A STUDY OF INFUSIONS DURING PARTURITION

by

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CHAPTER 1

INTRODUCTION

Introduction to the Problem

Post infusion phlebitis is a common sequel to intravenous fluid administration. The pathogenesis is far from clear. Although phlebitis usually persists less than a week after infusion, it may remain a problem for several months. The routine use of intravenous therapy in the hospitalized patient makes this a problem of current concern.

Factors which have been suggested as contributing to phlebitis include various forms of mechanical injury to the vein as:

1) a sharply beveled or dull needle

2) a restless patient

3) an improperly anchored needle or catheter

4) distention of the vein by injection fluid under pressure.

However the literature does not fully support these factors.

Among the factors proven to be of more importance is the length of time the infusion is left in place. In a study of 1048 patients with intravenous infusions by Hastabacka, Tammisti, Elfing and Tiitinen (13) the incidence of phlebitis was found to be directly

proportional to the duration of the infusion regardless of the type of needle or catheter used.

In a study completed by Druskin and Siegil (5) it was concluded by the researchers that there is a correlation between the time the catheter is in the vein and the incidence of positive cultures. The researchers found no demonstrable relationship between positive cultures and the use of antibiotics.

The relation of vein size to the size of the infusing needle or catheter is also important. If a needle or catheter completely fills a small vein and obstructs blood flow, the infusate can not be immediately buffered by the blood, as it would in a larger vein. The sclerosing potential of the infusate is thus exerted directly upon the venous endothelium. Solutions that are high in potassium, calcium, concentrated sugar solutions, certain antibiotics and most tumorcidal drugs are among those known to be sclerogenic. (11)

Most commonly used glucose solutions have a pH of about 4.0 to 4.5. The pH must be kept between 3.0-5.0 to prevent carmelization and degradation during sterilization. The neutralization of the solution after sterilization by the addition of bicarbonates or other buffers would violate the sterile seal. Neutralized buffers are not stable for more than one to three days so buffered infusion solutions have not been prepared commercially for clinical use. Fonkalsrud completed a study which indicated that post infusion phlebitis could be

reduced by as much as one third by the addition of buffers by hospital personnel. (12)

A survey was completed by the researcher in a general county hospital to estimate the occurrence of infusion phlebitis. It was found that 15 of the 34 patients with infusions had some degree of clinical phlebitis. Six of the thirteen patients on the post partum unit who had had infusions had clinical phlebitis. (See table 1)

Table 1

Incidence of Clinical Phlebitis

Area	Patients with infusions (N=34)	Patients with Phlebitis (N=15)
Surgery	6	3
Infected Surgery	7	3
Medicine	8	3
Obstetrics	13	6

Approximately 130 deliveries are done at this hospital each month. An infusion of five per cent dextrose in distilled water is started by the physician on call duty when the patient is admitted to the labor room. A #15 angio catheter is usually used to deliver this solution. This first infusion is discontinued after the birth of the baby and a second bottle of 1000 ml. of five per cent dextrose in distilled water is started. Twenty units of pitocin are added to the second bottle which is discontinued when the mother is taken to the post-

partum ward and the remaining infusate in the second bottle is absorbed. The total infusion is usually completed within 24 hours. The survey indicated that phlebitis was a problem for the obstetric patient. Because of the similarity of the population group and the similarity of the composition of the infusate they received, this department was chosen as the locale of a larger study.

Purpose of the Study

The purpose of the study was to determine if bringing the acid pH of commercial glucose solution to the pH of blood would reduce the incidence of post-infusion phlebitis.

Criteria for the Selection of the Study Population

The study was done on obstetric patients receiving identical infusions. The infusions were started in the hand or forearm using standard technique and equipment. The reliability of the study was influenced by:

1. Homogenity of population
    a) same sex
    b) similar age group
    c) similar health history
2. Similarity of length of time the infusion was in place and the rate of flow of the solution.

3. Use of similar technique in preparing the skin and inserting and anchoring the needle.
4. The use of similar materials.
   a) #19 scalp vein needles were used on all patients.
   b) Five per cent dextrose in distilled water was started on all patients.
   c) All patients received identical additives.

Definitions

Phlebitis was defined as erythema occurring around the site of intravenous infusions for the purpose of this study.

A #19 scalp vein or butterfly needle is a thin walled steel needle with an inner bore of the standard #18 gauge needle.

