UNIVERSITI PUTRA MALAYSIA

# A STUDY ON THE PATHOLOGY OF GENITAL TRACTS OF SOWS SLAUGHTERED AT SHAH ALAM ABATTOIR

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by

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## ABSTRACT

A total of 99 genital tracts of sows were collected from Shah Alam abattoir and examined macroscopically, microscopically and bacteriologically.

The most frequent macroscopic lesion observed was patency (26.5%) in the cervix, endometrial cysts (23.2%) in the uterus and paraovarian cysts (20.4%) in the ovary. Cystic ovaries were observed only in 3.1% of the cases and were unassociated with cystic endometrium and cystic cervix.

Microscopically, the most frequent lesions observed were chronic cervicitis, chronic endometritis, chronic salpingitis and old hemorrhages in the cervix, uterus, oviduct and ovary respectively. Most of the chronic salpingitis and chronic cervicitis were associated with chronic endometritis. An interesting finding in 10.3% of ovaries were bilateral hemangiomas.

The most frequent bacteria isolated were Escherichia coli followed by Staphylococcus spp. and Acinetobacter spp. while organisms isolated from uteri with endometritis were Corynebacterium pyogenes, Pseudomonas spp. and Escherichia coli in that order of frequency.

CONTENTS

## INTRODUCTION

A major problem confronting the animal breeder is the reduction of reproductive efficiency. The female genital tract is an important organ in reproduction and its impairment through diseases, injuries or nutritional deficiencies will lead to reduced fertility which will consequently exert profound ill-effects on the economic returns to the livestock industry. This certainly applies to the pig industry.

In most abattoirs, abnormalities of the genital tract of the sow usually escape accurate diagnosis because it is not always subjected to a complete post mortem examination. As a result, the underlying causes for the culling of the sows remain unestablished.

In Malaysia, abattoir studies on the genital tract of sows is totally lacking. It is therefore a wise indication to carry out such a study to serve as a start towards understanding of reproductive problems in the sows faced by pig farmers in our country.

The objective of this project is therefore, to study the pathology of the genital tracts of culled sows which may be the underlying cause of their infertility problems.

## LITERATURE REVIEW

The most common abnormality in the female genital tract of pigs as cited in the literature is cystic ovary and it accounts for the majority of reproductive failures.

Green and Nalbandov (1948) reported a 4.1% prevalence of cystic ovaries from the total of 436 non-pregnant genital tracts examined in a packing house and a 6.5% from a total of 1752 non-

pregnant tracts in another. The cystic ovarian disease has also been suggested as a cause of impaired fertility in swine (Warnick et al, 1949).

Vandeplassche et al (1971) found that 10.0% of old culled sows had cystic ovaries whilst Perry and Pomeroy (1956) reported that 24.0% of culled sows had cystic ovaries and about half of them were judged to have been completely infertile as a result.

In another survey, out of 112 unidentified non-pregnant reproductive tracts, cystic ovaries were observed in 19.0%, cystic endometrium in 38.2% and cystic cervix in 33.0% (Thain, 1965). The same author also reported that in 22 sows which had been culled for infertility, the incidence of cystic ovaries was 36.0% and that of cystic endometrium together with cystic cervix 33.0%.

In a recent study by Nath et al (1982) cystic ovaries were observed in 2 of 45 pig genital tracts examined.

The incidence of gross genital abnormalities in 5088 gilts and sows as studied by Wiggins et al (1950) were: tubal abnormalities (bursitis and hydrosalpinx) 1.4%, cystic follicles plus corpora lutea 1.1%, cystic follicles without corpora lutea 0.6%, missing parts 0.7%, double parts 0.1% and rudimentary male duct 8.9%. Goethals (1951) examined 1000 genital tracts from slaughter house in Belgium and found that among the mature animals, 1.4% had ovarian cysts or tubal abnormalities thought to be sufficient to account for infertility. The same author found 2.5% gilts and 8.0% sows to have one or more ovarian cysts.

Another study of impaired fertility in the female swine by Wilson et al (1949) revealed that the most common abnormalities affected the oviducts (31.3%) followed by cystic ovarian follicles (7.1%).

Ovarian tumors occur quite frequently in the bitch and cow but rarely in the cat and pig (Jubb and Kennedy, 1970). Among the ovarian tumors, cystadenoma and cystadenocarcinoma are the most common although they may not be so in all species (Smith et al, 1972).

In a review on the causes of reproductive failure in swine by Rasbech (1969), it was stated that no strict venereal disease is known to occur in pigs however some infections like that with Brucella suis and certain Leptospira spp. are widespread causes of abortion and stillbirth and some viral agents like that of hog cholera, pseudorabies and SMEDI are known to cause foetal death in pigs. The author also stated that some bacteria such as Streptococci, Staphylococcus aureus, Salmonella spp., Escherichia coli may cause the same condition and less severe endometritis.

Saunders (1958) found that bacteria and fungi were the cause of stillbirth and abortion in the sow in 14.0 to 30.0% of cases studied.

A laboratory examination of specimens from 824 porcine abortions revealed a 22.0% virus infection mainly enterovirus and a 16.5% bacteria infection mainly leptospirosis (Kirkbride and McAdaragh, 1978). However in another survey involving 250 porcine

abortions, a greater association with bacteria of 28.8% was seen than with virus of 7.6% (Holter, 1976).

## MATERIALS AND METHODS

Ninety nine genital tracts of sows were collected on scheduled visits to Shah Alam abattoir over a period of 4 weeks from 27th October, 1982 till 27th November, 1982.

Each tract was put in individual plastic bags and the whole collection for each visit was brought back to Universiti Pertanian Malaysia in a drum containing ice and put in the cold room for about 8-10 hours before a detailed examination was conducted the next morning.

The specimens were examined grossly and any abnormality present noted. In a few specimens the cervix, oviduct and ovary were not available for examination while the vagina was not available in most of the cases.

A mucosal swab at mid-uterus of each tract was taken aseptically for bacteriological studies. Internal macroscopic examination was done after opening the whole genital tract and again any pathological changes present noted.

Sections from mid-cervix, mid-uterus, the ampulla, half of each ovary and also any area with pathological changes were taken and fixed in 10% buffered formalin. Thin sections of these tissues were stained with hematoxylin and eosin and examined under light microscope.

Materials from the swabs were inoculated onto blood agar and Mac Conkey plates and incubated at 37°C for 24 hours. The number of colonies was then counted and the isolates identified using methods described by Cowan and Steel (1965). The organisms were classified only by their genera with the exception of a few common species.

## RESULTS AND DISCUSSION

### Macroscopic pathological observation

The gross lesions observed in the study are summarised in Table I.

Twenty four genital tracts were free from any gross lesions described while the other 75 had either one or a combination of the 13 types of gross lesions observed.

