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PYELITIS COMPLICATING PREGNANCY

SENIOR THESIS

UNIVERSITY OF NEBRASKA

COLLEGE OF MEDICINE

E. T. COATES

480483

INTRODUCTION

I have written on the subject of "Pyelitis Complicating Pregnancy" because I feel that this is a condition with which the obstretician is not infrequently confronted. Therefore it is a condition, about which, it would be well for anyone contemplating this specialty to be well informed. It is for this reason I have chosen this subject.

As a student I feel rather inadequate to cover the subject because I have had no way of evaluating the authors who have written upon the subject; I have had no practical experience clinically which would enable me to draw my own conclusions. Therefore, I have attempted to collect the opinions, of what appear to be the more accepted authorities on the subject, and from these opinions, to present the best methods of diagnosis and treatment of this disease, as well as to present the etiologic factors and the pathology of the infection.

History

It would be well to review briefly the hist* orical facts concerning the development of our knowledge of pyelitis in pregnant women. The condition is first described in Smellies Midwifery, in 1752. Pierre Rayer in an essay "Maladies des reins" (1841), first called attention to the occurrence of inflammatory processes in the renal pelvis during pregnancy, and pointed to their casual interrelation. Kaltenvack described the desease as a distinct clinical entity in 1872. In 1892, Theodore Reblaub discussed the subject more in detain, reporting several cases and their treatment to the French Congress of Surgeons in 1899. After Creveilhier had emphasized the frequent occurrence of ureteral dilatation in pregnant women, Albarran, Baumm, Roovsing, independently in 1899, stressed primary etiological factors, and conspicuous progress had been made in the recognition of the clinical aspects of the disease.

In 1899 Reed reported cases and classed the disease as relatively rare. With more modern methods of diagnosis this has proved not to be the case.

Luchs has told us that at least 70% of all pregnant cases show this infection. Benda on the other ahdn reports only 1%.

Over a period from 1893 to 1899, Olshausen reported 25 cases; Vinay, 9; novac, 11; and Reblaub,3.

Both in urology and obstetrics, the topic of pyelitis in pregnancy has received widespread interest for the past two decades, and still continues to be the subject of active investigation and lively discussion. Considering the large number of investigators who have interested themselves in attempting to discover the nature of the pathologic process involved in this condition, one might have thought that by this time essential points would have been established. Yet, real knowledge concerning the basic phenoma is yet lacking, and there is still widespread diversity of opinion as to the primary etiological factors, although considerable progress has been made toward the recognition of the disease as a clinical entity.

ETIOLOGY

The importance of infection superimposed upon urinary stasis a s the essential f ature in the development of pyelitis during pregnancy has been widely discussed. As a result of Opitz's presentation 1906 the condition became better known in Germany and since then has constituted one of the major themes for discussion. The majority of writers share Opitz's opinion that the condition is primarily due to compression of the ureter, especially the right one, between the uterus and the brim of the pelvis, followed by diltation of the ureter above; while the concomitant infection is interpreted as of either hematogenous origin or due to an ascending process. During the past few years However, the literature shows a tendency toward abandoning the pressure theory, as many cases of pyelitis occur in early months of pregnancy when the idea of such a mechanism can hardly be maintained.

In discussing the etiology of pyelitis in pregnancy , the writer wishes to quote from Tice the following:- Pyelitis is practically always caused by bacterial invasion or multipication. Traumatism, elimination of certain irritants drugs such as catharids, cubebs, urotropin, etc., the alteration of the urine in certain diseases (sugar in diabetes) may cause renal congestion but not Septic inflammation. Normally the kidney can eliminate without Harm to itself any variety of organism, the latter being

carries to it by the blood current from a focus such as a purulent prostate or urethera, the bladder, intestine or from some far distant focus, e. g., a lowering of its resistance as a result of some general cause, such as anemia overwork, worry, malnutrition, or inter current disease. Most commonly found, however, in the production of a pyelitis is obstruction in the urinary tract, which not only lowers the resistance of the kidney pelvis, but affords a favorable culture medium for the growth of various microorganisms. Obstruction alone though, in the urethera, bladder, or ureter will not cause suppurative pyelitis, but only a predispostion to it. For example, an an aseptic ligation of one ureter leads to compression atrophy of the kidney on the corresponding side, whereas septic ligation is followed by a suppurative process. From what has been said, therefore, it is obvious, that certain factors are generally present before a pyelitis is set up , viz, lowered resistance, urinary obstruction and pyogenic organisms, The healthy mucous membrame of the urogenital tract ordinairily resists septic infection, but there are exceptions to this rule and at times pyelitis will be set up without any apparent of discoverable cause. The most frequent cause of pyelitis is infection by the bacillus coli comunis. Next in importance are the Staphylococcus aureus or albus, usually the former, and the

Streptococcus. Other organisms, such as bacillus of typhoid fever, bacillus proteus, gonococcus, pneumococcus, bacillus mucosis ccapsulatis, bacillus Pyocyaneus, etc., are rather uncommon invaders. It is not uncommon to find one or more types of organisms associated in the condition, particularly in the advanced stages of the disease. Infections with the tubercle bacillus are quite common, but On account of the importance of the condition it is described separately."

Almost 1% of all pregnant women have pyelitis, in the majority of cases on the right side. In the first half of the last century Cruveilher found delatation of the ureters in the bodies of pregnant women; this was more frequent on the right than on the left. It was explained as being due to compression of the ureter by the pregnant uterus. As the uterus grows the distance between the cervix and the ureter decreases until it finally disappears altogether. The decreased convexity of the ureter is noticed as they are pushed outward. Weibel succeeded in demonstratin dilatation of the ureters and retention of urine in normal subjects Among one hundred women in various stages of pregnancy cystoscopic examination showed retention of urine in forty seven; the retention was sometimes in one, more rarely in both ureters. The right alone was affected or else it was affected to a greater degree than the left. Almost always the compression was about the level of the linea innominata, 11-15 cm. above the mouth of the ureter. This would indicate that the problem of pyelitis in pregnancy is chiefly a mechanical one. The stagnation of urine brings about

favorable conditions or infection. The more frequent involvement of the right side is explained by the physiological dextroposition and dextroversion of the uterus. The Mechanical factor is doubtless important with pathogenesis of pyelitis in pregnancy but it is not the only one .. Keherer thinks hyperemia of pregnancy is important and Stoeckel thinks the dilatation of the ureter is a part of the general enlargement of the pelvis organs during pregnancy. Pregnancy also affects the all bladder and bile ducts as well as the pelvis of the kidney. The two problems have much in common. Formerly the purely mechanical conception was held on the effect of pregnancy on the bile tract., but this too has changed. Westphal demonstrated a motility neurosis of the gall bladder and bile ducts during pregnancy from increased irritability of the vagus. It is manifested by increased tendency to the closure of Oddi's sphincter, and explains the tendency to stagnation of bile and gallstones in pregnancy. Westphal's findings are in harmony with the work of Louvos who examined blood pressure during pregnancy and found vagotonia of the vasomotor system in the second half of pregnancy. As all smooth muscle is innervated by the vegetative nervous system it was to be expected that the increased vagus tonus found by Louvos in the blood vessels and Westphals in the gall bladder and bile ducts would be found in the ureters also. The authors examinations lead him to believe that in the first half of pregancy in which sympathetic tonus is decreased, as a rule there is an increase

in the discharges from the ureter, while in the second half of pregnancy, during which vagus tonus is increased, there is a decrease in the number of discharges. If the activity of the kidney remains unchanged this would necessarily cause stagnation of urine in the kidney pelvis. So pyelitis gravidarium is not caused chiefly by a mechanical factor but chiefly by a neuro-muscular one. Stoeckel says in an article written in 1924 that, "if atony of the ureter is present, in consequence of pregancy, resulting in insufficiency of the ureter ostium, infective organisms may pass from the bladder into the ureters, and may be retained there, due to the weakness of the ureteral peristolsis, which is incapable of ejecting the individual agents. The infection may, under these conditions ascend as far as the renal pelvis in the capillary peripheral stream. The permeability of the atonic intestine for Bacillus coli is increased during pregnancy, with consequent invasion of the blood and urine on the part of the pathogenic organisms. In this sense pyelitis is primarily based upon intestinal disturbances, due to toxemia of pregnancy.