Methodology

This was a double blind study in which obstetric patients were randomly assigned to the experimental group or control group according to a randomizing schedule furnished by Abbott Laboratories. (Appendix A) Abbott Laboratories also supplied identical appearing vials marked A and B which contained either 20 ml. of distilled water or 20 ml. of Neut, a one per cent sodium bicarbonate solution. (2.4 mEq.) The hospital pharmacy received the vials and removed the identifying labels leaving only the coded identity. The pharmacist

was the only one who knew the identity of the vials until the study was completed.

An infusion of 1000 ml. of five per cent dextrose in water is routinely started on all patients in active labor in this hospital. The study population included those patients whose infusions could be started in the left or right forearm or hand with a #19 scalp needle. The physician on call duty started the infusions after using a 70% alcohol skin preparation. The labor room nurse added vial A or vial B to the infusions according to the randomizing schedule and marked the patient's name by the letter of the vial she had added. The experimental group received the one per cent sodium bicarbonate solution which changed the pH of their infusions from approximately 4.4 to 7.2. The control group received distilled water in their infusions which left the pH relatively unchanged. The labor room nurse marked the infusions to run at a rate of 100 ml. per hour. After delivery of the placenta, the first bottle of 1000 ml. of five per cent dextrose in water was replaced by another bottle of 1000 ml. of five per cent dextrose in water with 20 units of pitocin and a vial of Neut or control. Those who had received control originally again received it at this time. The bottle containing the pitocin was marked by flow tape to run at 200 ml. per hour.

The infusion sites were checked for erythema within 24 hours after delivery and each day the patient remained in the hospital. The

observations were recorded by a set scaled criteria as follows: 0 phlebitis indicated complete absence of erythema, 1+ phlebitis indicated erythema up to three centimeters, 2+ phlebitis indicated erythema between three and six centimeters, 3+ phlebitis indicated an erythematous area larger than six centimeters. Other studies have included pain as a criterion but the researcher felt that this was too difficult to measure with any accuracy.

The study was conducted in a general county hospital. The obstetric department had an average daily census of 28 patients with approximately 130 deliveries per month. Permission to carry out the study was obtained from the Chairman of the Department of Obstetrics and Gynecology and from the Director of Nursing Services at the hospital. The researcher oriented the residents, interns, and nursing staff to the study. The materials were supplied by Abbott Laboratories.

Limitations

The study was limited to those patients admitted to the labor room from August 10 to October 30 of 1970. Patients in active, uncomplicated labor whose infusion could be started in the wrist, hand or forearm with a #19 butterfly needle were admitted to the study. Excluded from the study were any patients with complications and those whose intravenous could not be started with the #19 butterfly

needles. The only additive was oxytoxin. The amount of activity of the patient was a variable which could not be controlled.

The results of the study could not be generalized to patients with a variety of illness. The study included only obstetric patients.

CHAPTER II

REVIEW OF THE LITERATURE

The review of literature included animal and human studies. The specific areas included were infections due to infusions, physiological changes caused by infusions and the effects of buffering of the infusate.

Infection

The minimum amount of potent pyrogen which can cause a reaction in man is one and one tenth microgram. (6) This minimal pyrogenic dose represents about 1,000,000 bacteria. One bacterium requires 20 hours to multiply to 1,000,000 bacteria. The skin has 10,000 bacteria per square centimeter. A one minute skin preparation with 70 per cent ethyl alcohol will reduce the bacterial count 75 per cent, from 10,000 bacteria to 2,500 bacteria per square centimeter. A 20 gauge needle has a cross sectional area of 0.062 square centimeter. The area of skin that would be penetrated by a needle of this size would harbor 62 bacteria, or after the one minute skin preparation with 70 per cent alcohol the skin would have only 15 bacteria. It is estimated that only five organisms would actually enter the body with insertion of the beveled needle through the skin surface. (16) This small number of bacteria which are introduced by infusion

needles means that the skin is probably not the primary factor in phlebitis. The pathogens introduced at cannulation take time to multiply and to overwhelm local defenses. The catheter serves as a foreign body and the irritation produced by the parenteral solution as well as the debility of the patient add to the impairment of body defenses.

Duskin and Siegel published a study in 1961 on bacterial contamination of indwelling intravenous catheters. (5) They cultured 54 catheters, 22 of which yielded growth. Thirty per cent of these patients had phlebitis. These data indicated no statistical relationship between phlebitis and the length of time the catheter was in the site, or the presence or absence of bacterial growth from the catheter tip. A significant positive correlation did exist between the length of time the catheter was in the vein and the incidence of positive cultures. There were 22 positive cultures from 42 catheters that were in place longer than 48 hours.

