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THE RESISTANCE OF ABSORBABLE SUTURES IN FETAL TISSUE AND FLUIDS*

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Despite the widespread clinical and experimental applications of intrauterine (IU) surgery, we could not find, after a thorough search of the literature, any studies published which describe the resistance of sutures under IU conditions. However, Adzick and co-workers[1] have demonstrated that the uterine closure with nonabsorbable material results in a decrease in fertility in animals. How fetal tissue, and especially amniotic fluid, which exhibit changes in composition during the last ten weeks of pregnancy[2,3] affect sutures, remains unknown. This study was designed to investigate the resistance of three different types of absorbable sutures under IU conditions, which are extensively used in "extra-uterine" surgery.

Material and Methods

Fifteen centimeter lengths of 4/0 chromic catgut (CC), proglactin 910 (V) and polydioxanone (P) suture materials were incubated in three groups:

Group I: By opening wide the amniotic sac of a ten-day-old chicken embryo (CE) of the genus *Gallus domestica*, amnioallantoic fluid and space formed using the technique described in previous reports[4-7]. One suture was incubated in each of these amnioallantoic cavities.

Group II: Using the same technique, one of the lower extremities of the CE was sutured, and the remainder of the suture was placed in the amnioallantoic cavity. All the eggs with CE and sutures were incubated at 38°C and in 90% humidity until the sutures were removed for measurement.

Group III: Human amniotic fluid collected during elective cesarean section operations in the thirty-eighth week, which had no known infection, was used for in vitro incubation at 37°C. A piece of each suture was incubated in a separate bottle.

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If the CE was infected or dead, or if the human amniotic fluid had become infected, the experiment was repeated for those specimens. Fifteen suture samples were tested at the beginning of the study in order to determine their initial tensile strengths. At the end of the study, ten samples of each suture were tested for two, four, six, eight and ten day periods in groups I and II, and for two, four, six, eight and ten week periods in group III. After washing the sutures in sterile saline, the tensile strengths were calculated using a Statimat II tensiometer operating at a speed of 50 mm/min. Tensile strengths were calculated as a percentage of the initial mean tensile strength of each type of suture. Student's *t* test was used to make a statistical evaluation of the results.

Results

The initial tensile strengths of CC, V and P sutures were (Mean ± SD) 1070 ± 126, 1912 ± 46, and 1923 ± 55 grams, respectively. The resistance curves of the sutures in amnioallantoic fluid are shown in Fig. 1, and in fetal tissue in Fig. 2. On the tenth day of the experiment, the preserved resistance of CC, V and P in chicken amnioallantoic fluid was 68 ± 6.0, 78 ± 5.0 and 80 ± 7.5 percent, respectively. For the first six days the resistances of the sutures did not significantly differ from each other. On the eighth and tenth days, CC had a