Sennewald in 1928 advanced another theory in 1928 to answer the question stated at the beginning of the discussion on etiology. "In order to get a clear idea of the cause of the stagnation of urine and dilatation of the upper part of the urinary tract, the author made several pyeloureterograms of almost all typical cases of pyelitis gravidarium that came to

his section in the course of a year, altogether 27 cases. He also tested the effect of catheterization of the ureters, in association with other methods of treatment. In judging the roentgen pictures it must be remembered that to a certain extent they represent an unphysiological condition, for normally the ureter only contains a small amount of urine, while in pyelography a large amount of a fluid that is not entirely different is introduced into the ureters and pelvis. In order to judge the peristalsis of the ureter, serial pictures were made in some cases, as the individual picture only represents one phase of a ureter in motion. Multiple pictures were made particularly of kinks+tortuosities of the ureter, in order to exclude chance spasm or artificial kink. The pyelograms showed a very considerable dilatation of one or both ureters, predominantly the right one. Control pictures of normal pregnant women also sometimes showed slight dilatation, chiefly of the right ureter, but never so marked as in pyelitis cases. A certain amount of pain from dilatation may also occur in normal pregnant women. The author has seen three such cases admitted under mistaken diagnosis of appendicitis with pain in the right side but they did not show temperature or other pathological conditions. Catheterization of the ureters showed slight stagnation but the urine was free of bacteria and did not contain many leucocytes. Symptoms were relieved by catheterization. Strassman has seen similar cases and proposed the name of "constipation of the ureter" for them.

Among the author's 27 pyelitis patients 17 were affected chiefly on the right side, three chiefly on the left and the others on both sides. Almost always the ureter on the side of the most intense pyelitis was most dilated. In most cases also there was slight and in some severe cases considerable dilatation of the pelvis of the kidney. In about a third of the cases only the ureter was dilated. In all of the cases in which roentgenograms were taken before delivery the dilatation of the ureter was limited to the part above the pelvis. Generally the dilatation stopped some centimeters above the linea innominata. There may be an obstruction where the ureter crosses the common iliac artery; generally on catheterization a certain amount of resistance is encountered here. It was impossible of course to decide from the roentgenograms whether the obstruction was due to hyperemia and edema or due to the pressure from the pregnant uterus. But in pictures taken 8 to 10 days after delivery, that is, at the time when the uterus had undergone considerable involution the dilatation of the ureter was still visible, but in many cases could be followed into the pelvis and in some cases almost to the bladder. This would seem to indicate that the toxins of pregnancy cause atony of the ureter. This would naturally effect the pelvic part of the ureter too, and explain the dilatation of that part of it after the obstruction was removed. Such a condition of atony would of course only recede slowly after delivery. The kinks and tortuosities

often seen in the pyelograms also indicate atony of the ureters; sometimes they are so great that they cause secondary obstructions and hydronephrotic changes. When such pictures are first seen it is hard to believe that they are temporary phenomena of pregnancy; but the author has examined such cases months after delivery and found that they have disappeared completely. Pyelograms are given of a typical case of this sort. It was a case of very severe bilateral pyelitis gravidarum. The pyelogram on the right side showed an almost corkscrew like tortuosity and distinct dilatation with hydronephrosis. The patient was a primipara 27 years of age who came for treatment on a desperate condition. But contrary to expectation repeated catheterization of the ureters in association with other methods of treatment, carried the pregnancy on in spite of repeated attacks of pyelitis to delivery of an almost mature child. A pyelogram after a months treatment showed that the congestion was not nearly so great as at first. The kidney pelvis and ureters remained in this condition until delivery. In a picture taken 19 days after delivery there was considerable less tortuosity. Kidney function had also improved; at first elimination of blue had been very much delayed on the right. A pyelogram 6 mos. after delivery showed the ureter normal and no hydronephrosis. After a treatment of Wildunger irrigations of the kidney pelvis with silver nitrate the patient is now free of

symptoms and the urine contains no bacteria,

In an article appearing in The American Journal of Surgery in 1929, Frances E. Shields has summarized the opinons of a number of well known authors on the subject of pyelitis in pregnancy as follows:- Of the predisposing factors in the gastro intestinal tract constipation undoubtedly leads the list. Some authors have expressed the opinion that as a result of intestinal stasis, there is an increased production of colon bacilli which eventually reach the kidney. Bacillus coli communis is the infecting agent in Over 90% of the cases

Clinical evidence points to the probability of the infection reaching the kidney by way of the bolld stream. However, it is a well established fact that it is almost impossible to produce an infection in the urinary tract without some sort of obstruction.

De Lee takes the stand that bacteriuria is found in a large percentage of cases of healthy pregnant women. He thinks this is probably due to constipation. The ureters particularly the right, ha e been found dilated and full of urine in about two thirds of the gravidae coming to autopsy. This, He claims, is caused by torsion, stretching or kinking of the ureters due to the enlargement and dislocation of the pelvic organs, or the swelling of the bladder mucosa but not ot compression, since the specific gravity of the pregnant uterus is about equal to that of the intestinal mass. Owing to stasis of the urine and the bactiuria a py

elo-ureteritis is easily set up but infection can reach the parts also through the blood stream or lymph channels.

Hunner, on the other hand, believes that in all cases of pyelitis in pregnancy there has been a pre-existing stricture of one or both ureters. This narrowing, he feels, may be congenital or acquired. He is convinced that time and more careful study will prove that some of the congenital cases are caused by inflammatory processes derived through the placental circulation. However, by far the greater number are acquired, the origin being in some cases traumatic, that is from injury at operaion or childbirth, or from pressure from tumors. A large number are associated with cancer of the cervix. A few are syphilitic. A simple inflammatory stricture due to focal infection in some other part of the body is overwhelmingly ffequent when compared with stricture from all other causes. Hunner is convinced that the stricture usually originates from some focus of infection.

Hunner's work has gone far to revise opinions on the cause of the urinary stasis which undoubtedly exists in these cases. But to date the vast majority feel that the actual cause in most cases is pressure on the ureters by the pregnant uterus. Two or three outstanding facts have influenced many persons in this conviction. First in 80% of cases the pregnant uterus during its growth is deviated to the right side of the abdomen and is twisted on itself from left to right

.....Second, in pregnancy there is a constant right - sided ureteral dilatation, the left ureter and pelvis usually escaping this dilatation, and a consequent more frequent occurrence of right-sidded than left-sidded pyelitis. The knee chest position in pregnant women with pyelitis frequently will give complete and lasting relief. The conclusions drawn by the adherents to this theory are that the ureter is compressed at the brim of the pelvis by the pregnant uterus, the urinary flow is obstructed , the urine becomes infected and pyelitis results.

Hofbauer of Johns Hopkins, after microscopic study of the paremetrium in a series of 43 specimans obtained from pregnant women, reports the constant finding of a phagocytic tissue which appears at the base of the froad ligament during pregnancy. This is intensified by long labor and by the existence of infection.

Rosenow is of the opinion that this first lesion is in the kidney parenchyma. Craig, on the other hand, adheres to the theory that the cause of the stasis is pressure of the uterus on the ureter where it enters the pelvis.