A study of 153 cutdowns was completed by Anderson and associates indicating that the chances are an even 50 per cent that a catheter will produce phlebitis when kept in place for three and one third days. (1)

Moran and associates did a double blind study on 89 cutdowns to evaluate the effectiveness of locally applied antibiotic ointment in controlling cutdown complications. (15) Antibiotic and placebo

ointments were applied topically to the wounds and catheters. Eighteen per cent of those treated once daily with antibiotic ointment were positive for organisms, whereas 78 per cent of the cutdowns that were treated with placebo ointment were positive at the termination of the cutdown. In this study five out of nine cutdowns in place longer than 48 hours were bacteriologically positive. Morans study supported the results of the study by Druskin and Segel in that a large percentage of the infusions that had been in place over 48 hours had a growth of organisms on culture. Both researchers found a lack of correlation between clinical phlebitis and infection.

Bogen analyzed a series of 234 saphenous cutdowns for complications. (17) Those cutdowns were done on patients who had bilateral saphenous catheterizations before surgery. The cutdowns were all done in the same location with the same type of equipment and by a variety of over 50 skilled operators. The cutdowns were all done simultaneously in both legs by two different doctors with two completely different sets of equipment. All patients received broad spectrum antibiotics throughout the period that the catheter was in place. There were 34 complications: 11 cases of local pain without inflamation, one case of massive local swelling, ten cases of infection of the cutdown site, two cases of separation of the wound after the sutures were removed, and ten cases of phlebitis. The researcher found a strong positive correlation between the length of time the

catheter was in place and the incidence of phlebitis.

Collins, Braun, Zinner and Kass studied 176 hospitalized medical and surgical patients for catheter infections. (4) Only eight of them were scored as receiving "adequate" local care consisting of daily inspection and application of topical antibiotics. The mean duration of catheterizations for the entire group was 2.6 days. Thirty-nine per cent of the catheterizations were complicated by phlebitis. This included marked erythema, induration, and palpable venous cord at the time of removal. The incidence of phlebitis increased with the duration of catheterization, occurring in almost half of those patients whos infusion lasted three days or more. On culture of the catheter tip from phlebitic patients only 43 per cent were positive. Seventy-three out of 213 (34.3%) catheter tip specimens yielded organisms. In the group with the positive cultures 48 per cent occurred in patients with phlebitis. Four cases (1.9%) of catheter-induced bacteremia were elicited in the study group. Catheter-induced sepsis was a contributing cause of death in two debilitated patients. The author recommended meticulous attention to sterile insertion and daily care of polyethelene catheters with restriction of their use to bona-fide cases. The researcher recommended the use of steel needles whenever possible although their study did not include information about steel needles.

Physiological Changes

A study was conducted at the University of Minnesota to determine the incidence of thrombus formation. (8) Formanek and associates studied: 1) the duration of the catheterization, 2) the thrombogenicity of various plastic catheters, 3) whether the thrombus started on the catheter surface or the puncture site and 4) what happened to the thrombi which remained in the arterial system after the catheter was removed.

Formanek's sample of 93 patients was studied by aortography and arteriography. (8) Following percutaneous arterial catheterization the catheters were withdrawn close to the puncture site and arteriograms were obtained during the manual injection of five to ten milliliters of contrast materials. The arteriograms were examined for thrombi. Thrombus formation was noted in 50 of the 93 patients undergoing diagnostic catheterizations. Polyethylene, teflon and siliconized polyurethane catheters were used during this study. The frequency of clot formation was higher in the group in which teflon catheters were used, namely 22 of 32 participants developed thrombus. Eleven of 24 of those with siliconized polyurethane catheters developed thrombus. The diameter of the catheter appeared to be unrelated to the initiation of thrombus formation despite the fact that it is a commonly accepted theory that the larger catheter is more

likely to cause thrombi than the smaller catheter. Complete occlusion of the femoral artery occurred in one patient, with clinical evidence of peripheral embolization in two other patients. Septicemia and septic emboli developed in one patient. Considerable thrombus formation was noted in 13 indwelling size #16 French catheters used for chemotherapy infusion for one to 14 days. With withdrawal of the catheter mobile thrombi either remain in the femoral artery at the catheterization site or are washed away as emboli. This study concluded that postcatheterization thrombosis is due to clot formation on the outside of the catheter. As the catheter is withdrawn the thrombus grows, piles up, and may occlude the arterial lumen while the catheter emerges free of any thrombus from the puncture site.