The most common abnormality in the cervix was patent cervix. The condition is unusual outside the time of parturition and estrus, and is usually associated with cystic ovaries due to the stimulation of estrogenic hormone (Jubb and Kennedy, 1970). However in this study the association was observed only in 2 of 26 cases present.

An ovary is considered to have cystic follicles when the size of the follicles is greater than one centimeter in diameter containing the clear pink fluid (Wilson et al, 1949) and this was observed in only 3 cases (3.1%) in this study. One case had abnormally large cysts of 12cm. in diameter affecting both ovaries, single on the right and bilobed on the left (Fig.1). In other 2 cases, multilocular cysts were present on both ovaries together with corpora

## Table I

## Gross lesions observed in the genital tracts of 99 sows

| Organ | Lesion | Number observed | Total• | % |
|---|---|---|---|---|
| Cervix | Patent cervix | 26 | 98 | 26.5 |
| | Cervical cyst | 3 | 98 | 3.1 |
| Uterus | Endometrial cyst | 23 | 99 | 23.2 |
| | Hydrometra | 21 | 99 | 21.2 |
| | Fibroma | 20 | 99 | 20.2 |
| | Paratubal cyst | 8 | 99 | 8.1 |
| | Hematoma | 6 | 99 | 6.1 |
| | Granulomatous endometritis | 2 | 99 | 2.0 |
| | Abscess | 1 | 99 | 1.0 |
| Oviduct | Adhesion to ovary | 1 | 98 | 1.0 |
| Ovary | Paraovarian cyst | 20 | 98 | 20.4 |
| | Cystic ovary | 3 | 98 | 3.1 |
| | Inactive ovary | 3 | 98 | 3.1 |

• 1 cervix, 1 oviduct and 1 pair of ovary was not available for study.

lutea. The prevalence of cystic ovaries seen is considerably lower than that of other studies, (Thain, 1965; Vandeplassche et al, 1971; Perry and Pomeroy, 1956).

Jubb and Kennedy (1970) suggested that ovarian cysts occur when pituitary gonadotrophin is not released in early estrus and mature follicles are not exposed to the luteinizing hormone and that high incidence of the condition develops following the use of progestational compounds for estrus synchronization. Roberts (1971) however proposed a relative deficiency of luteinizing hormone required to induce ovulation as the cause of the condition.

Liptrap and his co-workers (Liptrap, 1970, 1973; Close and Liptrap, 1975; Scholten and Liptrap, 1978) demonstrated that stress is somehow involved in the pathogenesis of the cystic ovarian diseases. These workers found that administration of adrenocorticotrophic hormone (ACTH) or imposition of stress during the follicular phase of the estrus cycle would readily induced development of ovarian cysts.

Ovaries are classified as inactive when there are no visible follicles and corpora lutea. In studies done in sheep by Hawk (1961), a variation in the inflammatory response during the estrus cycle was observed in the endometrium whereby the highest leucocyte response occured during estrus and was low during luteal phase. It has been shown that estrogen promotes development of terminal blood supply to endometrium, increasing its blood flow and providing increased quantities of phagocytes to the site of infection, it also stimulates

uterine contraction which may affect the removal of bacteria through the cervix (Rowson and Spriggs, 1942). The 3 animals with inactive ovaries in this study also had endometritis. It is likely that the endometrium of sows with inactive ovaries, not being under estrogenic stimulation, shows less leucocytes response and as a result is more susceptible to infection.

Endometrial cysts were observed in 23 uteri (Fig.2), 6 of which were considered marked (more than 10 cysts), 8 moderate (5-10 cysts) and 9 slight (less than 5 cysts). Endometrial cysts are often associated with cystic ovaries as a result of prolonged estrogenic stimulation (Jubb and Kennedy, 1970). This association is however not seen in this study.

Paraovarian cysts were observed in 20 genital tracts, 13% affecting the right horn, 4% the left horn and 3% both horn. The cysts usually represent dilated vestigial segments of the embryonic Wolffian body (Smith et al, 1972) or may have originated from of either mesonephric or paramesonephric tubules and ducts (Jubb and Kennedy, 1970).

Adhesion of oviduct to ovary has been incriminated as a cause of infertility in the cow (Summers et al, 1974). In this study one such case was observed (Fig.3) and the adhesion was at the hilus of one of the ovaries. Its significance in the sow is unestablished.

Uterine abscess is not a common observation and is thought to follow severe metritis or localised traumatic injury to the infected endometrium (Jubb and Kennedy, 1970). One case of this

condition was observed in this study but unfortunately no organism was isolated on culture studies.

There were 2 cases of granulomatous endometritis with typical microscopic appearance. Grossly they appeared as miliary whitish-yellow nodules (Fig. 4i and 4ii) which are often seen in Brucella suis infection (Jubb and Kennedy, 1970). No organism was unfortunately isolated on culture studies.

Hydrometra was observed in 21 cases, 8 of which had concurrent endometritis and 2 had cystic endometrial hyperplasia. None of these sows had cystic ovaries. The occurrence of hydrometra concurrent with endometrial hyperplasia has been described by Jubb and Kennedy (1970).

Six uterus had localised hematoma and endometritis. Hematomas are possibly a sequel of severe endometritis.

Cystic structures adjacent to the cervix and uterus were diagnosed as paratubal cysts. The cysts may intefere with parturition if it becomes too large as seen in one of 8 cases present in this study (Fig.5). The cysts contained gelatinous material and had an epithelial lining. In the other 7 cases, the paratubal cysts were about 2-3 cm in diameter.

Twenty cases of fibroma were observed involving the serosal surface of the uterus (Fig.6). Its significance in interfering with fertility is questionable.

Histopathological observation

The microscopic lesions affecting the genital tracts are

summarised in Table II. Fifteen of the genital tracts were free of lesions, 5 of which also did not have any gross lesion .

Both endometritis and cervicitis were observed in 20 cases while all the three lesions of endometritis, cervicitis and salpingitis together in 2 cases. Jubb and Kennedy (1970) suggest that cervicitis is either an extension of endometritis or attributable to manipulation during artificial insemination.

Most cases of salpingitis were reported as ascending infection from the uterus or after rectal manipulation of ovaries and oviducts (Miller and Campbell, 1978; Jubb and Kennedy, 1970). In this study, only 4 of the 39 sows with endometritis also had salpingitis infering that endometritis does not always lead to salpingitis (Fig.7).

Endometritis, endometrial cysts and cervical cysts together were observed in 2 cases, endometritis with endometrial cyst in 13 cases and cervical cysts with cervicitis in 2 cases. Association between all these were observed in the ewes (Adam, 1975).

Cystic endometrial hyperplasia was observed in 13 cases (Fig.8). In human it is usually due to long continual estrogen administration (Craig, 1979; Smith et al, 1972). However Jubb and Kennedy (1970) suggest that cystic endometrial hyperplasia may predispose to the development of endometritis. Four of the 13 cases had both these condition.

