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Factors in S.P.F. Program . . .

Substitutes Needed For Biological Protection

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The most common means of spread of many of the common endemic diseases of swine is by transmission from the dam to her offspring during the first few days of life. In the great majority of cases the swine fetus is free of all organisms until it passes the cervix. Utilizing adequate technique, pigs can be delivered surgically and removed to rearing areas without exposure to swine organisms.

Such pigs are extremely susceptible to a variety of normally non-pathogenic organisms in their environment. A high percentage develop diarrhea and die from the third to the tenth day of life. This can be prevented by institution of mechanical barriers to prevent contact of the pigs with the majority of organisms. This technique has been described by Young and Underdahl (1951 and 1953) and by Young et al. (1955) as well as others and forms the basis for procurement of foundation stock for the current S. P. F. program.

In the course of the present work the possibility of supplying protective factors that would allow the baby pig to cope with the normally non-pathogenic organisms present in its environment was investigated. This may be envisioned as the substitution of biological protection for mechanical barriers to secure survival of the pigs for the first few critical weeks of life. The principal advantages of such a biological protection system is the reduced expenditure necessary for rearing facilities, the better adaptation of such pigs to conventional early weaning rearing procedures and the saving of valuable dams for additional litters.

Methods and Results

The physical facilities adapted for this study were modest although adequate. Aseptic surgery was done in one area and the pig was immediately passed by the surgeon into a positive pressure isolation cubicle through a tight-fitting sliding door. The pigs took their first breath in this collection cubicle. After the necessary attention, the pigs were removed from the collection room without exposure to the surgical area and were transported to a rearing area well removed from swine.

Breeding histories and dates were available on the sows. The usual procedure was to allow the sows to go until evidence of impending parturition before performing surgery. This was evidenced by milk let-down, restlessness or nest building. This entailed considerable observation of the sows and was materially assisted by the familiarity of one author (T.J.M.) with the various lines of sows. It is estimated that the great majority of pigs

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were delivered within 12 to 36 hours of natural birth. The range of days from the last breeding date to surgical delivery of the pigs was 111 to 118 days with the majority falling between 112 and 114 days. This observation is based on over 150 sows.

The sows were hauled to the surgery building, restrained, scrubbed and the right lateral abdominal area shaved. The surgical site was thoroughly disinfected. Two or three rows of deep infiltrations of 2 per cent procaine were made in the region of the surgical site. An attempt was made to infiltrate to the peritoneum. Caution was used to avoid penetration of the uterus.

Several attempts were made to utilize tranquilizers and pentothal sodium anesthesia of the sows, but in most cases these drugs caused undesirable depression of the pigs so their use was discontinued. Two attempts to employ epidural anesthesia were unsuccessful although some surgeons have reported favorable results with this technique in swine.

The sow was then moved into the surgery area. An exhaust fan was placed a few inches from the sow's nose and the sow's head and nose and the exhaust fan were covered with a plastic drape. This was done to exhaust respiratory aerosols from the sow out of the room.

During the period the sow was being prepared, three surgeons, usually one of the ambulatory clinicians and two senior veterinary students, scrubbed and prepared themselves for the surgery. Caps, masks, gloves and long sleeve operating gowns were consistently used. The use of long sleeve gowns to cover the arms was considered essential because in many cases it was necessary to reach into the peritoneal cavity up to the elbow in search of pigs in the gravid uterus.

The use of a plastic surgical film (Vi-Drape)* over the operative site was used on every case. This film was adhered to the skin by a spray-on aerosol adherent (Vi-Hesive)*. Within fifteen seconds the material was sufficiently dried to create a bonding surface that firmly secured the film to the skin. The sow was then completely covered by a 6' x 8' sterile muslin drape. These drapes were especially made for this operation. An opening 4” x 12” in the center of the drape was placed over the plastic film. Sterile hand towels were placed and secured around the drape opening with towel forceps. The sow was then ready for surgery.