According to Waldeyer the bladder is displaced downward owing to the pregnany uterus. As a result of this downward displacement the ureter becomes kinked or narrowed at the point at which it crosses the bony pelvis. Urinary stasisand dilatation follow.

As to the question of mode of entrance of the colon bacillusI believe that the infection is a blood borne one. It

Has been urged that, as colon bacilli have not been found in the blood stream, the infection by this organism could not be a blood borne one. Dick and Dick have shown that in nephritis of infective origin the organism causin the primary process amy be recovered from the urine by cultural methods, although the blood culture may fail to demonstrate it in the blood streame. It is, therefore, possible for an organism to pass through the blood stream in numbers so small that cultural efforts to find it fail and still grow secondarily in the kidney,

The distended and congested kidneys which are found as a result of obstructions t the ureters forms a locus minoris resistentiae, and colon bacilli which exist in enormous numbers in the large bowell may easily be deposited there by the blood stream.

Suber experimented upon rabbits to determine whether an artificial obstruction to the ureter could influence the production of a pyelitis. He placed a loop of catgut in such a manner that it pulled upon but did not completely occlude the ureter. He then placed solution of the animals own faeces in the bladder as well as irritating bodies, such as croton oil . His conclusion was that the infection was not an ascending one, although his previous view had been to the contrary.

While it cannot be assurred that the infection is invariably of hemogenic origin, and I do not feel that I havee

proved that to be the case, I believe it may in the large majority of cases be looked upon as a blood-borne infection. Recent work upon their transmission to distant parts of the body must cause us to believe that htis method of transmission is much more frequent than was formerly believed.

The writer, here wishes to give more time to an article previously mentioned by J. Hofbauer of John Hopkins University which is very convincing in its manner of presentation but which as we will later show, is contrary to later opinions.

With regard to the conditions of the ureter in pregnant women, two facgs have come to be established on a firm basis during the past two decades: namely, the frequent occurrence of ureteral dilatation and consequent upon it a certain degree of atony of the ureter, as shown by a delay in ureteric action. While former investigators(Olshausen), when studying the gross features of the ureter at autopsy, reported that dilatation was noted in 19% of pregnany women; modern methods of examination, particularly pyelograms, reveal an incidence of 80% and even more(Albarran, Halstead, Kretschmer and Heaney, Luchs, Crabtree, and others) J. Kidd and Stoeckel, in reviewing the results obtained by themselves and others, emphasize the common occurrence of ureteral dilatation in pregnant women and consider a moderate degree of hydroureter an almost constant physiologic concomitant of pregnancy. Kaltenschonee reported the results of investigations conducted in Zangmeister's clinic, and showed that in

pregnant women there is both a marked delay in the excretion of injected dyes and a prolongation of the contraction period of ureteral peristalsis. H. S. Pugh in a recent communication reports that in 100 apparently normal pregnant women examined between the seventh and ninth months of pregnancy he noted that the ureters were very sluggish in their action with 80% of the cases In practically every instance ther was ureteral retention, mostly on the right side.

Since conceptions put forwatd in regard to etiologh of t these phenomena have generally been ajudged insufficient to elucidate the process we have attempted to find an acceptable explanatio by carefully studying the morbid anatomy of the urinary tract with theview of ascertaining , if possible , the existance of some obstructive lesion in its lower portion. Such a study appeared the more desirable since many investigators hold, that in all cases of urinary infection, the presence of some existing inadequacy in ureteral calibre should be considered the chief cause of dilatation, and that such obstructions are more commonly present than is generally believed(H. P. Winsberg, White, Ball).

Upon studying the conditions obtaining in the pelvic portion of the ureter during pregnancy, we noted certain definite hyperplastic and hypertrophic changes both in the musculature and the connective tissue, to which we believe attention has heretofore not been directed. Such hypertrophy is particularly pronounced in the juxtavesical portion of the ureter where it passes through the parametrium and liesin close contact with theBladder and the

anterior vaginal vault. Similar conditions likewise obtain in the trigonum vesicae and account for certain changes in that region which con be readily seen on cystocopic examination . It is characteristic that the hypertrophy of t the constituents of the ureter within the abdominal portion, although distinctly noticeable, is decidedly less marked than its pelvic portion.

For a proper understanding.....; while in the lower portion or pelvic part of the ureter The connective tissue is relatively scanty and the whole wall becomes more muscular, and circularly and obliquely disposed bundles are intermixed with the longitudinal layers and extend almost to the epithelium. Near the lower end , the ureter is ensheathed by a number of longitudinally arranged muscle fibers which appear to be continued with the bladder wall, but are in reality a development of the outer longitudinal muscular layer of the ureter itself. The ureter sheath.....
The most important feature of this picture is the excessive p hypertrophy o the ureteral sheath..... Another point to which I desire to direct attention is the occurrence of hyper trophy and hyperplasia in groups of ganglion cells lying between muscle bundles of the bladder as well as at its periphery where its wall is traversed by the ureter.....
Consistent with specific structural changes noted both inthe juxtavesical and the intravesical portion of the ureter,

ther occurs during pregnancy a definite thickening of the entire trigonal muscle from the interureteral ridge to the vesico-ureteral orfice. This hypertrophy is most pronounced in two different localities in the interureteral ridge and adjacent to the vesical orfice, and it is associated w with an edematous Imbibition of the interstices ~~of~~then the individual muscle fibers.

Another essential alteration in the structure of the trigonum consists in the increase in number and size of the elastic fibers and a condensation of the connective tissue resultinf from a considerable development of young fibers. By the close binding together of the bands of muscular fibers, on the one hand, and the hypertrophied connnective tissue, on the other the trigone becomes converted into a dense and unyielding structure..... The evidence thus far adduced serves to establish the fact that during pregnancy there occur definite alterations in the architecture both of the trigonum vesicae and the lower part of the ureter. By reason of these structural changes, a multiplicity of obstructive processes make their appearance in the lower urinayr tract by without any demonstrable indication of an active inflammatory process. The development of newly formed tissue elements in our various specimans corresponds with observations made conderning other biological phenomena

which occur elsewhere during pregnancy in response to some growth-stimulatin agent..... It is in no way my desire to underestimate the significance of congestion and edema of the mucosa as contributory factors, as it is quite in accord with prevailing doctrines that such an occurrence may eventually turn the tide and render positive a hitherto potential obstruction of the ureter. More significant, however in this regard, appears to be the development of an angulation of the right ureter at the distal end of its juxta vesical portion, as a result of the common dxtrorotation of the pregnant uterus the firm attachment of the trigonum vesicae to its cervical portion; while, on the other hand, the same processes predispose to a stretching of the left ureter.

Among other theories as to the causation of obstruction is that one which is put forward by only a limited few which is that stricture is a result of infection in childhood and is aggravated during pregnancy resulting in obstruction.

In an article published by J. W. Duncan and M. I. Seng of McGill University, many of the theories advanced by writers of the above articles were refuted.

Contrary to the findings of Gauss, corroborated by Stoeckel, Hofbauer and Luchs, we were unable to demonstrate an insufficiencyof the ureterovesical value at any stage

of pregnancy or in any of the puerperal cases in our series".

Reading further in this article we find the following- "is ther an interference with proper renal and ureteral drainage? We believe that there is. Beginning in the fetus of six months and in the full-term new born child we have found consistently by a histologic study that the uretero pelvic portion of the ureter shows a moderate amount of muscle and fibrous connective tissure the middle third a less amount, whereas the pelvic and intra vesical portions present a more marked degree of the same.