None of the ovaries in the 13 cases with endometrial hyperplasia were cystic. This is inconsistent with the finding that cystic and non-cystic endometrial hyperplasia in cows are invariably

Table II

Microscopic lesions observed in the genital tracts of sows

| Organ | Lesion | No. observed | Total* | |
|---|---|---|---|---|
| Cervix | Chronic cervicitis | 28 | 91 | 30.8 |
| | Acute cervicitis | 4 | 91 | 4.4 |
| | Microscopic cyst | 10 | 91 | 11.0 |
| | Cystic endocervical hyperplasia | 7 | 91 | 7.7 |
| | Goblet cell hyperplasia | 2 | 91 | 2.2 |
| Uterus | Chronic endometritis | 33 | 99 | 33.3 |
| | Acute endometritis | 4 | 99 | 4.0 |
| | Cystic endometrial hyperplasia | 13 | 99 | 13.1 |
| | Myxomatous change | 18 | 99 | 18.2 |
| | Microscopic cyst | 4 | 99 | 4.0 |
| | Vasculitis | 2 | 99 | 2.0 |
| | Squamous metaplasia | 1 | 99 | 1.0 |
| Oviduct | Chronic salpingitis | 4 | 98 | 4.1 |
| | Squamous metaplasia | 2 | 98 | 2.0 |
| Ovary | Old hemorrhage | 20 | 97 | 20.6 |
| | Hemangioma | 10 | 97 | 10.3 |
| | Dysplasia of interstitial gland of rete ovary | 2 | 97 | 2.1 |

* Only 91 cervix, 98 oviducts and 97 pairs of ovary were examined microscopically.

associated with ovarian follicular cysts or granulosa cell tumor, the two potential causes of hyperestrogenism (Jubb and Kennedy, 1970).

Squamous metaplasia of uterus was observed in one sow with no evidence of concurrent chronic endometritis. This is contrary to the believe that squamous metaplasia of the uterus is associated with chronic endometritis as a result of chronic irritation (Jubb and Kennedy, 1970). The condition has also been produced in the uterus of guinea pig fed an excess estrogen in their food (Smith et al, 1972).

Microscopic cervical cysts (Nabothian cysts) were observed in 10 cases. Their development was possibly due to the obstruction in the ducts of the cervical glands.

Hemangiomas were seen in 10 of 98 pairs of ovaries examined affecting them bilaterally (Fig.9i and 9ii). Hemangioma of ovary has not been reported in the literature reviewed in this paper. The condition appears to have interfered with fertility of the sows since all affected ovaries were inactive.

Bacteriological observation

Infection, defined as the presence of bacteria within the uterus, was observed in 54 of 99 uteri examined with 30 harbouring single species of bacteria, 22 double infections and 2 triple infections.

The most frequent genera of bacteria isolated in order of frequency and their association with endometritis are summarised in Table III. The bacterial population is almost similar to those found in the ewes (Adam, 1975).

Table III

Bacteria isolated from 54 uteri of sows

| Organism | Frequency of isolation in uteri with endometritis | without endometritis | Total |
|---|---|---|---|
| Escherichia coli | 13 | 9 | 22 |
| Staphylococcus spp. | 2 | 11 | 13 |
| Acinetobacter spp. | 2 | 11 | 13 |
| Klebsiella spp. | 4 | 7 | 11 |
| Pseudomonas spp. | 6 | 2 | 8 |
| Proteus spp. | 2 | 2 | 4 |
| Corynebacterium pyogenes | 3 | - | 3 |
| Streptococcus spp. | 1 | 1 | 2 |
| Aeromonas spp. | 2 | - | 2 |
| Pasteurella spp. | 1 | - | 1 |
| Micrococci | 1 | - | 1 |
| Total | 37 | 43 | 80 |

Endometritis was observed in only 42.6% of the uteri that yielded bacteria on culture. In a study done by Adam (1975) in ewes, a close association was shown between the presence of bacteria and the occurrence of endometritis ($P < 0.001$) but Kenney et al (1967) observed this association in only 75.0% of the cases studied. The low percentage may indicate that some organisms isolated were not pathogenic. For example, Klebsiella spp. when present alone in the uterus was not associated with endometritis but together with other organisms such as Escherichia coli might have contributed to the endometritis present.

Bacteria were isolated from 43 uteri in which there was no endometritis and 37 uteri with endometritis. Microorganisms isolated from the 4 cases with acute endometritis were Corynebacterium pyogenes, Escherichia coli, and Acinetobacter spp. Mc. Erlean (1959) suggested that Corynebacterium pyogenes, Pseudomonas spp. Mycobacterium tuberculosis were causes of endometritis, sporadic abortion and stillbirth in swine.

In the present study, Corynebacterium pyogenes was totally associated with endometritis, Pseudomonas spp. second with 75% association and Escherichia coli third with 59.0%. Corynebacterium pyogenes was isolated 3 times from uteri having acute endometritis.

Staphylococcus spp. were isolated in 13 cases either as pure culture or in combination with other organisms. These organisms are considered to be the cause of sporadic abortion, stillbirth and endometritis in pigs (Fennestad et al, 1955; Thorne and Nilsson, 1961).

Several other organisms have also been isolated from aborting sows, including Erysipelothrix rhusiopathiae and Corynebacterium pyogenes (Vet. Invest. Surv., 1960), Pseudomonas spp. and Pasteurella spp. (Menzies and Hughes, 1962) and Salmonella spp. (Contini, 1959).

Klebsiella spp., Aeromonas spp., Proteus spp., Acinetobacter spp. and micrococci have not been reported as causes of endometritis in swine. Since these organisms were isolated from uteri with endometritis in the present study their significance should not be overlooked.

## CONCLUSION

The most frequent lesions observed involved the uterus, the ovary, the cervix and the oviduct in that order of frequency. It can therefore be concluded that poor reproductive performance in the sows is largely due to the abnormalities affecting the uterus and ovary.

Sows such as those used in the study are usually culled from the herd and sent for slaughter because they either show some definite disability, aged or are considered by the owner to be the least productive of his sows. However it was not possible to trace the source of these sows in order to obtain some history especially on their reproductive performance. It was thus not possible to carry out any correlation and epidemiological studies on the abnormalities observed and the bacteria isolated. The usefulness of the data is limited to merely reporting the presence of these abnormalities and bacteria.

Time is a another constraint in the study. The 6-week period allocated was too short and the many laboratory procedures involved were too laborious and time consuming. This is why isolation studies for other organisms such as anaerobic bacteria, mycoplasma and Hemophilus spp. were not attempted.

Statistical analysis was not done considering that the number of samples was inadequate and sampling was not totally random.

Nevertheless, this project does serve as a start towards knowing and understanding the abnormalities that may be present in the genital tracts of sows.