This study was done on patients undergoing cardiac or vascular catheterizations. The great incidence of thrombus in such short term catheterizations would indicate the probability of an even higher incidence of thrombus formation in patients with long term venous infusions.

Hohn and Lambert reported the results of using special thin walled teflon catheters 50 centimeters long in eight children for a period of two to six weeks. (14) These catheters were placed in the inferior vena cava and were infused with concentrated solutions of antibiotics. Upon withdrawal of the catheters the puncture wound healed cleanly and the withdrawn catheters had no evidence of

thrombus formation. None of the patients had any complications despite the irritating solutions infused. The researchers felt this was due to immediate dilution of the infusate by the large rapid flow of the inferior vena cava. The mean velocity of the vena cava in the resting state is 20 centimeters per second. (3) Hohn and Lambert stated that the lack of tissue reaction and the minimal clotting was a result of the construction of the catheter from teflon. They stated that the negligible wettability of teflon makes clotting unlikely. In two of their patients whose intravenous infusions had inadvertently stopped, the catheter had to be withdrawn because of a clot which was totally inside the catheter. In view of the findings of Formaneck and his associates in the last cited study the question could be raised as to how much clot was lost into the general circulation when the catheter was withdrawn from the vein. The skin edges may have acted as an efficient wiping agent on the outside of the catheter.

Strickler, Erwin and Rice completed a study of the use of polyethylene tubing in the intravenous therapy for surgical patients. (7) They described polyethylene as nonabsorbable, unmodified by tissue fluid, chemically inert, noncarciogenic, a material that does not inactivate antibiotics and which causes no tissue reaction unless it is not cleansed of the diacritylphosphate retained from its commercial preparation. Polyethylene tubing was used in a wide variety of patients in order to evaluate the local and systemic reactions which

might occur. Three hundred sixty-six veins were catheterized and the polyethylene tubing left in place from one to 42 days. Local reactions occurred in 98 veins. Inflammatory reactions occurred in 16.6 per cent of the veins. The duration of continuous catheterization contributed to the incidence of local inflammatory reaction in the vein. The researcher considered the microscopic to-and-fro motion of the tubing to be the factor introducing the infection from the skin. He based this theory on the observation that a small red spot on the site of the puncture was uniformly followed by an ascending inflammatory reaction within 24 hours. The use of collodion or bacitracin ointment or flamed tape at the site of the skin opening failed to reduce the incidence of inflammatory reaction. It was consistently observed that longer tubing allowed for a more prolonged period of catheterization before inflammatory reaction developed than did shorter tubing.

Buffering

A study was completed at the University of California, Department of Surgery, in Los Angeles, to evaluate the effects of neutralization of hospital prepared and commercially available five per cent dextrose solution on the incidence of thrombo-phlebitis in infusions after 24 hours. (9) Sodium bicarbonate (3.75 gram of 44.6 mEq. per 50 ml.) was titrated into infusion solutions. This was done until a pH of 7.4 was achieved. The University of California prepared

solutions required 15 ml. to achieve this pH while the commercially prepared solution required 12 ml. The study included 185 randomly selected post-operative patients. A double blind technique was used. Criteria for acceptability to the study specified that a member of the study group insert the #19 scalp vein needle in the dorsum of the hand or the forearm after surgery. No solutions or drugs other than the study drugs were infused and no other infusions were attempted or given in the same arm. There were no blood pressure readings or injections given in this arm during the study. Fifteen of the 69 men and 18 of the 91 women developed phlebitis. Twelve of the 35 patients given unbuffered University of California prepared solutions developed a 1+ phlebitis. This was described as mild discomfort extending cephalad from the venipuncture site, presence of erythema and persistance of discomfort after cessation of the infusion. Two patients developed a 2+ phlebitis which was described as moderately severe with persistent discomfort, erythema, and heat. Of the 42 patients receiving buffered University of California solutions, five developed a 1+ phlebitis and one developed a 2+ phlebitis. Three of the 41 patients receiving buffered solutions developed a 1+ phlebitis and none developed a 2+ phlebitis.