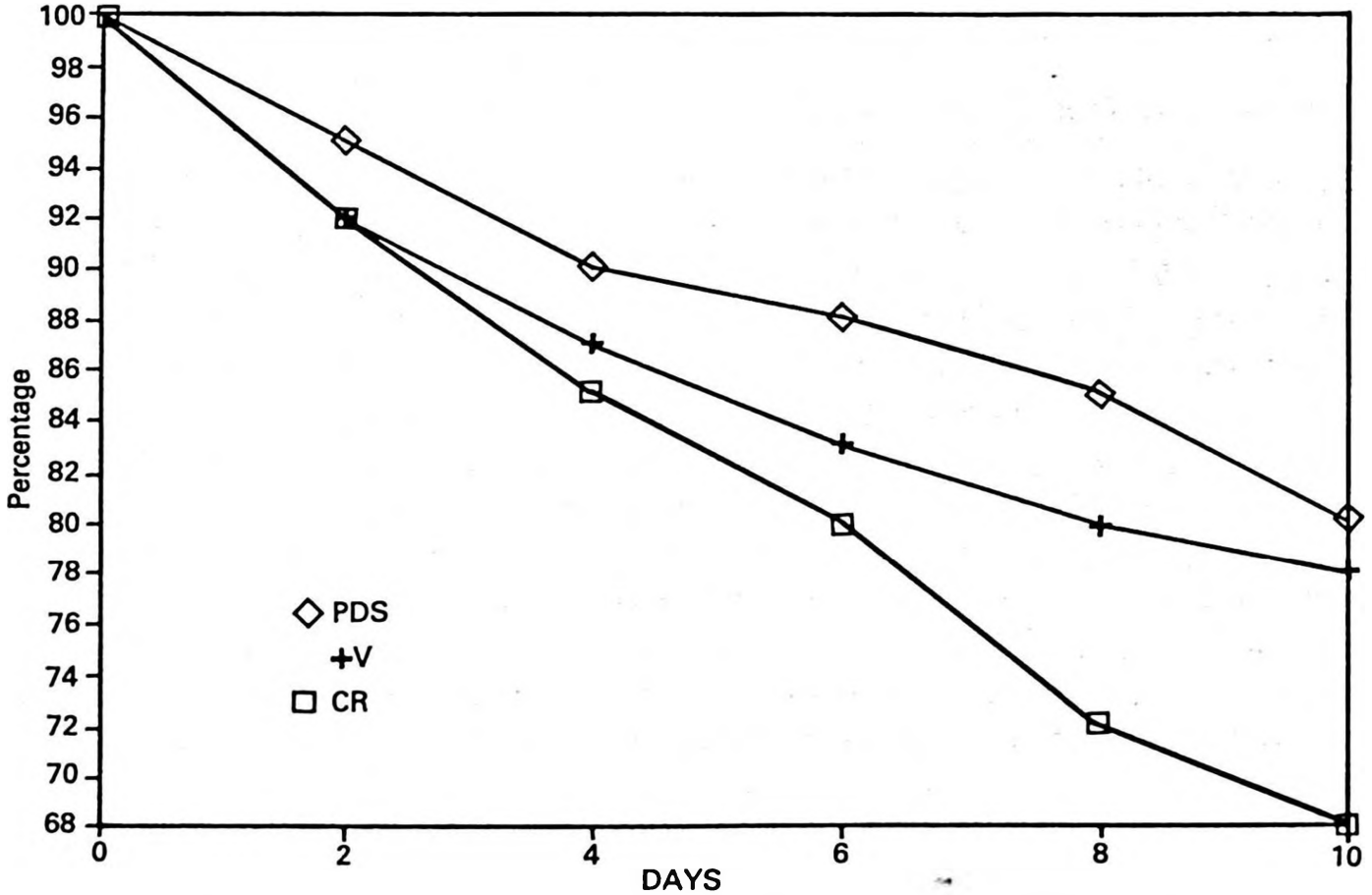

Fig. 1: Resistance curves of sutures in amnioallantic fluid of chicken embryo expressed as a percentage of initial tensile strength