Further studies especially on the epidemiology and the correlation of the abnormalities to reproductive failure are necessary.

## BIBLIOGRAPHY

Adam N.R. (1975): A pathological and bacteriological abattoir survey of the reproductive tract of Merino ewes in Western Australia. Aust. Vet. Journal. 51: 351 - 354.

Close R.W. and Liptrap R.M. (1975): Plasma progestrone level in sows with induced cystic ovarian follicles. Res. Vet. Sci. 19: 28 - 34.

Contini A. (1959): Suddi una nuova forma di aborto infeltivo dei suini 'I' aborto da salmonella Atti Soc - Ital. Sci. Vet. 13; 378. Abst. Vet. Bull. 1960, 30: 3817 - 3843.

Craig J.M. (1979): Pathology of the female reproductive tract. American Journal of Pathology. 94: 385 - 437.

Dawson F.L.M. (1963): As cited by Adam (1975): A pathological and bacteriological abattoir survey of the reproductive tract of Merino ewes in Western Australia. Aust. Vet. J. 51: 351 - 354.

Fennestad K.L., Pedersen P.S. and Moller T. (1955): As cited by Rasbech (1969). A review of the causes of reproductive failure in swine. Brit. Vet. J. 125: 599 - 614.

Goethals P. (1951): As cited by Perry J.S. and Pomeroy R.W. (1956): Abnormalities of the reproductive tract of the sow. J. Agric. Sci. Camb. 47: 238 - 248.

Green J.A. and Nalbandov A.V. (1948): Incidence and histology of reproductive abnormality in the sow. Journal Ani. Sci. 7: 540 - 541.

Hawk H.W. (1961): Variation in the inflammatory response and bacterial activity of the sheep uterus during the estrus cycle. Am. J. Vet. Res. 22: 689 - 692.

Holter J.A. (1976): Survey of laboratory finding in porcine abortion in Proceedings, 19th Ann. Meeting, Ani. Assoc. Vet. Lab. Diag. 47 - 50.

Jubb K.V.F. and Kennedy P.C. (1970): Pathology of Domes. Ani., 1: 2nd ed: Academic Press Publication. 487 - 585.

Kenney R.M., Lein D.H., Loomis W.K. (1967): A study of equine fertility. Rep. New York State Vet. College 68: 114 - 115.

Kirkbride C.A. and McAdaragh J.P. (1978): Infectious agent associated with fetal and early neonatal death and abortion in swine. J. Am. Vet. Med. Assoc. 172: 480 - 483.

Liptrap R.M. (1970): Effect of corticotrophin and corticosteroid on estrous ovulation and estrogen excretion in the sow. J. of Endoc. 47: 197 - 205.

Liptrap R.M. (1973): Oestrogen excretion by sows with induced cystic ovarian follicles. Res. Vet. Sci. 15: 215 - 219.

Mc. Erlean B.A. (1959): Abortion in a sow due to avian tubercle bacillus. Irish Vet. J. 13: 198 - 202.

Menzies D.W. and Hughes L.E. (1962): As cited by Lawson, J.R. (1963): Bacteria and mycotic agent associated with abortion and stillbirth in the domestic animal. Animal Health Branch Monograph No.5, F.A.O. Rome 22.

Miller R.I. and Campbell R.S.F (1978): Anatomy and pathology of bovine ovary and oviduct. Vet. Bulletin 48: 737 - 753.

Nath K.C., Purbey L.N. and Luktuke S.N. (1982): Genital disorder of porcine female. Indian Vet. J. 59: 878 - 881.

Perry J.S. and Pomeroy R.W. (1956): Abnormalities of the reproductive tract of the sow. J. Agric. Sci. Camb. 47: 238 - 248.

Rasbech N.O. (1969): A review of the causes of reproductive failure in swine. Brit. Vet. J. 125: 599 - 614.

Roberts S.J. (1971): Vet. obstetric and genital disease. Distributed by Edwards, Bros. Inc. Ann. Arbor, Michigan. 561.

Rowson L.E.A. and Spriggs D. (1942): As cited by Rowson L.E.A. Larming G.E. and Fry R.M. (1953): The relationship between ovarian hormones and uterine infections. Vet. Rec. 65: 335 - 340.

Saunders C.N. (1958): Abortion and stillbirth in pigs. An analysis of 67 outbreak. Vet. Rec. 70: 965 - 970.

Scholten J.A. and Liptrap R.M. (1978): A role of the adrenal cortex in the onset of cystic ovarian follicle in the sow. Can. J. Comp. Med. 42: 525 - 533.

Smith H.A., Jones T.C. and Hunt R.D. (1972): Veterinary Pathology 4th ed: Lea and Febiger Philadelphia Publication. 1299 - 1350.

Summers P.M., Campbell R.S.F. and Dennet D.P. (1974): Herd studies on the genital pathology of infertile beef cows. Aust. Vet. J. 50: 150 - 154.

Thain R.I. (1965): Cystic ovaries and cystic endometrium in swine. Aust. Vet. J. 41: 188 - 189.

Thorne H. and Nilsson P.O. (1961): Staphylococcus aureus as the cause of abortion in swine. Acta Vet. Scand. 2: 311 - 315.

Vandeplassche M., Spincemaille J. and Bouters R. (1971): Die zystose Eierstock degeneration bei der Sau. Dt. tierarztl. Wschr. 78: 91 - 93.

Vet. Invest. Service. (1960): A survey of the incidence and cause of mortality in pigs, II; Finding at post-mortem examination of pig. Vet. Rec. 72: 1240 - 1247.

Warnick A.C., Grummer R.H. and Casida L.E. (1949): The nature of reproductive failures in repeat breeder sows. J. Ani. Sci. 8: 569 - 577.

Wiggin E.L., Casida L.E. and Grummer R.H. (1950): The incidence of female genital abnormalites in swine. J. Ani. Sci. 9: 269 - 276.

Wilson R.F., Nalbandov A.V. and Krider J.L. (1949): A study of impaired fertility in female swine. J. of Ani. Sci. 8: 558 - 568.