We believe that this reenforcement of the upper third of the ureter is primarily to produce peristalsis but at the same time, perhaps, also to protect the renal pelvis to some degree from regurtation-the same contention may be applied to the similar occurrence of the lower third, only in a more pronounced manner. The dilablity of the middle third of the ureter is up to a certain point, physiologic and only tends to become pathologic, in our opinion, when the musclature of the ureter as a whole becomes atonic.

Here again the authors of this article disagree with the work of Hofbauer.

They say that-"While one is prepared to accede some responsibility for the actual development of hydroureter and hydronephrosis in pregnancy to this hyperplasia and hypertrophy, it would seem impossible to concede to it, according to Hofbauer's interpretation, the position of greatest factor in the development of these conditions.

mWe prefer to interpret this hypertrophy and hyperplasia as one of physiologic development, for the purpose of protection and of adding to the ureter a greater power to accomplish successfully a larger amount of work .....We prefer to consider the hypertrophy and hyperplasia described by Hofbauer as a result of primary physiologic overdistention rather than the cause of obstruction.

n The first probable factors in the production of obstruction of the ureters during pregnancy is increased vascularity in the cervix and parametrium with its pressure capacity and consequent production of congestion-the pressure from the general overcrowding of the growing uterus, which develops equally and in all dimensions, as exibited on bowel, thebladder, and consequently must produce an effect on the ureters themselves: a marked congestion and distortion of the vesical trigone: and lastly: the well recognized dextro-rotation ofthe uterus.

To these combined physiologic forces Seng and

Duncan attribute the hyperplasia and hypertrophy found in the ureter during pregnancy.

They reach the following conclusions: Physiologic forces external to the ureter cause obstruction to ureteral and renal drainage in pregnancy, which is relieved almost immediatley upon the termination of gestationl

In pregnancy there is a constant right sided ureteral dilatation: while right hydronephrosis is only slightly less frequent.

In pregnancy the left ureter and renal pelvis escape this dilatation in a remarkably high percentage of cases.

Bilateral hydroureter and hydronephrosis were of very frequent occurrence.

The multiparous woman showed theseconditions earlier, more frequently, and in much more marked degree than primipara.

Stasis as measured by inability of the renal pelvis and ureter to empty themselves within the normal time limits, is a definite and almost universal finding in the antepartum women. In the postpartum woman it is still persistant, in a lesser degree, over a prolonged period of time.

By the demonstration of an unexpected amount of pus

and coliform organisms in the bladder and kidney of these supposedly healthy pregnant and postpartum women, we believe there is some justification for the use of the term" a hidden infection".

Every pregnant women has obstruction of some degree a definite dilatation of the ureters and renal pelvis, with a well defined stasis. This continues over a long period of time. We have demonstrated in the apparently healthy pregnant and puerperal patient a probable renal complication, the presence of pus and coliform organisms. The line of demarcation between the physiologic and the pathologic in these cases is a very fine one. Trauma and a lowered immunity or resistance are the remaining factors.

Sietz' conception is that the bladder and ureters are involved in the reaction which a fertilized ovum produces in the body. This produces a change in the nutrition of the urinary apparatus. A severe hyperemia of the mucous membrane develops, a certain hypertrophy of the parietal elements: also an growth and extension. The change in the blood supply may be recognized during cystoscopic examination on the uniform velvet red color and the "extension" by increased capacity. The result of this, even in normal conditions is a slightly tor-

tuous course of the ureters besides a dilatation.

He also believes that the innervation and equipoise between sympathetic and parasympathetic excitation is also changed in pregnancy. There usually being a shift in the sense of an atony, This decreased innervation of the ureters and of part of the bladder, coupled with mechanical factors impairs the regular outflow of urine favors stasis, and thus decomposition of the renal excretion within the body.

Simple pyelitis is almost universally recognized as being a secondary infection. In most cases it has its origin in a foci of infection in the upper respiratory tract and its accessory sinuses, in infected teeth or in the gastrointestinal tract.

Of its predisposing factors in the gastro intestinal tract constipation undoubtedly plays an important part Some authors have stated that as a result of intestinal stasis, there is an increased production of colon bacilli which eventually reach the kidney. Bacillus coli communis is the infecting agent in over 90% of the cases. Occassionally strepticoccus or staphlococcus are associated with the colon bacillus and very infrequently the gonococcus, pheumococcus or bacillus typhosus and rarely the tubercle bacillus.

Clincal evidence points to the probabilityof the

infection reaching the kidney by way of the blood stream. However, it is a well established fact that it is almost impossible to produce an infection in the urinary tract without some sort of obstruction of the healthy resistance of the renal tissue is impaired by the drain ing back of urine from pressure on the ureter then conditions are favorable to the onset of inflammation in the area of lowered resistance. Its severity will depend on the virulence of the organisms and the completeness of the obstruction.

That htere is an obstruction in the urinary tract which precedes the actual symptoms of pyelitis during pregnancy is an accepted fact How this obstruction occurs is still a much disputed question.

From the foregoing material one is readily able to ascertain that the conditions necessary before pyelitis will develop are stasis, the presence of infection, together with a lowered resitance or an extremely virulent organism. The obstruction which produces the stasis is without a doubt the point about which the greatest controversy is created.

From the opinions mentioned above it would seem that a great many factors influence this obstruction. Among these are- Diatation, which follows obstructi on,produc-

ing a greater amount of stasis.

In some cases stricture, either congenital or acquired (Hunner) is thought to be an influencing factor.

Edema, kinking, redunduncy, and pressure on the ureters by the pregnant uterus are said by others to be the primary cause of this obstruction which reults in stasis, lowered resistance which together with infection finally results in pyelitis

From the investigations of the above writer it seems very probable in my mind, that not one of these factors is alone responsible for this obstruction but at least two and more often a treater number of these factors figure together in producing the obstuction, dilatation etc. which finally result in the appearance of the disease.

This opinion is strengthened by the fact that normal pregnant women who have carried their child to full term and who have had an uneventful puerperium, have had urine infected with Bacillus colli and other organisms and yet have not developed pyelitis even though it has been shown that all pregnant women exibit some degree of obstruction, dilatation etc., conditions which are predisposing to the disease.

It is my opinion that lowered resistance of the individual to infection plays a very important part in the production of the disease

Pyelitis is spoken of as being an ascending infection (urogenous) or descending infection which implies that it is either hematogenous or lymphogenous.

The hematogenous theory as set forthe by F. E. Shields is that the colon bacilli are gransplanted by the blood stream and although in compartively few cases hasit been possible to isolate the bacilli from the blood stream.

In support of the lymphogenous route of infection Francke, who made an exhaustive study of the lymphatics of the large baowel and the lymphatic route of infection has recieved a good deal of consideration.

He was able, by injecting the lymphatics of the large bowel, to prove that the lymphatics on the right side pass over the capsule of the kidney. According o Stahr the lympnatics of the kidney capsule communicate with the deep lymphatics of the kidney. Francke believes, therefore, that there exists on the right side and probably on the left a communication between the large bowel and the kidneys by way of the lymphatics.

In support of the urogenous route it was proved many years ago by Goldschmidt and Lewis, Markus and others that under certain conditions antiperstaltic movement may take place in the ureter: causing the contents of the bladder to be propelled in to the kidney to oblitera e the closure of the ureteral orfice, the result being that each variation in the intravesical pressure is transmitted to the

renal pelvis.

By means of a series of cystograms made in normal persons by filling the bladder with various solutions opaque to toentgen rays Kretchmer was able to demonstrate regurtation in bothe nermal and pathologic bladders.

The mode of intrance of the infecting organism into the renal pelvis have been discussed . The problem of general or local decrease of resistance and accompanying infection constitute the main considerations.