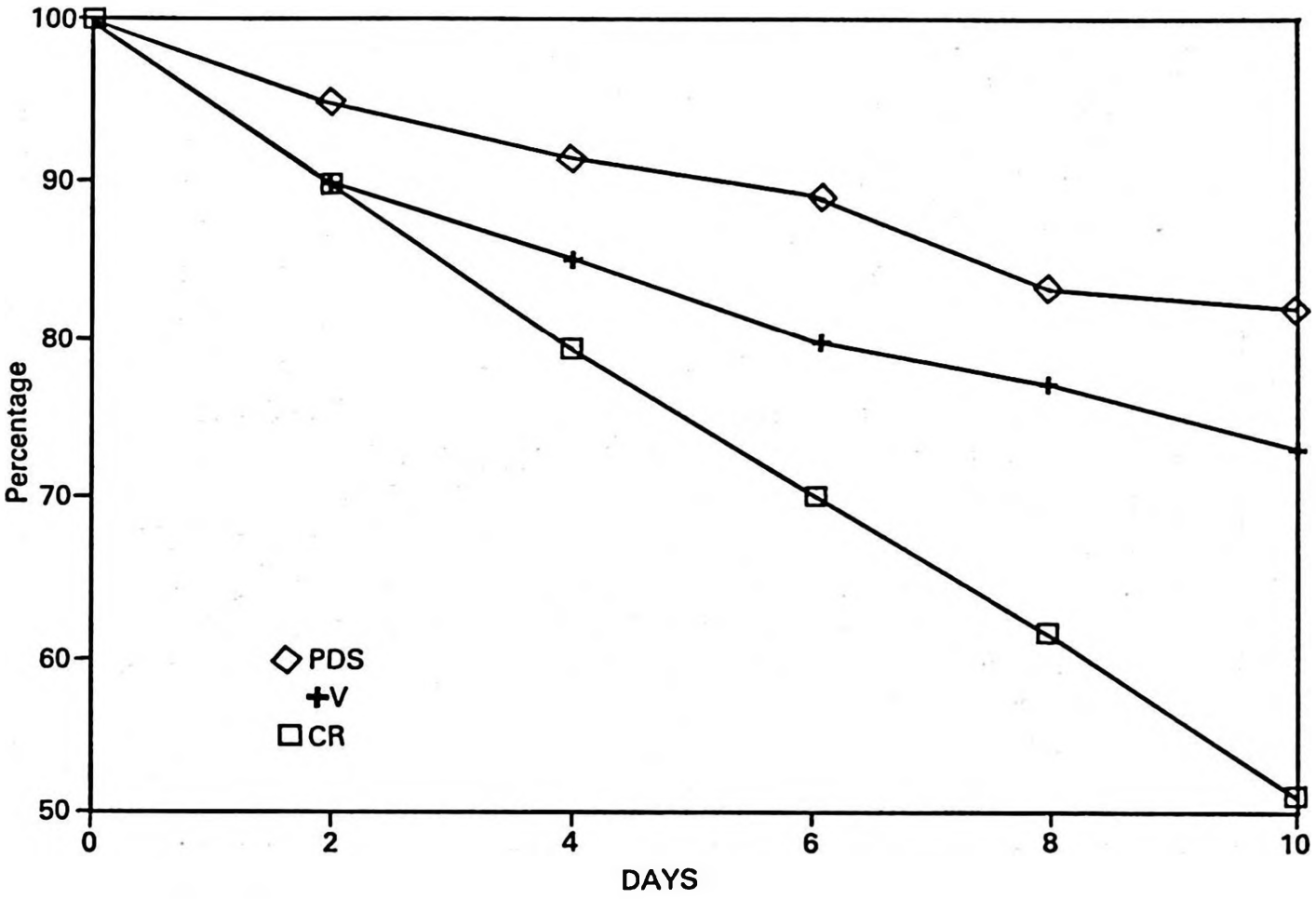

Fig. 2: Resistance curves of sutures in fetal tissue of chicken embryo expressed as a percentage of initial tensile strength.

statistically impaired loss of tensile strength when compared to the other types ($p < 0.01$). On the tenth day, the preserved resistance of CC, V and P in chicken fetal tissue was 51 ± 6.9, 73 ± 5.7 and 82 ± 6.7 percent, respectively. CC also had a significant loss of resistance in fetal tissue after the fourth day when compared to V and P ($p < 0.01$). V had a greater loss in tensile strength than P in fetal tissue on days two, six, and ten ($p < 0.01$).

When differences in resistance between incubations in fetal fluid and tissue were investigated no distinction was found for V and P. But CC could not preserve its resistance in fetal tissue, as it had done in the fluid. The difference was 17 percent on the tenth day and significant after the second day ($p < 0.05$ on the second day and $p < 0.01$, thereafter).

Resistance curves following in vitro incubation with human amniotic fluid are shown in Fig. 3. In the tenth week, the retaining resistances of CC, V and P were 10 ± 5.8, 35 ± 7.5 and 47 ± 12.2 percent, respectively. P preserved its tensile strength better than the other two sutures ($p < 0.01$ for the last eight weeks) and V preserved its resistance better than CC for the last four weeks ($p < 0.01$).