APPE DIX

Fig. 1: Large bila eral follicular cysts in the ovari s of sow


Fig.2: Endometrial cyst in th mucos of th ut rus

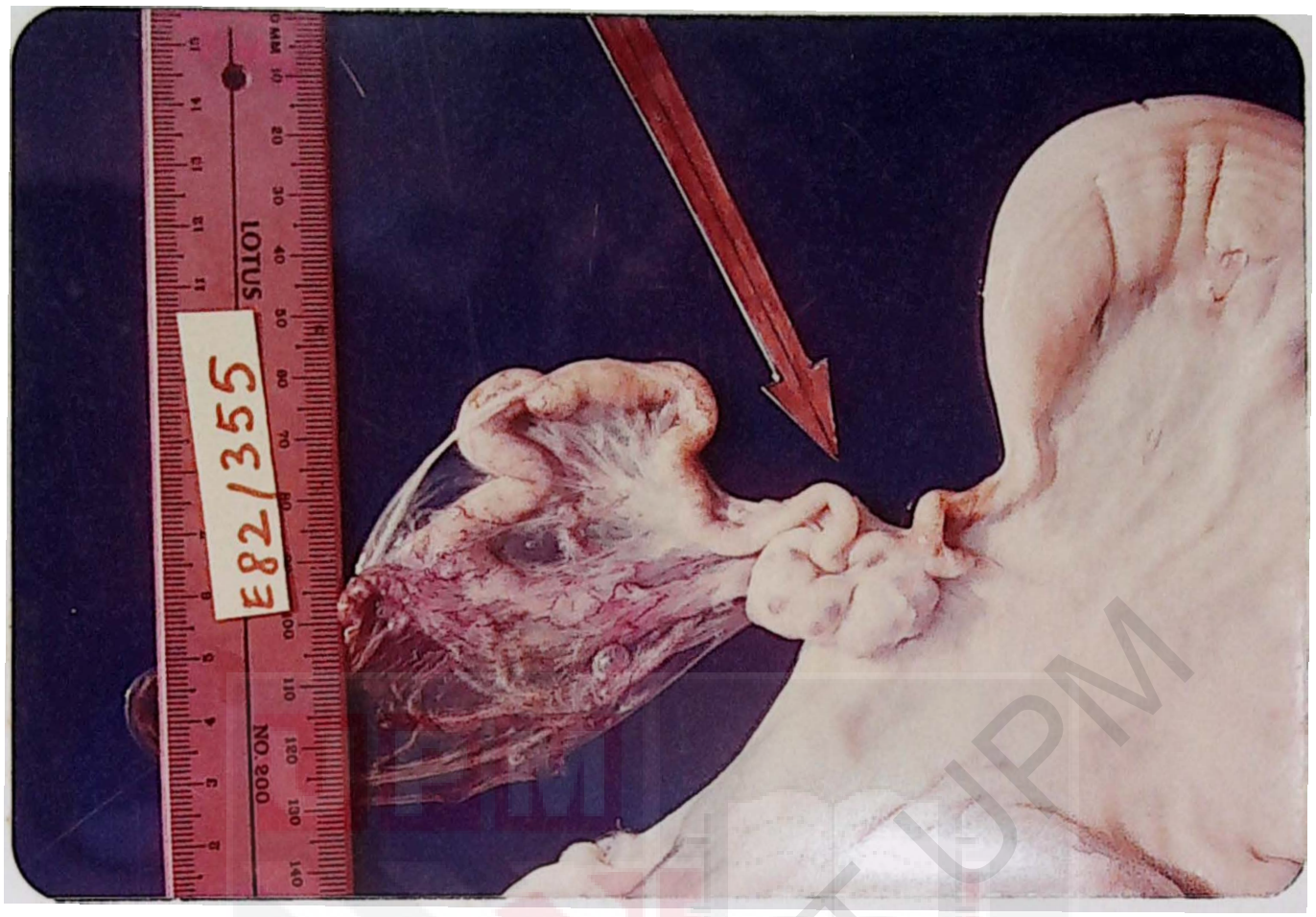


Fig.3: Adhesion o oviduct at the hilus of the ovary

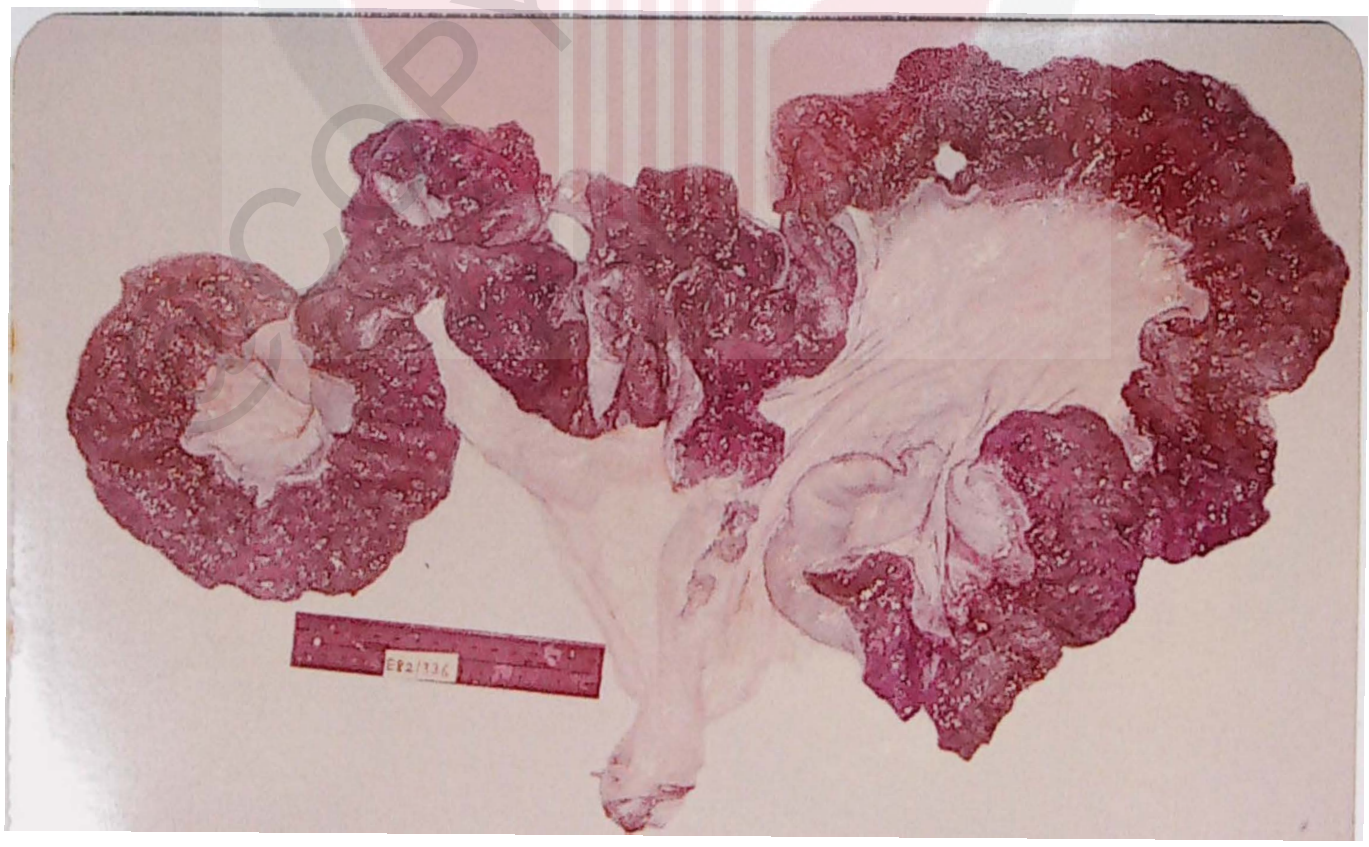

Fig. i: Gra lomatous endomet i is ch ac eri ed by miliary y llowish-whi o ul s in h uteri nucosa.