We have before stated that the merer coincidence of ureteral dilation and presence of bacteria although essential to the development of pyelitis, are not sufficient to set up infection: as another determining factor the disturbance of the equilibrium due to lowering of the normal immunity, has equally to be considered in the etiology of the disease. Credit for advance in knowledge of this subject is largely due to the clinical studies of Frank Kidd which is now recognized by Schlayer, Breminghaus, v. Rehmer H. Simon and others. In experiments done by Dr. Imgard Dresel of Johns Hopkins at the request of Hofbauer it was determined htat in 6 of 53 pregnant women, a marked decrease in immune reaction of the serum could be noted, as evidenced by a sharpe fall in the opsonic index(determined by counting the polymorphonuclear leukocytes which contained bacteria and those which had no bacteria). In four out of seven, the very low index obtains thru-

out the whole course of testing, while in the alter two the low opsonic index obtained in only two of the columns.

These observations indicate that, in about one women out of every nine, conditions are present which would markedly facilitate the occurrence of infection. With regard to these statements it would be interesting to learn that Pugh found renal infectio in nearly 10% of all pregnant women examined.

It has been previously shown by other men that the pregnant organism has a lowered resistance to the tubercle bacillus, (Kaessler and Newman of Vienna), pneumonia, influenza, measles(Dr. Bur). Sano has published results from a large number of experiments which show clearly a marked lowering of resistance on the part of the organism against infection.

It has been shown as regards local resistance that t the "Protective Mechanism" (an aggregation of both lymphcytes and mononuclear cells of the machrophage type with the submucous layer and sometimes within the deeper zones o f connective tissue) is present in the pelvis and ureters.

For clinical purposes it must be kept in mind that, despite the presence of bacteria in the stagnating urine, the gacterial balance within the tissues of the renal pelvis is well provided by the natural forces or by the vital activity of the phagocytic tissue is in operation. In order to set up inflammation the invading bacteria

must either by of a virulent type or they must have secured a foothold in the underlying tissues thruough a breech in the defending barrier: such a breech may be an over distention of the renal pelvis.

The changes exhibited by the pelvis of the kidney, the seat of infection, may be designated as catarrhal, suppurative, hemorrhagic, membranous, and gangrenous. In the catarrhal variety, the mucous membrand becomes congested and is covered with a thin layer of pus or m mucous. If the inflammation becomes more ixtensive and ecchymotic areas develop, the term hemorrhagic is applicable. In the suppurative variety, the pelvis contains free pus, there is an imflammatory thickening of the pelvic walls, the pelvis becomes distorted, and ulceration occurs on its surface. Some pouching of the pelvis may occur sufficient ot allow and accumulation of pus like the"Bas Fond" of the bladder seen in prostatic hypertrophy. This pus accumulation plus the swelling of the mucous membrane, may cause sufficient inroachment upon the caliber of the uretero- pelvic juncture to close it.

The membranous type is that form of pyelitis in which the pelvis is covered by a membrane made up of shreds of fibrin and bacteria giving the surface the

appearance of a diphtheritic membrane. Areas of ulceration or gangrene may be noted, either localized or general. There is also some chnge to be noted in the ureter as a rule, although in some cases it may show no changes whatever, The ureter change may vary in its degree of involvement. It may be dilated or hypertrophied. Indeed, all the changes described as occuring in the renal pelvis may be noted in the ureter. The practical significance of this is that in treating pyelitis by pelvic lavage, the catheter should not by introduced too far up into the ureter byfore making injection in order to secure medication of the ureter itself. In cases wherer the condition is more of a pyelonephritis that a pyelitis, in addition to changes noted in the pelvis, there are chnges to be noted in the kidney. The kidney becomes small and dense, and shows a lobulated surface with an adherent capsule, and perhaps a small number of cysts containing serum or seropurulent substance.
The chief changes are noted in the cortex. The latter may show fibrous tissue degeneration, containing lobules of fat. There may be nothing abnormal in the pyramids. Histological section reveals an infiltration of the stroma, with fibrous and fatty tissue which by their contraction cause obliteration of both tubules and glomeruli. This interstitial fibrosis is irregularly distributed, and where

Sclerosis is not present, the secretory epithelium tends to undergo compensatory hypertrophy. It may be well to note at this point that many authors are of the opinion that a pyelitis never occurs in which there is not some involvement of the kidney. This assertion is difficult ot check as a kidney may be damaged even in an acute nephritis and yet recover even as it must in pyelitis

SYMPTOMS

The symptoms of pyelitis in pregnancy are frequently so mild that the detection of the disease is made difficult on the other hand, cases of the disease may come on so suddenly and with such acuteness as to simulate to a certain extent diseases such as acute appendicitis, the more acute pelvic infections, gall-bladder disease etc.

It has been found that the disease is often present before any subjective symptoms are observed. Butler has said that there often may be no symptoms present when the ureters are not blocked by pus, mucous, fetal pressure or edema in the ureter. Plugging of the ureter may on the other han, followed by absorption of toxins, give rise to the typical symptoms of severe sepsis. Pain may be entirely absent especially if there is no obstruction o the ureter.

The symptoms mild or severe may appear early or late in pregnancy. However it has been found that in the g greater number of cases the usual onset of subjective symptoms is found at or near the middle of pregnancy.

Eisendrath says that the difference in the severity of the infection or more particularly the clinical picture is almost always due to the virulence of the causative organism.

He has classified his cases clinically as (1) mild, (2) moderately severe, and (3) very severe.between which there is no definite line of demarcation.

In the mild cases there may be absolutely no symptom s Attention only being directed to the kidney infection by the persistant pyuria or bacteriuria. This mild time may go to the mildly severe and then to the very severer or make a more radical change to the very severe type.

He further states that there are two findings which vary greatly in individual cases. These are symptoms referring to the bladder and the degree of evidence of infection as found in examination of the urine.

Careful examination is often necessary to discover the milder types because in many cases of renal infectio n such symptoms as frequency , painful urination are but little complained of and even experienced clinicians may be led astray and demand more evidence in the form of bladder symptoms before they are willing to even consider the urinary tract as the source of the symptoms.

In the milder forms of pyelitis there may be a moderate rise in temperature and pulse rate, or these may be normal. Backache or more localized tenderness over a single kidney or referred to the lower abdomen may be the only symptoms. The urine may be of such a nature that it may not enable one to confirm his diagnosis.

In the moderately severe picture the pain and tenderness over one or bothekidneys and the lower abdomen,

especially over Mc Burney's point on the right side, are as a rule, more marked. In pregnancy then we must consider salpingitis, appendicitis, twisting of the pedicle of an ovarian cyst or dermoid , or even an acute colelecystitis in the differential diagnosis. bContinuous recurrence of high temperature may or may not be preceeded by a chill. One is apt to be led astray in some patients however in bimanuel examination by the presence of localized areas of tenderness in the broad ligament because such an increased sensitiveness may be due to an enlarged and inflamed ureter, which is often to be felt as a tender cord. Colics and profuse hematuria are not frequently seen but the possibility of their occurrence should not be forgotten.

In the bery severe form of pyelitis the symptoms which direct our attention to the kidney retire more and more into the gackground. The clinical picture becomes more that of a sever bacteriemia without localizing symptoms.

The more important symptoms in a case of pyelitis are then, pain in the back or over the lower abdomen, radiating down one or both ureters(most generally unilateral): frequency of urination , burning on urination, together with general malaise and weakness, headache, nausea, vomiting, rise in temperature and pulse. This symptoms to-

gether withphysical findings and laboratory finding s should enable one to make a correct diagnosis. The remarkable thing about the symptomotologh of pyelitis is, I believe its variability in different individuals who have the disease. Also to be remembered is the fact that the height of the temperature does not depend upon the severity of the infection and bears no special relation to the amount of pyuria or bacilluria.