An elaborate array of surgical instruments was not necessary. The following instruments have been sufficient:

- 2 Bard-Parker No. 4 surgical knives with No. 20 blades
- 2 Surgical scissors—1 curved, 1 straight
- 6 Towel forceps
- 1 Needle forceps
- 6 Hemostats
- 2 4” Atraumatic needles
- 2 Curved cutting needles
- 4 x 4 gauze packs
- No. 3 Chromic Catgut
- No. 1 Chromic Catgut
- Heavy Linen suture
- Alligator electrical clamps
- 1 Blunt curved bistoury
- A bold eight-inch initial incision was made in the right paralumbar fossa. No attempt was made to avoid blood vessels. Those which were incised and hemorrhaging were clamped off with hemostats. Each muscle layer was carefully incised and as the incision approached the peritoneum the retroperitoneal fat came into view. This fat was removed by means of a curved scissors. When the fat was removed the peritoneum appeared. By having the fat removed, the peritoneum was sutured more easily when the surgery was completed. The peritoneum was grasped by a hemostat and a small incision made. A blunt curved bistoury was inserted in this small peritoneal opening and a six to seven inch opening completed. Caution was necessary at this point. Since the sow was not under the influence of general anesthesia, struggling frequently occurred. If this did happen intestines

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were forced out of the peritoneal cavity and all surgical hands were needed to keep things in place. In spite of the struggling, which varied from sow to sow, in no case was it impossible to cope with the problem of controlling the prolapse of the intestines.

The gravid uterus was directly within the peritoneal opening. The pig nearest to the incised opening was brought out. A longitudinal incision was made in the uterine wall over the anterior end of the pig. As the pig was removed from the uterus, pressure was brought to bear on the pig’s throat so as to prevent the pig from taking its first breath in the operative atmosphere. As soon as the pig was removed from the uterus an alligator type electric clamp was placed on the umbilical cord within an inch of the umbilicus. The cord was manually severed and the pig was quickly passed through a sliding door into the pressurized module.

If the cesarean operation was performed within a few hours of normal birth the fetuses would usually pass through the uterus quite readily. In many cases only one incision in each horn was necessary. If difficulty was encountered in sliding the pigs through the uterus, several uterine incisions were required to deliver the pigs. It was almost impossible to pass pigs through the bifurcation. Therefore, when the bifurcation was reached no attempt was made to force pigs through it. As soon as the ovarian end of the uterus was reached, care was taken not to apply additional traction. Rupture of the ovarian artery could easily occur and death of the sow would quickly follow.

No attempt was made to remove the placenta. If a portion of the placenta became detached that portion was removed. All mummified fetuses were removed if they were encountered. No. 1 chromic catgut, using a straight atraumatic needle and a single row of infolding right angle Cushing sutures, was used to close each uterine incision. Continuous sutures of No. 3 catgut were used to close the peritoneal cavity and muscular layers. Interrupted linen sutures placed every inch in the skin completed the surgery.

Post operative care of the sow has been insignificant. A few sows were given 75 mg. of diethylstilbestrol with the thought that this drug would facilitate the removal of the placenta. This practice was discontinued when it was learned that the placenta would pass on its own within twenty-four to forty-eight hours. The need for therapy in these sows was seldom necessary. Most sows were ready to eat the following day. Milk flow would usually start within twenty-four hours after the surgery and many of the operated sows have been used to nurse orphaned and extra pigs. Over thirty cesarean sectioned sows have been rebred and operated the second time. Five or six sows have had cesarean sections a third time. No evidence of abdominal adhesions has been observed.

As the pigs were passed into the collection cubicle by the surgeon they were received into a sterile towel. The membranes and fluids were rapidly wiped from the nostrils and mouth and the pig was gently but firmly swung, head down, in a short arc to remove excess fluids from the respiratory tract. Respiration usually started during the first or second time the pig was shaken. The pig was then rubbed dry and placed in a front opening egg incubator operating at a temperature of approximately 95° F. Adequate towels were placed on the floor of the incubator to insure firm footing for the pigs.