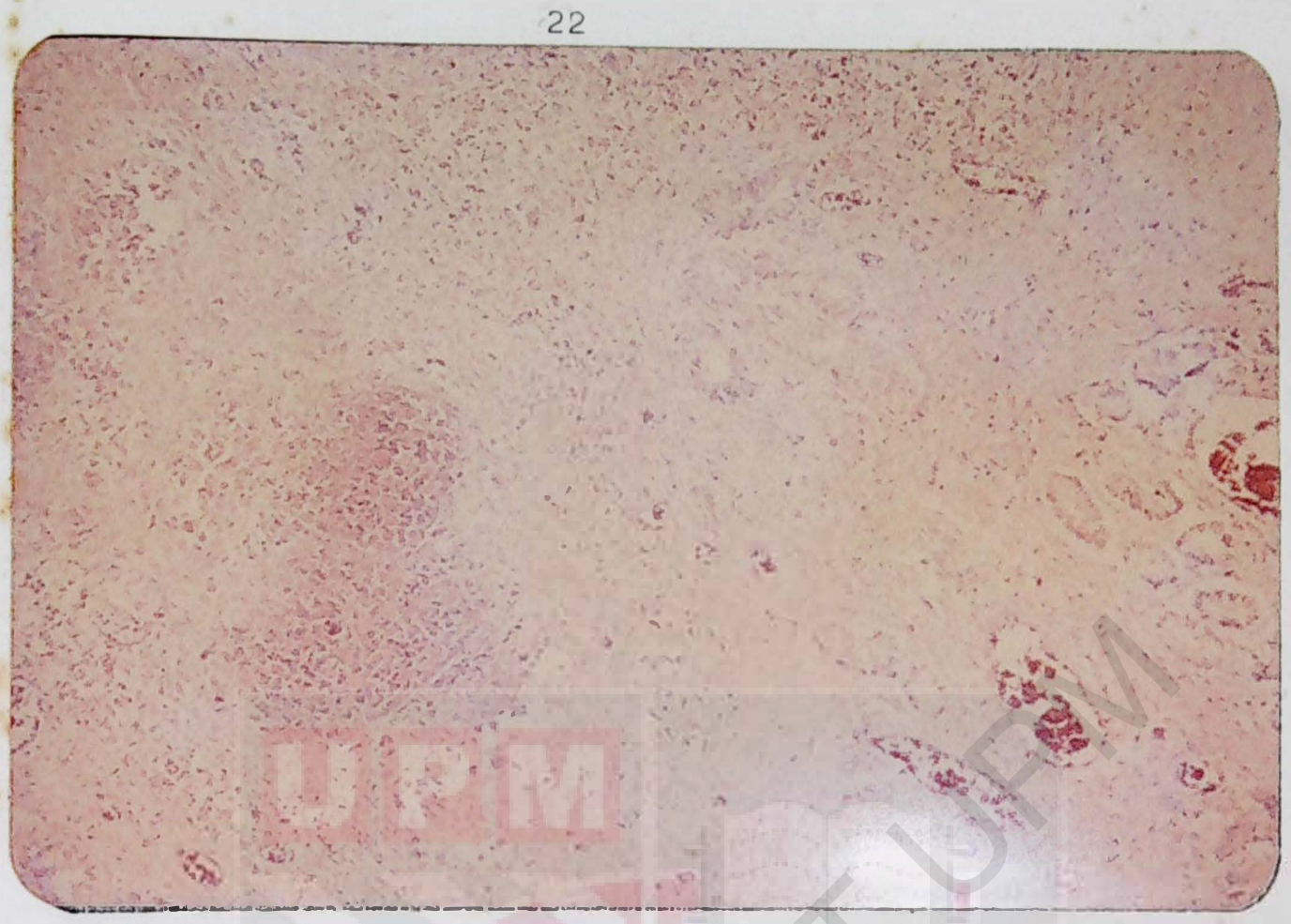

Fig.4ii: Granulomatous endometritis in the endometrium


Fig.5: A large paratubal cyst adjacent to the cervix

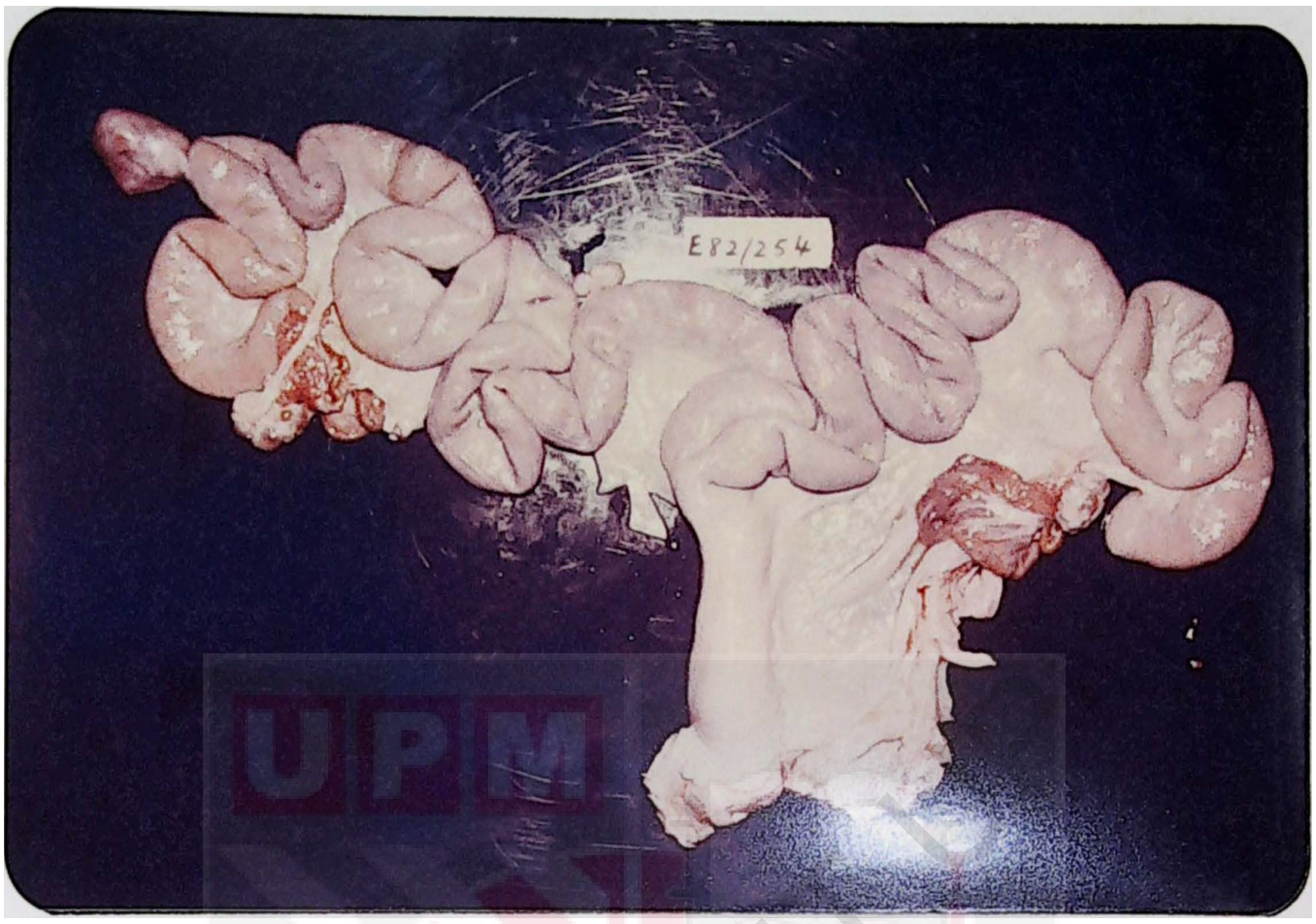