The physical examination may also vary with different individuals. The head neck and chest are essentially negative in so far as we are concerned with physical findings in pyelitis but it is not unusual to determine from the history that the patient has just recovered from a head cold or have one at the time of the pyelitis.

The face may be flushed due to temperature, the tongue is dry and respiration rapid. In other words those symptoms attendant with any febrile reaction are present.

Palpation over the abdomen may elicit tenderness on the affected side. There may be increased tenderness over Mc Burney's point. There may also be a slight rigidity over the affected kidney or in some cases where both kidneys are affected the entire abdomen may exibit a slight rigidity.

Pain can be illicited usually in the lower back area

corresponding to the area over the kidneys. The kidneys may at times be palpated.

Pain at times may be illicited over the bladder.

From a series of six cases presented by M. J. Groat The followin laboratory findings are presented:

Leukocytosis is nearly always present and is usually low, rarely exceeding 15,000 except in severe cases. Fall, in a series of 19 cases determined an average of 9,000.

Haemaglobin exibits a rather marked secondary anemia. An averaged low being 63%. It was determined that there was a more marked lowering of the hemoglobin in the more acute cases as would be expected.

The red cell count averaged 3,300,000.

Hemoglobin Average: 70% High: 85% Low- 60%

Red blood cells. Average: 3,000,000 High: 4,500,000 Low: 2,900,000 In every case poikilocytosis and anisocytosis was present.

Leukocyts Average 14,200 With one severe case with a count of 26,000. Polymorphnuclear leukocytes predominated Average 85% High 90% LOw 69%

Resistance, as in any infection was directly proportional to the height of the poly count.

URINE

Urine is almost always acid prior to medication. Color is usually darker than normal. It is cloudy in

appearance in the event of an actively purulent infection However clearness of the urine does not mule out the presence of bacteria.

Albumen is present in a varying degree, ranging from a trace to 3 plus.

I am of the opinion that in cases with a more marked albuminuria one is likely to find the disease has involved the kidney itself to a greater or less degree. The prognosis of the disease is probably also some what affected by this findings.

The microscopic examination of the urine is probably the most important. Pus cells will be exibited in all but the mildest of cases. Red blood cells will be seen but are as a rule not numerous unless there is extensive damage to the kidney itself.

Bacteria will also be present in varying numbers and types. Cultures of these organisms have shown that 90% will prove to be colon bacilli,

Kidney epithelium and casts will be observed more particularly in those cases which would better be termed pyelo-nephritis. Crystals debris etc, will be noted, but are of no diagnostic value.

DIAGNOSIS

Diagnosis is made from the above findings as described but this in itself is not sufficient to clinch a diagnosis of pyelitis in a great many instances. Urine analysis for determining the presence of disease in the urinary tract is admittedly subject to wide variation of error and is not dependable in many cases. One kidney may have complete loss of function while the other is secreting normally, or there may be various anomalies of the kidneys and ureters which cause subjective symptoms. Many times one speciman will be normal while a later one will show definite evidence of disease.

Thus we see the value of the cystoscope in making an accirate diagnosis of pyelitis together with the uereteral catheterization, bougie, wax-tipped catheter, pyelogram and x-ray in order not only to determine the patholog y and the extent of pathologh but also to rule out possibility of some organic lesion of the urinary tract which may be responsible for the pyelitis.

Cystoscopic examination will reveal any inflamed areas of bladder mucosa which although not always present, some times aide in diagnosis. The trigone will have dropped away according to Duncan and the capacity of the bladder may seem to be lessened. With the cystoscope properly placed catheters may be inserted usually slight d

difficulty will be encountered by the operator as the tip of the catheter enters the ureteral orfice but after this difficulty is overcome the remainder of the catheter enters easily.

Then examination of the urine from each individual kidney may be instituted. The side involved frequently is revealed by inflammation about the orfice of the ureter on cystoscopic exam but if it does not urine collected from each o the catheters is located. It is well to run a functional test at this time by the use of phenosulphonphthalein which will aide somewhat in the determination of damage to the kidney. There is always a definite decrease on the side affected. If both kidneys are affected there will be variance of the amount of PSP excreted according to the amount of pathology. The use of the wax-tipped catheter will serve to illiminate the possibility of ureteral stone . It should be remembered , however, that in order to get the best results and to insure the least damage from trauma the cystoscope should be in the hands of an experienced urologist.

Diagnosis is further facilitated by the use of the injection method, for it not only demonstrates the presence of pathology but often show the anatomical extent of the lesion. It is especially adaptable to cases

of pyelitis in pregnancy because in these cases the treatment should consist of drainage and lavage.

Injection of the urinary tract in pregnant women may at times present a difficulty in locating the uretheral orfices or as a result of uterine pressure but generally the solution can be forced beyond the pressure point.

Ureteral kinks will usually allow the passage of the solution. With the use of sodium iodide there is no danger in injecting both sides at the same time, a procedure which at one time was thought to be dangerous. Routinely four large films are taken, one after the first kidney is injected, the second when the catheter has been with drawn to the level of the mid-sacrum , the third after the second kidney is filled and the f fourth when the second cayheter has been withdrawn to the same level. The ureter must be injected as the catheter is being withdrawn.

This method is praised by Dr. J. T. Williams of Boston when he says,"No other single diagnostic means gives us the same accurate picture of the pathology present as does the pyelogram". He farther states t that not a single case showed an unfavorable reaction in a group examined. The pain was transient and disappeared quickly after completion of the examination

even when the ecamination was made during the acute stage s.

With this procedure dilatation, kinks hydro-nephrosis and the condition of the calyces may be noted. Presence of renal calculi may also be noted. Stricture of the ureter, renal tumors etc may be picked upin this examination. The value of catheteriaation, cystoscopy and x-ray canbe seen to be of inestiable value as aides in making a definite diagnosis of pyelitis. This two aides together with history, urinary findings and symptoms should enable one to make an unquestionable diagnosis.

Among the more important diseases to be differentiated are pelvic infections, cystitis appendicitis(often extremely difficult), gall-bladder disease. Every case should be considered potentially one of renal tuberculosis. This condition can be differentiated not only by careful microscopic and bacteriologic examination of urine but also by repeated guinea pig innoculation.

Gall-bladder disease is defferentiated by a history of indigestion, careful urinary examination, and a Grahm-Cole test. Presence of jaundice may also help to differentiate the condition.

Cystitis may only be ruled out by ureteral catheterization. The patient will give a history pointing

to bladder pain. I would consider a cystitis a symptom rather than a disease entity itself.

Pelvic infection on the other hand may be differentiated by careful history, character of pain, urinary findings, bimanuel examination and cystoscopy.

Appendicitis probably offers one of the most difficult diseases to differentiate. The two may go hand in hand which makes the diagnosis doubly difficult. The subjective complaints, history of indigestion, careful urinary examination, and study of the course of the disease should serve to differentiate this disease.

Such lesions as ureteral stricture, ureteral calculus, renal calculus, tumor, and hydro-nephroses may be differentiated withe use of x-ray.

PROGNOSIS

In literature read the writer found mention of only two cases of pyelitis in pregnancy which proved fatal. It used to be that abortion was rather frequent with pyelitis during pregnancy but with the more modern and more effective mthods of treatment it has been found that even abortion has grown less frequent.

As to the return of the disease in future pregnancies there has been a great deal written on both sides, some authors believing that one attack makes the patient subject to an attack more easily during the succeeding pregnancies. Other authors are of the opinion that the patient who has had pyelitis has an increased local and general resistance which will enable her to more easily resist succeding infection.

The arguments for immunity would seem to be supported by the fact that the disease or at least the symptoms of the disease are almost at once alleviated following the emptying of the uterus. However it has been shown by Duncan and Baughman that the dilatation and bacteriuria may persist for as long as 9 years. Some authors are inclined to believe the greater percentage of cases pyelitis iin the multipara is the result of the dilatation of the ureters and the kidney pelvis.