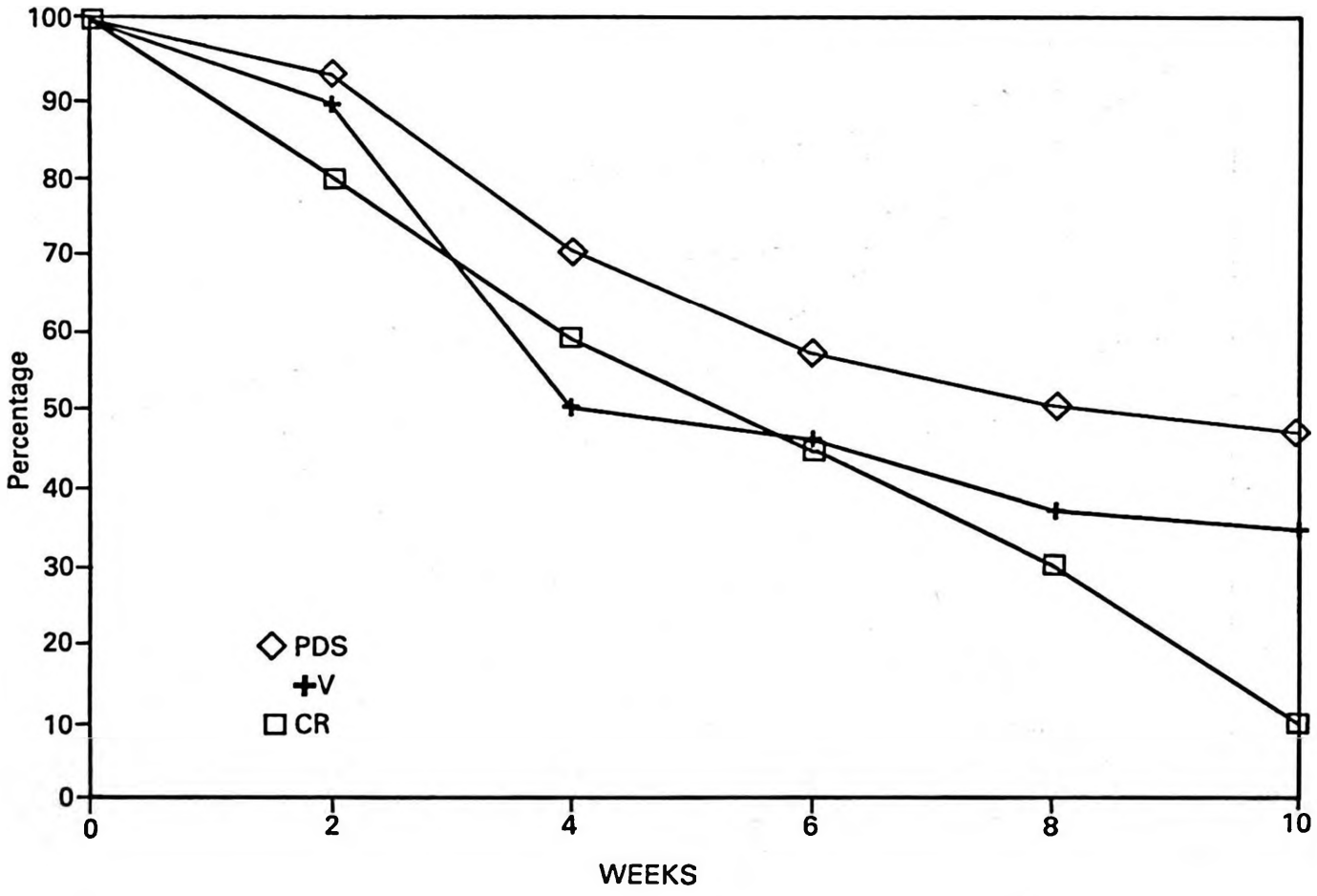

Fig. 3: Resistance curves of sutures after in vitro incubation with human amniotic fluid expressed as a percentage of initial tensile strength.

Discussion

The resistance of absorbable sutures is affected by environmental conditions. Chromic catgut in the human stomach is destroyed within 24 hours[8], and polyglycolic acid in proteus infected urine within three days[9]. Data regarding the effect of fetal tissue and fluids on the resistance of sutures would be a reference for the selection in IU surgical practice.

In the present study, we demonstrated that the resistance of V and P in fetal tissue was approximately the same as that in fetal fluids. On the other hand, the resistance of Chromic catgut disappeared more rapidly in fetal tissue than in fetal fluid. The reason for this difference may be the presence of different absorption mechanisms in sutures. Chromic catgut is absorbed by proteolysis, and the other two types of sutures by hydrolysis[3]. As a result of a slow loss of resistance in fetal fluids, the particles of CC dermal sutures in fetuses would transmit into free foreign bodies in amniotic fluid after some time of IU surgery. This is not the case for the other two types of sutures.

Human amniotic fluid has a lower osmolarity and sodium level and a higher urinary excretion of substances than the other body fluids during the last ten weeks of

pregnancy[2,3]. However, this did not affect the resistance of the sutures in this study. All three suture types preserved some of their tensile strengths until the tenth week, practically the same as they had been preserved in tissue[8]. Since it was not possible for us to carry out this study in collaboration with the gynecology department of our University where routine amniosyntesis is performed, we were not able to determine the effects of amniotic fluid prior to the thirty-eighth week of pregnancy.

Since the physiologic osmolarity of body fluids in birds is nearly 1.5 times lower than that in mammals[6], the CE model may be not a plausible one. However, the cost of this model is quite low, and it can be easily implemented in a hospital without a research laboratory. Therefore, we preferred this model for our study. Due to certain technical problems, studies on fetal tissue reactions to sutures and the effects of sutures on IU growth could not be performed. Further investigations into such studies might result in a more liberal use of suture materials in IU surgery.

Summary

The resistance of three different types of absorbable suture materials was studied in three groups which simulated intrauterine conditions. In group I the sutures were incubated in the amnioallantoic cavity of chicken embryo (CE) and in group II in the fetal tissue of CE. For incubation of sutures in group III, human anmiotic fluid collected during cesarean section operations in the thirty-eighth week of pregnancy was used. We discovered that chromic catgut had a lower resistance in fetal tissue than in fetal fluid ($p < 0.01$), which could be an important point in the selection of fetal dermal sutures. In vitro incubation in human amniotic fluid did not effect the known rate of loss of chromic catgut, proglactin 910 and polydioxanone.

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