Fig.6: Ov l sh e fibromas tt cl d to th. uterine sero a

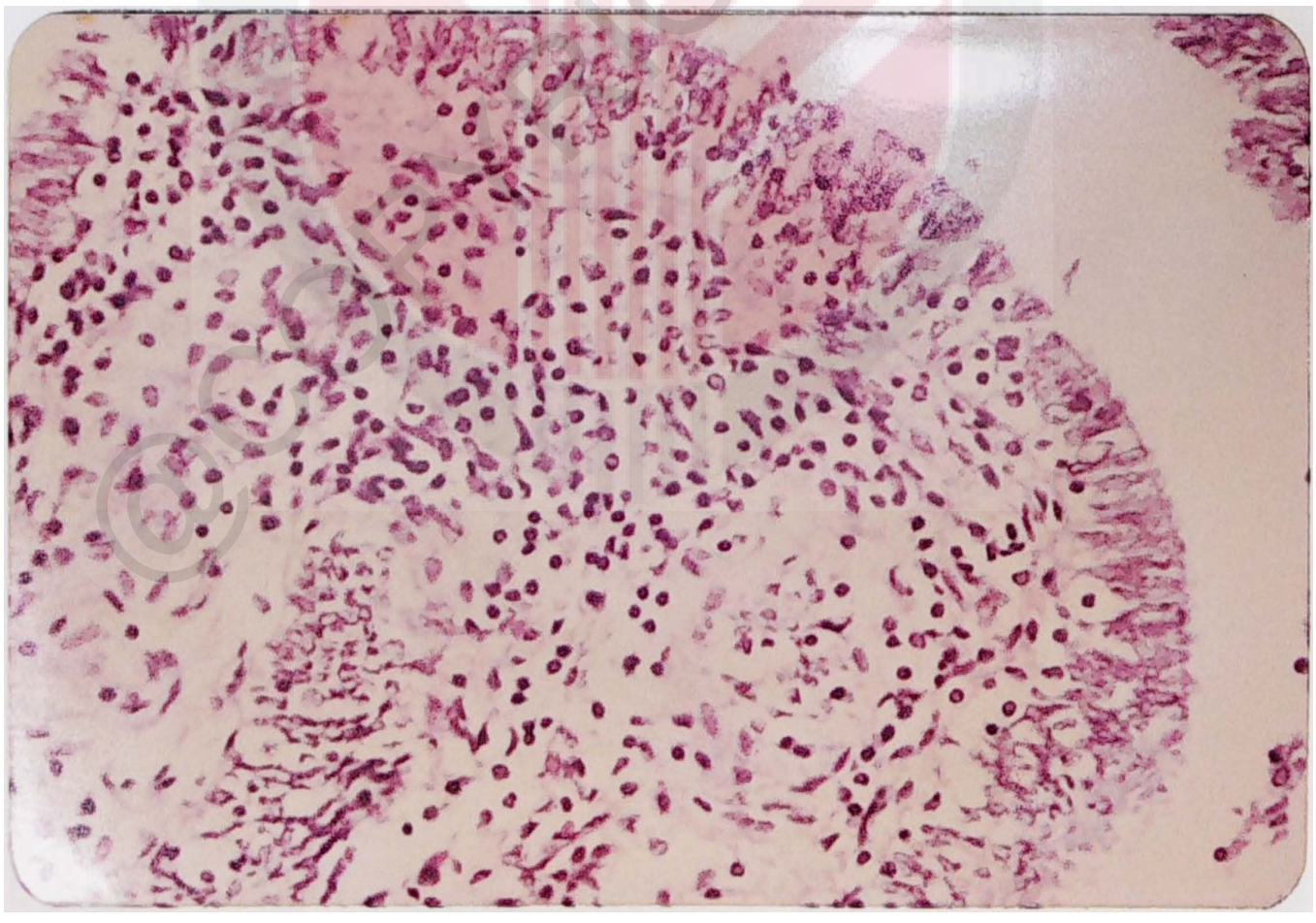

Fig.7: Chro ic sal irgiti char cteri- by massive infiltr tion c mononuclear c lls n h sub-pith lium