Hofbauer , on the other hand, is of the opinion that the patient is predisposed to pyelitis in follow-

ing pregnancies because of an incomplete involution process in the ureteral wall during the first infection.

DeBeaufond is of the impression that pyelitis becomes completely and spontaneously cured following delevery. Falls does not believe the patient necessarily has a return of symptoms in the succeeding pregnancy but should this be true he is of the opinion(as other authors) the progress is better due to increased local as well as general resistence to the infection.

In only a very few cases has the prognosis for the mother been bad more particularly in recent years because with the modern improved methods of treatment and diagnosis the disease can usely be readily checked early in its course. The prognosis may be unfavorable for the mother if some other process intereferes with the carrying of the child to full term.

As to the prognosis for the child. Mayer and Chauffard have said that one third of all cases are premature. Leavett says that 40% of all cases of pyelitis result in miscarriage. Falls noted a fetal mortality of 28% due either to spontaneous abortion in the earlier months or death following premature delivery. In addition 17% of the patients who came to the hospital with a diagnosis of pyelitis and threatened abortion. Their symptoms were

followed to delivery. Some of these patients he believes did not go to term and of the babies born at or near term at least a few did not survive the first year.

I believe from opinions given by various authors the prognosis should be guided at least somewhat by the virulence of the organism together with the resistence of the patient when the in fection begins.

TREATMENT

PYelitis of pregnancy is serious because of the immediate disability produced in the mother: because of the frequent deleterious effect on the fetus, and because of the manifold possibilities for permanent renal damage.

It was formerly believed that pyelitis in pregnancy was more or less a self-limited disease and that it disappeared in the puerperium. An increased experience with this disease in pregnancy has led us to the positive conclusion that such a belief is erroneous and dangerous. While it is undoubtedly true that the clinical history and laboratory evidence of pyelitis often diappears after delivery, the fact remains that numerous patients with this disease will present definite evidence of renal infection long after the puerperium, if adequate treatment has not been given during pregnancy. So thoroughly has this been impressed upon us that we now regard a patient suffering with pyelitis in pregnancy as a patient who should have the attention of the urologist as well as the obstetrician. In fact, successful treatment is largely a urologic problem.

The prophylaxis of pyelitis in pregnancy is the prophylaxis afforded by careful prenatal care with special emphasis laid upon the eradication of oral sepsis, foci of infection in tonsils, accessory sinuses and consti-

pation. Abscessed teeth and infected teeth are of greater etiologic significance in this regard than is commonly recognized, both because of their direct focal danger and because of the intestinal stasis which they may indirectly engender. Constipation is best treated by a diet consisting chiefly of vegetables and fruit, and by drinking at least eight glasses of water daily, and by the occassional use of a vegetable or saline laxative.

One should not be deterred from attempting the removal of foci of infection at the time of the appearance of the pyelitis, if they have not been removed earlier, just because of a slight increased risk of causing abortion. The far less risk than the risk of letting such foci remain to destroy the effectiveness of active treatment of the pyelitis..

In discussing the treatment of pyelitis, the subject divides itself into two phases, once the diagnosis has been derived: (1) medical management and(2) urologic treatment. The tendency has been too much toward the former to the neglect of the latter.

In cases of acute colon bacillus pyelitis, instrumental or local treatment ordinairely is contra- indicated. Although J. T. Williams of Boston has said that the procedure is harmless, However it is almost universally conceded that with pyelitis complicating pregnancy instrumental treatment is of the greatest value.

I will attempt to give the medical treatment usually resorted to as a first measure as is given by a number of authors.

From Tice: Various drugs have been recommended such as the administration of bicarbonate of soda, 1-2 to 1 teaspoon full, well diluted, three times daily. Salol has been highly recomended by some, but it has very little practical value. The only drug which is used by practically everyone is hexamethylenamine 7.5 to 10 grains, well diluted in water every 4 hours. Its value is doubtful, as Hinman has shown that urotropin has little value at the level of the kidney pelvis. The acidity of the urine should be tested by examination with litmus paper, and if there is definite alkalinity, about 10 grains of sodium phosphate should be given every 4 hours until the urine becomes acid, for the well known reason that hexamethylenamine has no sure therapeutic value unless it acts in an acid medium. If for example, in some cases, urotropin causes external irritation or the production of hematuria and is contra-indicated, benzoic acid should be substituted. From a medical or internal standpoint, however, more important than the drug administrated is the drinking of l rge quanities of water. Lithilated spring water or other proprietary waters have no greater value than ordinary

drinking water, unless it be given for its psychological effect.

J. H. Moore and H. G. Woutat: Medical treatment should consist of the following (1) Identification of the infecting organism by urine culture and a daily examination of the urine for control of treatment: (2) Regulation of the diet and the ingestion of adequate amounts of water daily (alkalinized or plain): (3) Free but gentle catharsis: (4) A definite plan of alkalinizing the urine: (5) The use of sedatives to promote sleep and to control pain.

Most of the cases of pyelitis in pregnancy will be found to have an acid urine in which colon bacilli are grown in almost pure culture. It must be remembered, however that staphlococci, streptococci and tubercle bacilli are found at times and that the etiologic organism will influence the type of treatment.

Urinary antiseptics have a place in the treatment of this condition but not to the exclusion of the older drug. hexamethylanamine. One advantage that the newer urinary antiseptics have over the older drug is that they are effective in alkaline urine.

If at the end of a weeks treatment with alkalis, the urine shows a decided improvement , it is sometimes well to use one of the urinary antiseptics for a few

days and carefully watch the results. However a week or ten days is adequate time in which to employ medical treatment. If the clinical and laborato ry evidence of improvement is not definite, it is time to gegin the second phase of treatment, the direct urologic treatment.

D. N. Eisendrath: By expectant treatment I mean rest in bed , drinking of large quantities of water, a bland diet, and the administration of urinary antiseptics in as large doses as the patient will tolerate. You may think I am rather radical when the statement is made that the administration of drugs or special waters to render the urine either acid or alkaline is not any more effacacious than the simple dilution of the urine by drinking water freely. I have seen equally good results by this simpler method, and Graff in a recent article on the entire subject of renal infection has expressed a similar opinion.

J. Hofbauer in his article advocates the use of pituitary extract as a drug of great value in combating congestion and inhigiting exudation in the ureters, and at the same time stimulating their action. " According to the experimental work of L. T. Paulsson, the development of inflammatory processes may be checked by its administration while its consolidating effect upon the capillaries is shared only by adrenalin.

(Auer and Metzer, Exner, Tainter and Hanslik)..... All that I can say is that in a small number of cases relief of subjective symptoms, as well as a drop in the temperature, was distinctly noticeable soon after the administration of the drug.

Danforth: Many cases will respond sufficiently to palliative treatment alone. Postural treatment is of great value.

Pilcher: In a given case it is perfectly safe should the symptoms not be too severe, to wait for eight or ten days without attempting to catheterize the u ureters: if at that time there be a persistant temperature with pain and pyuria, or even without pain, it is indicated to pass a catheter to the places of the affected kidney to drain it.....

Vaccine therapy has been given a thorough trial in the treatment of pyelitis, but has given the same futile results in this disease that it has given in most diseases wherein it has been tried. However, there are a number of authorities who believe in their efficiency and highly recommend them.

A certain number cases of pyelitis get well without any treatment whatever and it is quite probable that cases of pyelitis which respond to vaccine therapy really belong to this class.

The treatment of pyelitis in pregnancy by the cystocopic method is not materially different from the treatment of the condition where it does not complicate pregnancy.