After the entire litter had been collected the umbilical cords were ligated with sterile string. Care was taken to ligate the cord high enough to include a ring of skin. It was necessary to avoid closure of the prepuce in boar pigs. As an added precaution, about three-fourths of an inch of the cord below the ligature was crushed 2 or 3 times with an angiotribe and the excess cord removed. Subsequent removal of the ligature was not necessary as it dropped off when the pigs reached 7 to 10 days of age. Failure to include the skin in the ligature often results in development of umbilical hernias. The stump of the umbilicus was treated with tincture of iodine. The pigs were then transported in the incubator to the rearing area.
Two completely different systems of rearing the pigs have been utilized. The first was rearing on an artificial diet and the second was rearing on disease controlled foster sows. The latter system could not be utilized until a repopulation program had progressed to the stage that first generation sows were farrowing. In addition it could be economically utilized only in those cases where the surgically delivered pig was of enough genetic value to warrant the loss of the naturally farrowed pig.

The physical facilities utilized to hand rear the pigs were either isolation rooms or a modified chicken brooder house adequately removed from any swine. The rooms had provisions for heating to 80° F. Some of the units had washing facilities while others did not. The pigs were housed for the first 10 days of life in individual 24-dozen cardboard egg cases. These were bedded with about 2 or 3 inches of clean woodshavings. The egg cases were placed side by side on a bench and a light bulb or heat lamp was suspended above each box and adjusted so that there was an area of the bedding heated to about 85° or 90° F. The pig could move from this area to cooler areas if desired. Provisions were made for the caretaker to change into clean coveralls and boots and to wash his hands and boots in disinfectant before caring for the pigs. The rearing room, complete with assembled boxes and supplies, was fumigated with formaldehyde gas prior to introduction of the pigs.

Immediately after arrival at the rearing area, the pigs were placed in individual boxes. They were fed, by stomach tube, 10 ml. of a commercial swine serum concentrate. The stomach tube used was one-eighth inch O. D. Tygon tubing that had been soaked in alcohol to impart increased rigidity. Five ml. of the serum concentrate and 2 ml. of a polyvalent Clostridium perfringens antitoxin were administered subcutaneously.

Two different serum concentrates were used but the one preferred* was a 2X concentrate containing primarily beta and gamma globulin. This product underwent chemical fractionation, pasteurization, filter sterilization and contained a preservative. Samples of this product cultured on several different bacteriological media failed to yield organisms. No Mycoplasma sp. could be isolated. No viruses were detected in primary swine kidney cell cultures. In addition the subcutaneous administration of this product produced the least shock in the pigs, although about 5 percent evidenced some shock. All such pigs recovered. In addition each pig received 2 mg. of vitamin K orally.

The pigs were fed two different rations. One was the cow’s milk based ration suggested by Young and Underdahl (1951). The second was S. P. F. - lac®. This latter ration appeared to be adequate and was very convenient to use. The pigs were fed in disposable paper dog watering dishes. The dishes were placed in a concrete form to secure them while the pigs drank. The pigs were fed 4 times daily for the first ten days. In general, the pigs were drinking the milk well by the second or third feeding. After the pigs learned to drink they were fed all the milk they would drink in a 3 to 5 minute period. The dishes were then removed and incinerated.

The boxes were not cleaned or changed for the first 10 days although additional shavings were added from time to time. At about 10 days of age the pigs were removed from the boxes and placed in groups of 4 to 5 in open pens in the room. About 1½ to 2 sq. ft. of space was available per pig. Water and a complete pig starter ration was available to the pigs in these pens. Two types of floors were used. The first was a solid wood floor bedded with shavings. The second was a wooden slat flooring with no bedding. The bottoms of both pens were several inches above the room floor. The pigs were more comfortable and did better in the bedded pens although more labor was required to clean the bedded pens.

The night feeding of milk was eliminated when the pigs were grouped. In another 3 or 4 days the noon feeding was eliminated. The milk feeding was discontinued when the pigs were about 3½ to 4 weeks of age. At 5 weeks of age the pigs were transferred to clean, isolated pens.

* Stericon—Allied Laboratories
* Bordon Co.
ventional early weaned pig rearing quarters. The creep feeds used were high in milk and milk by-product rations (30-40%). A pelleted feed was most satisfactory as the meal caked in the feeders. At five weeks of age the pigs usually weighed 12 to 15 lbs. and were quite vigorous.