The incidence of phlebitis was 18.1 per cent in the dorsum of the hand which was 23.4% higher than that of patients who had infusions into the larger veins of the forearm. The researchers

concluded that the rate of infusion was not related to the development of phlebitis. If phlebitis was only a problem of pH it would seem that using a larger vein and infusing the solution slowly would increase the ability of the blood to buffer the infusate and decrease the incidence of phlebitis. The researcher concluded that the study indicated conclusively that the low pH of glucose infusion solution was a major factor in the etiology of phlebitis. The researchers acknowledged that other factors in the preparation of infusion solutions may also be significant in the development of phlebitis. However one wonders if the researchers' conclusions can be accepted when there was a 16.2% difference in the incidence of phlebitis between patients receiving University of California and commercially prepared solutions, both with the same pH. If pH were really the causative factor in phlebitis the incidence should have been the same in the patients who received both solutions.

Fonkalsrud, Murphy and Smith studied 16 dogs which were given pentobarbitol (pH 10-11) through symmetrical cutdown incisions into the saphenous vein of both hind legs. (10) Intramedid PE plastic catheters were inserted 2.5 cm. into the vein and secured with silk ties. Unbuffered solution was infused in one leg and buffered solution in the other leg at the rate of 40 ml. per hour. The infusion time was eight or twenty hours after which the vein was ligated and the wound closed. Twenty-four hours later the dogs were

sacrificed and one centimeter interval segments of the saphenous veins six to ten centimeters proximal to the tip of the infusing catheter were taken. The sections were examined histologically to evaluate intraluminal thrombosis, endothelial damage and leukocytic infiltration. The lumen of 14 of the 16 veins infused with unbuffered solution had a thrombus formation classified as 2+ or greater. Endothelial injury, evidenced by vaculation of the endothelial cells by disruption or complete absence of endothelial lining appears to be the most sensitive index of venous damage following infusion. All of the veins infused with unbuffered solutions had endothelial injury classified as 3+ or greater. In several of the veins infused for twenty hours no evidence of an endothelial lining could be found up to ten centimeters proximal to the tip of the infusion catheter. Those veins infused with buffered solutions had less endothelial injury as only one leg out of 16 had changes classified as greater than 2+.

Inflammation with leukocytic infiltration of the vein wall occurred most often immediately beneath the endothelium but frequently extended to the adventitia. The inflammation extended from the vein wall directly into an intraluminal thrombus in several of the dogs. Ten of the 16 dogs infused with unbuffered fluids had an inflammatory reaction in the vein wall classified as 2+ or more while only two of the 16 infused with buffered fluids had this degree of inflammation. Venous injury was slightly more pronounced when the

infusions were continued for 20 hours instead of eight.

In this study each dog served as his own control. The technique of the infusion was identical for each hind leg. The researcher concluded that neutralization of the pH of intravenous fluids reduced the histological evidence of phlebitis in dogs. How much of these data can be extrapolated to humans remains unanswered. It should also be noted that the buffered solution was originally basic instead of acidic.

Elving and Saikku had reported a high incidence of clinical phlebitis when unbuffered sugar solution was administered to patients for only two to three hours. (6) In their study 76 patients received 50 ml. of ten per cent invert-sugar solution buffered by a phosphate solution. This changed the pH from 3.5 to 6.8. The patient was his own control with infusions in the back of each hand, one with an unbuffered solution and the other with a buffered solution. The time for both infusions was the same. The infusion equipment was the same. One doctor started all of the infusions. No other drugs or infusions were given. The criterion for thrombophlebitis was a palpable thrombus measuring at least 0.5 centimeter. There was a significant difference in the amount of thrombophlebitis in the two groups. The incidence in the control group was higher, 18 per cent compared to an incidence of five per cent in those who received the buffered solution.

Summary

The literature indicates that phlebitis is not caused by a single factor. There is a strong positive correlation between the length of time the infusion is in place and the incidence of phlebitis. There is also a strong positive correlation between the length of time the infusion is in place and the incidence of growth of organisms when the catheter tip is cultured. There is a lack of correlation between the incidence of clinical phlebitis and infection. Instead of an inflammatory process with bacteria as the primary cause, much of the phlebitis is caused from mechanical irritation. This includes the type of catheter or needle used to deliver the infusate, the amount of movement of the needle or catheter in the vein and the type of infusate used, including the pH and its sclerosing potential. There is strong evidence that the buffering of intravenous fluid will reduce the incidence of clinical phlebitis.