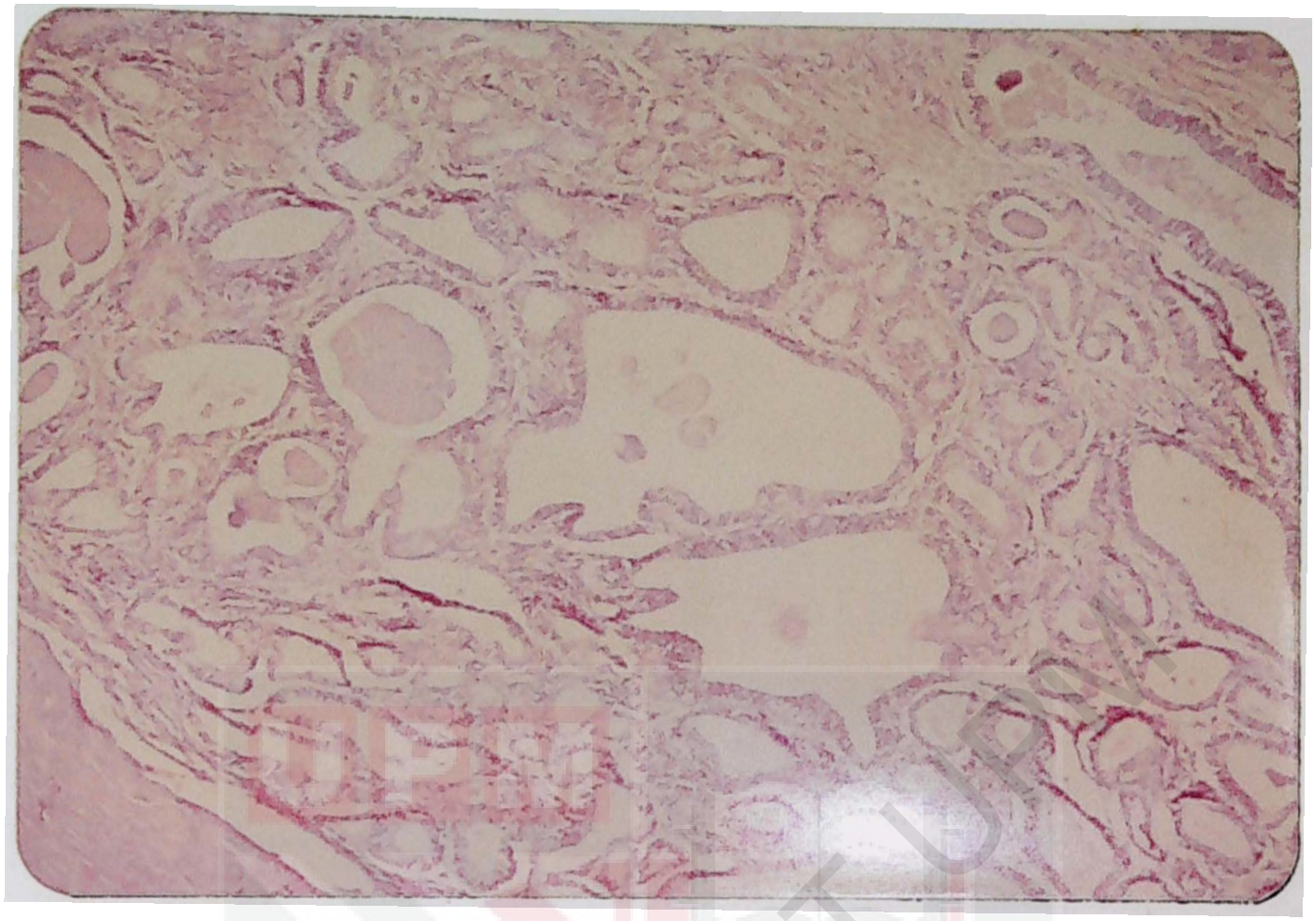

Fig.8: Cystic endometrial hyp rplasia characterised by hyp rplastic and dilated uterine glands


Fig.9i: Hem ngioma o he ov y cha c ris by pur lish o e dish 'scolo ation d markedly enlarg d

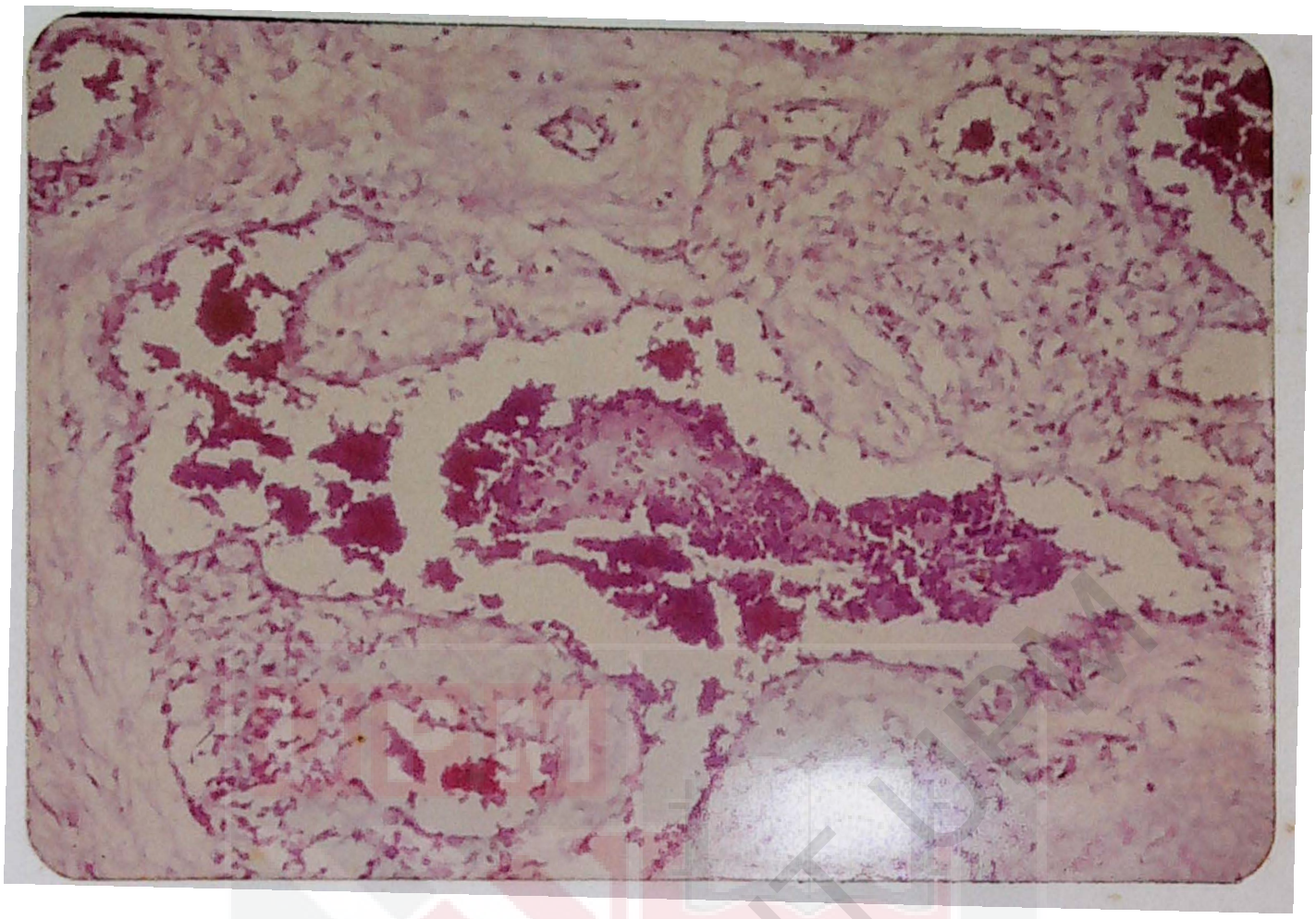

Fig.9ii: Hemangioma of the ovary characterised by vascular spaces and neoplastic endothelial cells.