Fourteen groups of pigs have been reared during the course of this work. Slightly over 85 percent of the approximately 145 pigs survived to 5 weeks of age. With the exception of 2 or 3 extremely small pigs that were destroyed, no attempt was made to select large pigs.

The rearing of pigs on disease controlled foster dams gave a more nearly normal sized pig. The foster dam was preferably farrowed in a farrowing crate placed in a conventional farrowing pen. The surgically derived pigs were transferred to the foster dam as soon after farrowing as possible. Best results were obtained when the transfers were made within 48 hours after farrowing. The naturally farrowed pigs were removed from the sow and the sow was treated with purified oxytocin principle. A few minutes later the foster pigs were quietly placed with the sow 1 or 2 at a time. If the sow had just farrowed, the use of milk letdown hormones was not necessary. Care was taken to get the foster pigs to nurse soon after being placed with the sow. With good dispositioned sows there were no serious problems getting the sows to claim the foster litters.

The foster litters usually grew as rapidly as naturally farrowed pigs. The main precaution observed for the first several days was to keep the pens well cleaned. In fact, no foster dam transfers should be attempted in anything but well cleaned buildings and no transfers should be attempted in farrowing houses where diarrhea exists in the young pigs. It is estimated that the mortality rate in the foster litters has been about 1 or 2 pigs per litter greater than would have occurred in naturally farrowed litters. This observation is based on well over 100 foster dam transfers. At 8 weeks of age the foster dam reared pigs will usually weigh 45 to 60 lbs. and appear like naturally farrowed pigs. However, they will still experience very exaggerated reactions when placed on ascarid ova infected pastures.

Well over 200 litters have been delivered surgically. Eight of the sows have died. Of one group of approximately 150 purebred sows under close observation, 75 percent have been used to rear the litters of grade, disease controlled sows. In general, the sows passed the placenta within 24 to 48 hours after surgery. At this time, a nearly normal milk supply was present and the sow would actively call for the pigs. If pigs are placed with the sow at this time, she will readily accept and rear them.

The conception rate of sows that have been operated on has been lowered by an estimated 15 to 20 percent. Sows that have nursed litters tend to have normal estrus cycles after weaning of the pigs. Sows that did not nurse pigs often came in estrus 5 to 8 days after surgery, but subsequently had a somewhat lengthened estrus cycle before returning to normal.

Discussion

It was possible to hand rear surgically delivered baby pigs in inexpensive open boxes when adequate biological protection was provided the pig. The surgically derived pigs nursing a foster dam after she had farrowed and been nursed by her litter for 2 or even 3 days still obtained enough biological protection from the milk to be able to survive under clean farrowing house conditions. A limited number of pigs a few days old and 3 weeks old reared by both of these systems did not have normal serum protein patterns when evaluated by means of electrophoresis. At 3 weeks of age the gamma globulin level was approximately one-third that of naturally farrowed colostrum fed pigs. Therefore, it appears that the system described does not furnish the pig with the same degree of protection that it receives from colostrum but does give the pig enough protection to survive the first few critical weeks.

One of the primary weaknesses of the open box-hand rearing system developed in this work was its simplicity. This may encourage people to attempt to utilize it
for disease control who do not appreciate or practice the isolation or quarantine measures necessary to prevent introduction of swine diseases into the pigs. Nevertheless, it appears that there should be many cases where this technique can be utilized.

Summary

A technique for rearing surgically derived baby pigs either on disease controlled foster dams or in open cardboard boxes is presented. The surgical procedure utilized is described. Utilizing this technique about 96 percent of over 200 sows have survived.

The pigs reared in open boxes were given sterile porcine beta and gamma globulin containing serum concentrate, both orally and subcutaneously, to afford them with enough biological protection to cope with their environment. About 85 percent of 145 pigs contained in 14 groups have been reared to 5 weeks of age by this procedure.

Experience gained in transferring over 100 litters of surgically derived pigs to disease controlled foster dams is presented. Such pigs grew as rapidly as naturally farrowed pigs, but there was an increased mortality of 1 to 2 pigs per litter.

Sows delivered by cesarean section had a 15 to 20 percent lower conception rate on subsequent breeding than those that farrowed naturally.

REFERENCES