CHAPTER III

REPORT OF THE STUDY

The purpose of this study was to determine if bringing the acid pH of commercial glucose solution to the pH of blood would reduce the incidence of post infusion phlebitis. Data were collected at a large general county hospital on 65 obstetric patients. The women were randomly assigned to the experimental or control group according to a schedule furnished by Abbott Laboratories. The experimental group received Neut, 20 ml. of a one per cent sodium bicarbonate solution in each of the two intravenous solutions administered to them. The Neut changed the pH of the 1000 ml. of five per cent dextrose in water which was started in the labor room from 4.8 to 7.2. The second bottle of 1000 ml. of five per cent dextrose in water which was substituted for the first bottle following delivery of the placenta contained twenty units of pitocin and a vial of Neut changing the pH of this solution from 4.8 to 7.45. The control group received infusions with additives that appeared identical to the experimental solutions but which were actually placebo solutions. The pH of the 1000 ml. of five per cent dextrose in water in which the placebo was added was changed from a pH of 4.8 to 5. pH determination was done in the department of obstetrical and gynecological research at the University of Oregon Medical School.

There were 33 women in the experimental group and 32 women in the control group. The women had had uncomplicated pregnancies with vaginal deliveries. The control group ranged in age from 17 to 35 with a mean age of 22.8 years. The experimental group had a similar age range from 17 to 34 with a mean age of 22.3 years. Of the 32 patients in the control group 19 were multiparas, 20 of the 33 patients in the experimental group were multiparas, as shown in Table 2.

Table 2

Number of Multiparas and Primiparas in Study Group

	Multiparas	Primiparas	Total
Control	19	13	32
Experimental	20	13	33

The concern of this study was post infusion phlebitis. The study was undertaken with obstetric patients because a pilot study had indicated that almost half of the patients on the post partum floor were developing phlebitis. However only two of the 65 patients in this study developed phlebitis. One had received buffered and one unbuffered solutions. Both patients received infusions through wrist veins. They delivered within three hours of each other indicating that the infusions probably had been started by the same physician. Other

patients delivered within a similar time period and had infusions started by the same physician but did not develop phlebitis.

None of the women in the study group had infusions in place more than 15 hours. The literature indicated that most phlebitis occurs after infusions have been in place 48 hours. However, one study reported clinical phlebitis occurred after administration of an unbuffered invert sugar solution in two to three hours. (5) Infusions of 20 hours or less have caused histological changes in the veins of experimental animals. (10) The survey conducted on the same ward in the same hospital with patients receiving like infusions showed that approximately 50 per cent (N=13) of the patients developed phlebitis. The survey was made on patients receiving infusions through #15 angio catheters and a high incidence of phlebitis was found. In the present study #19 scalp needles were used in all of the infusions and a negligible number of patients developed phlebitis. The difference between the survey findings and the findings in the present study can be explained only by the difference in equipment, that is the catheters or needles.

All of the infusions were started by a physician who prepared the skin with 70 per cent ethyl alcohol. Seventy per cent ethyl alcohol is an effective germicide for the skin. A one minute skin preparation has been found to reduce the bacterial count 75 per cent. It is estimated that five organisms enter the body with the insertion of a

beveled needle through the skin surface and that it requires 20 hours for a bacterium to multiply until it is pyogenic. The kind of skin preparation that was done along with the short time the infusion remained in place in these women could also explain why the women in this study did not develop phlebitis.

In the experimental group most (N=21) of the infusions were started in the veins of the forearm. Twenty-five of the infusions in the control group were started in the same area. (see Table 3)

Table 3

Infusion Sites N=65

Site	Experimental Group N=33	Control Group N=32
Arm	21	25
Hand	9	5
Wrist	3	2

It will be recalled that the two patients who developed phlebitis were receiving their infusions in a wrist vein. These patients are encouraged to grasp their knees and bear down with contractions during the second stage of labor. This increases the mechanical irritation that the needle causes to the wrist vein. Wrist restraints are routinely applied to all patients on the delivery table. This is another factor which could increase the incidence of phlebitis in

patients with wrist vein infusions. It also raises the question as to why all of the patients with wrist infusions did not develop phlebitis.

The intent of the study was to measure the influence of buffering on phlebitis. Because of the low incidence of phlebitis which developed in both study and control groups nothing could be concluded about the role of buffering in this study.

Problems in Carrying Out the Study

There were a variety of problems that arose throughout the study. They are discussed here so those who become involved in another study of this nature will be able, hopefully, to avoid them.

