; (b) wider use of local anesthesia where indicated and feasible; (c) alkalinization of, and emptying the stomach contents prior to the administration of a general anesthetic; (d) competent administration of general anesthesia with full appreciation of the dangers of aspiration during induction and recovery; (e) adequate delivery-room equipment, including transparent anesthetic masks, tiltable delivery table, suction, laryngoscope, and bronchoscope; and (f) differential diagnosis between the two syndromes described, and prompt institution of suitable therapy.

NOTE.—The factors used in the animal x-ray experiments were: 50 kilovolt peak, 36 inches, 3 seconds, 40 milliamperes, using a cassette and Bucky diaphragm.

The author wishes to thank the members of the Lying-In staff for permission to use the private cases included in this study. Acknowledgment of technical assistance in the animal x-ray work is expressed to Miss Mildred Powlitis.

References

1. Winternitz, M. C.: Collected Studies on the Pathology of War Gas Poisoning, New Haven, 1920, Yale University Press.
2. Leriche, R.: De L'action Vaso-dilatatrice de la novocaine, La Presse Medicale, November, 1938: 1626.
3. Malherbe, A.: L'infiltration Novocäinique des Ganglions Stellaires dans L'asthma Nasal et Bronchique, La Presse Medicale, October, 1939: 1398.

Discussion

DR. PALUEL J. FLAGG (by invitation).—I would like to present several observations. It seems to me that these accidents may be divided into the acute emergency, the asphyxial accident that occurs on the operating table, and the postasphyxial problem presented by the aftercare. It seems strange to me that there is no anesthetist on this program, as it largely is an anesthetic problem. It confirms an impression I have had for a long time, that we need a pneumatologic service in our hospitals, and that means a group who will care for the administration of gases, for the control of open anesthesia and, of course, we include local and basal anesthesia and other methods of general, as well as the use of gases for resuscitation, and the use of gases for inhalation throughout all the postasphyxial stage.

The pathology that has been described here seems to line up very closely with the pathology we meet with in anoxia. The studies as to the effect of hydrochloric acid are rather new, but the other phenomena that were described are quite usual in anoxic anoxia and obstructive asphyxia.

I desire to present a case which bears out the need of the triple service which I have referred to.

The operation was a cesarean section, done Jan. 9, 1940. No premedication. Gas-oxygen-ether anesthesia was used. Induction was smooth—relaxation early; pronounced salivation; high oxygen concentration maintained to the delivery of the infant, which was somewhat dusky in appearance, but breathed spontaneously.

As the uterus was being closed I noted that the patient's respiratory tidal volume was shallow, that the rate was up, and that it was difficult to oxygenate the blood with concentrated oxygen. There seemed to be some form of respiratory obstruction. Filling the bag with pure oxygen produced no effect on the patient's color. The obstruction was not the kind that produces cyanosis or labored breathing, but there seemed to be something interfering with the interchange of air. The patient was laryngoscoped, and I noted gastric contents in the pharynx and dark brown gastric contents escaping from the glottis. I intubated at once a No. 7 endotracheal tube and practiced endotracheal suction, the intubation taking place without any resistance. The glottis was open. Endotracheal suction resulted in the removal of a large quantity of gastric contents from the trachea and bronchi. Respiration improved and the color returned. The respiratory rate remained increased until the patient was returned to bed. Twenty-four hours after operation the patient developed a cough with expectoration, increased respirations, and pain in the chest. Examination of the sputum showed Type XVIII pneumococcus. She was put in a tent and given sulfonamides. In order to raise the tent oxygen concentration two tanks of oxygen were used simultaneously, so that we were using 25 to 30 liters of oxygen a minute. With this delivery a tent concentration of 50 to 60 per cent of oxygen was maintained. In other words, there is no point in giving oxygen unless you are getting a flow which is sufficiently high to reduce the asphyxiation. The respirations throughout were never labored, nor did they exceed 32 a minute. There was no bloody expectoration, and the color was satisfactory at all times. The use of the tent was discontinued on January 15, and the patient had recovered completely.

After the patient had been returned to bed there was pronounced aphonia, and she complained of distress on coughing. On entrance to the hospital the hemoglobin had been 60 per cent; it dropped to 47 per cent, and then returned to 60 per cent. An admission the red blood cells had been 3,800,000; they dropped to 2,900,000, and then returned to 3,800,000.

This case suggests the following comments:

The patient was properly prepared for operation, and yet there was enough fluid in the stomach to drown her. Mouth suction should always be at hand during obstetric anesthesia and, by being at hand, it should be turned on, and the suction tube should hang on the operating table where it can be reached and used instantly. It is not a question of merely having the apparatus; it should be on hand so it can be used if necessary.

Aspiration of stomach contents may take place without cough or struggle.

If a mask is strapped to the patient's face, preventing the escape or knowledge of gastric regurgitation, drowning may easily take place.

A laryngoscope should be at hand in every operating room and the anesthetist should be familiar with its use.

An oxygen tent is useless unless it contains the required oxygen. This should be constantly and accurately determined by the attending pneumatologist or pneumatologic technician.

DR. JAMES R. MILLER.—For the last eight years we have had in the Hartford Hospital a well-conducted "pneumatologic" service. During this time we have had 26,764 deliveries with 24 deaths, or 1 per 1115. We have had no asphyxial deaths, although several times a year we come near to it. The anesthetists are under the control of men who are skilled in the use of the laryngoscope, and suction, piped in the wall, is at hand.

There have been six deaths which occurred during or at the time of delivery or soon thereafter. One was in a cesarean section, a cerebral vascular accident; one was in a case of toxemia which should not have been operated upon, but would have died in either case; one was a spinal anesthesia death, in which the procedure was used under the protest of the anesthetist; one was a rupture of the uterus before admission; another was a severe toxemia; and one other was a rupture of the uterus, with possibly an associated aspiration, though no autopsy was done; and the last one died undelivered with a massive pulmonary embolism, proved at autopsy.

We feel very strongly the necessity of having a well-coordinated physician-controlled anesthesia department which is in control of all the pneumatologic and transfusion services.