The protocol was written by the researcher in consultation with the drug company and the head of the obstetrical department. It was accepted by the drug company which insisted on strict adherence to the protocol throughout. There was not adequate consultation about the protocol with the residents and interns who were to carry it out.

It was known that the #19 steel needles were inflexible and sharply beveled and that obstetric patients were restless, however there was no reason to believe that an infusion could not be maintained through the #19 needle. Those scalp needles were thin walled and large enough to accommodate all solutions including blood. The medical staff cooperated initially, somewhat reluctantly because of the type of needle that was specified.

The #19 scalp needles were used and infusions were started in the hand. The use of the hand had to be discontinued because of the high incidence of infiltration. The incidence of infiltration was reduced when the veins of the forearm were used but many of the infusions became plugged when the patient was moved from the labor room to the delivery room. This move was usually made either during or immediately after a contraction. Contraction of the muscles of the hand and arm forced blood through the needle into the curled tubing. At this time the infusion bottle was placed on the patients bed without clamping the tubing or flushing the needle with solution while the patient was moved to the delivery room. This usually resulted in a plugged intravenous. It occurred at a time when the nurse had the least time to stop to irrigate the infusion and at a time when the maintenance of a patent infusion was of most importance. The nursing staff was cooperative in flushing the tubing with solution and clamping the infusion tubing with a rubber tipped forceps when this problem was pointed out to them. Unfortunately by this time in the study the resident staff, which had felt the scalp vein needles inadequate from the beginning, were no longer willing to consider the scalp vein needles safe. They switched to the #15 angio catheters previously in use. The number of patients who could be included in the study became so sparse that the study was discontinued.

CHAPTER IV

SUMMARY AND RECOMMENDATIONS

Summary

A survey had been completed in a 32 bed obstetrical department which included 13 patients who had had infusions. Six of these patients were found to have clinical phlebitis. Studies reported in the literature indicated that buffering of infusion fluids reduced the incidence of phlebitis. Accordingly a study was undertaken for the purpose of ascertaining if bringing the acid pH of commercial glucose solution to the pH of blood would reduce the incidence of post infusion phlebitis. A drug company was interested in the study and provided the materials and the randomizing schedule. The Chairman of the Obstetrical and Gynecological Department approved the study. The researcher oriented the physicians and staff to the study. All of the patients included in the study received two bottles of 1000 ml. of five per cent dextrose in water through a #19 scalp vein needle. The physician on call duty started the infusions after a 70 per cent ethyl alcohol skin preparation. None of the infusions ran longer than fifteen hours. The study was carried out on 65 women randomly assigned to a control (N=33) or experimental group (N=32). The experimental group received Neut which changed the pH of their infusions from 4.8 to 7.2. The control group received identical appearing vials of placebo which left the pH of their infusion relatively unchanged. All

of the women had uncomplicated pregnancies and vaginal deliveries. Sixty per cent of the patients were multiparas. The mean age of the women in the study was 22.5 years. Two of the patients developed post infusion phlebitis. One of these patients was in the experimental group and one was in the control group. Both of these patients received their infusion through the wrist veins.

The study results were disappointing because of the absence of phlebitis but it gave some satisfaction to eliminate the problem for the sake of the patient. The pilot survey showed that phlebitis was a problem in the obstetric patient in this hospital. Observation indicates that phlebitis remains a problem in those patients whose intravenous infusions are started with a #15 angio catheter. Two of the patients who were started in the study but whose intravenous infusions were restarted with angio catheters because of the infiltration with the butterfly needles developed phlebitis at the site of the intravenous started with the angio catheter. Despite an area of infiltration there was no irritation, erythema or tenderness at the site of the infiltration when started with the butterfly needle. It would seem that the size and type of needle used in the study reduced the number of cases of phlebitis. Obviously more research is indicated.

Recommendations

The study could be repeated using #15 angio catheters instead

of #19 butterfly needles. This would meet the criterion of changing only one variable and would be more acceptable to the physicians and the study could be expanded to include a larger population. If phlebitis did develop, the solutions could be buffered and differences noted.

Since the #19 butterfly needles used in this study did not produce phlebitis in these short term infusions another study could be done with patients whose infusions are needed for a longer period of time.

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APPENDIX

APPENDIX A

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RANDOMIZATION SCHEDULE FOR BUFFERED SOLUTION STUDY

Patient No.	Therapy Code	Patient No.	Therapy Code	Patient No.	Therapy Code
1	A	21	A	41	A
2	B	22	B	42	B
3	A	23	A	43	A
4	A	24	A	44	B
5	B	25	A	45	A
6	B	26	A	46	B
7	A	27	B	47	A
8	B	28	B	48	B
9	A	29	B	49	B
10	B	30	B	50	A
11	A	31	A	51	B
12	B	32	A	52	B
13	B	33	A	53	A
14	A	34	A	54	B
15	A	35	B	55	A
16	B	36	B	56	A
17	A	37	A	57	A
18	B	38	B	58	B
19	A	39	B	59	B
20	B	40	B	60	A

Typed by Donna L. Olson

AN ABSTRACT OF THE THESIS OF

Dorothy Dichtel Sells for the Master of Science in Nursing
(Name) (Degree) (Major Department)

Date of receiving this degree June 11, 1971

Title: A STUDY OF INFUSIONS DURING PARTURITION

Approved: _____
(Professor in Charge of Thesis)

A survey had been completed by the researcher in a general county hospital to determine the occurrence of post infusion phlebitis. Six of the thirteen patients on the post partum unit who had infusions had clinical phlebitis. These findings lead to undertaking a larger study to determine if bringing the acid pH of commercial glucose to the pH of blood would reduce the incidence of post infusion phlebitis. A double blind study was done in which obstetric patients were randomly assigned to the experimental or control group according to a randomizing schedule furnished by Abbott Laboratories. Abbott Laboratories also supplied identical appearing vials marked A and B which contained either 20 ml. of Neut, a one per cent sodium bicarbonate solution (2.4 mEq.) or 20 ml. of distilled water. The hospital pharmacy had received the vials and removed the identifying labels leaving only the coded identity. The pharmacist was the only one who knew the identity of the vials until the study was completed.

The study population included those patients whose intravenous

could be started in the left ot right forearm or hand with a #19 scalp needle. The physician on call duty started the infusions after using a 70 per cent alcohol skin preparation. The labor room nurse added vial A or vial B to the infusions according to a randomizing schedule and marked the patients name by the letter of the vial she had added. The experimental group received the one per cent sodium bicarbonate solution which changed the pH of their infusions from approximately 4.4 to 7.2. The control group received distilled water in their infusions which left the pH relatively unchanged. The labor room nurse marked the infusions to run at a rate of 100 ml. per hour by the use of a flow strip. After delivery of the placenta the first bottle of 1000 ml. of five per cent dextrose in water was replaced by another bottle of 1000 ml. of five per cent dextrose in water with twenty units of pitocin and a vial of Neut or control. Those who had received control originally again received it at this time. The bottle containing the pitocin was marked by flow tape to run at 200 ml. per hour.

The infusion sites were checked for erythema within 24 hours after delivery and each day the patient remained in the hospital. The observations were recorded by a set of scaled criteria as follows: 0 phlebitis indicated complete absence of erythema, 1+ phlebitis indicated erythema up to three centimeters, 2+ phlebitis indicated erythema between three and six centimeters, 3+ phlebitis indicated an erythematous area larger than six centimeters.

The study was carried out on 65 women randomly assigned to a control (N=33) or an experimental group (N=32). All of the women had uncomplicated pregnancies and vaginal deliveries. Sixty per cent of the patients were multiparas. The mean age of the women in the study was 22.5 years. Two of the patients developed post infusion phlebitis. One of these patients was in the experimental group and one was in the control group. Both of these patients received their infusions through the wrist veins.

The study results were disappointing because of the absence of phlebitis. The pilot study showed that phlebitis was a problem in the obstetric patient in this hospital. Observation indicates that phlebitis remains a problem in those patients whose intravenous infusions are started with a #15 angio catheter. Two of the patients who were started in the study but whose intravenous were restarted with angio catheters because of infiltration with the butterfly needles developed phlebitis at the site of the intravenous started with the angio catheters. No erythema was noticable at the intravenous site where the scalp vein needle had been inserted. It would appear that the size and type of needle used in the study reduced the number of cases of phlebitis. Because of the absence of phlebitis no conclusions could be made about the role of buffering in reducing the incidence of post infusion phlebitis.

It is recommended that the study be repeated using #15 angio catheters instead of the #19 butterfly needles. This would meet the

criterion of changing only one variable. The procedure would be more acceptable to the physicians and the study could be expanded to a larger population.