Alteration of bladder contour, due to pressure of the uterus in the latter months of pregnancy frequently calls for slight changes in technique. Aside from this the procedure is the same as in routine cystoscopic examination.

Special care should be taken to avoid discomfort to the patient. An hour before treatment a sedative is administered. After the patient is placed in position, surface anesthesia is applied to the urethra and the base of the bladder inspected for evidence of pathology in this viscus. Ureteral catheter are passed to the kidney pelvis and urine collected from each kidney. A few drops of urine from each catheter placed on separate marked slides and immediately examined for pus. This is found in most cases coming from the right pelvis. Occassionally the disease is bilateral.

The capacity of the inflamed kidney pelvis is then determined this is followed by lavage with sterile water to the capacity of the pelvis. When the water is drawn off, 5cc. of 1% solution of silver nitrate is injected and allowed to drain through the catheter.

Large sized catheters are used for this purpose to facilitate drainage. The catheter is left in the ureter up to 6 hours but is removed at any time drainage ceases or if it causes discomfort.

Medical treatment continues as outlined. If the symptoms recur o have not abated the lavage is repeated in one week.

With this plan of treatment we have found a marked reduction in the number of patients upon whom obstetric interference was necessary. Nevertheless there will be an occassional who will not yield to treatment until the pregnancy is terminated.

Pilcher says if given a case one should wait for 8 or 10 days without attempting catheterization: if at the end of this time there is a persistent temperature with pain, it is indicated to pass a catheter to the pelvis of the infected kidney to drain it thoroughly, and then to instill one ounce of 25% argyrol solution . If the same case be examined one week later, the absolute number of pus cells will be treatly reduced, showing beyond a question, the effect of the treatment . In case there is a large amount of retention the pelvis of the kidney, with considerable pus present, it is indicated to leave the ureteral catheter in place after washing the pelvis of the kidney, for 4 or 5 hours or even longer, repeatedly washing the pelvis with some anti-

septic solution.

Abortion or premature labor, is seldom necessary in this class of case, but where there is bilateral involvementwith persistant pain and pyuria that does not decrease and a continuous fever, after trying perscribed methods of treatment, termination of pregnancy in the interests of the mother is justifiable. This is especially true of cases of infectuous origin.

Tice says concerning cases of pyelitis during pregnancy: Three method s of theatment have been advised a) Emptying the uterus : (b) surgical removal of the Kidney: and (c) pelvic lavage. The first two methods are too radical and should be rarely if ever considered. The author has treated a number of cases of pyelitis of pregnancy in which the patients were highly toxic and where interferences, such as termination of pregnancy, or surgical interference upon the kidney, seemed necessary yet he succeeded by pelvic lavage in not only permitting pregnancy to extend the normal period, but also relieved the patients of all symptoms. If conscientious and prolonged treatment of the pyelitis of pregnancy pelvic lavage and other methods of treatment fail and the patient is getting progressively worse, then consideration of the above named surgical interventions may be in order.

Sennewald- In most cases of pyelitis the author

uses indifferent solutions to irrigate the pelvis, in a few cases he has injected 1% Silver nitrate solution in each pelvis after an irrigation but he is not convinced that such injections are harmless and doubts they disenfect the kidney as he will not use them int he future. But he generally leaves the catheter in for 24 hours after the irrigation though it may cause tenesmus and slight hemorrhage. Some times considerable amounts of pus are discharged after a long interval.

If the catheter becomes occluded of course it must be irrigated. If the secretio stops for some time an injection of 1-2 cc. glycerin exercises a strong stimulation.

In severe cases while the catheter was still in the author has given continuous intravenous drop infusions of physiological salt solution, 3 or 4 liters in 24 hours and continued them some time after removel of the catheter for 5 days. Some times the physiological salt solution, brought about prompt defervescence in cases in which chills had continues in spite of catheterization and irrigation of the kidney pelvis. It almost always stopped vomiting too. In order to supply nutrition he some times added as much as 300 cc. of 15% grape sugar solution in 24 hours. He generally gave 5 to 10 cc. cylotropin and 2 cc.euphyllin daily with

infusion and heart tonics if needed. In fatal cases he had to give it up on account of beginning broncho-pneumonia. But he recommends it heartily for severe cases of pyelitis. In milder cases catheterization and irrigation of the kidney pelvis is enough. By these methods interruption of the pregnancy can be prevented except in cases complicated by ileus and colon bacillus in fection.

J. T. Williams of Boston in discussion of an article by P. F. Butler says","drainage of the renal pelvis by the uretheral catheter has made therapeutic abortion unnecessary to relieve pressure of the ureter. At the Boston City Hospital no induction of labor for pyelitis during pregnancy has been done for many years." He says farther that ureteral catheterization should never be attempted after the fetal head has entered the pelvis.

The earlier writers upon the subject have given different opinions as to how radical the treatment should be in the more severe cases. The more modern writers have found that radical treatment does not have to be resoted to in nearly so many sinstances as it was once necessary to do.

Danforth has said that " if the infection advances to a degree that the integrity of the renal parenchyma is believed to be in danger, more radical means must be

considered. The induction of labor must in frequent cases be resorted to. In the endeavor to escape this radical operation, a number of authors have tried and recommend nephrectomy. This has been done during pregnancy sucessfully by several writers notable Opitz, Seguen, Kehrer, McDonald, E. P. Davis, and Cora.

Davis reports three such cases. If necessary, a nephrectomy may be done later, but in several of these cases the renal fistula is said to have closed after delivery. In case of severe infection which the kidney has undergone irreparable damage, nephrectomy may be carried out during pregnancy. Cora reports 23 cases in which this operation was done during pregnancy successfully. In thirteen cases pregnancies subsequently occurred . It seems scarecly possible that such a procedure should be necessary or justifiable in a case which had been under competent observation from the start In cases which are first seen after the development of a severe pyelonephritis it is conceivable that nephrectomy might be necessary and justifiable procedure. My own view is that in cases in which the kidney seems likely to undergo damage in sufficient degree to render later nephrectomy necessary would present a reasonable indication for the induction of labor. One should consider carefully before allowing the infection to proceed in

a case which is seen early, to a point at which sacrifice of the kidney would be necessary.

Nephrectomy may be much more lightly undertaken for here the kidney is preserved with a high degree of liklihood of it later resuming full functional activity. Barth believes that nephrotomy is preferable to induction of labor, and there is at least some justification of his view. But the extreme view of Stoeckle, that induction of labor is never necessary, can scarcely be supported, and is not concurred in by the majority of writers

By far the most important thing in the infection is the recognition. And this depends upon careful observation and urine analysis on the partof the physcian. If pyelitis be early recognized and the treatment be instuted immediately, a great majority of cases may successfully be carried through.

CASE REPORTS.

Case one. Mrs. Felsen, aged 28.

Two-para; last period three months ago; some leucorrhoea for past five months; had one child three years ago, labor normal; no miscarriages; general health good. Patient has had considerable nausea and vomiting for the past three months; two weeks ago begun to have a slight bloody vaginal discharge; four days ago was seized with severe cramp-like pains in the lower part of the abdomen; had numerous slight chills; two days ago had a sudden sharp pain in the abdomen, and fainted; has had great difficulty in urination accompanied by pain and buring; October 9, was admitted to the hospital; temperature 99.4 and pulse 100; desired to pass urine every five minutes; urine cloudy and foul; reaction acid; specific gravity 1.030; large quanitity of pus present; leucocytes 11,000; polymorphonuclears 86 per cent. Medical treatment was instituted with elevation of the head of the bed but no improvement was noted during the next three days; temperature reached as high as 103.6 persistant vomiting; pain was referred to the region of both kidneys.

October 12, 1908, cystocopic examination showed marked general cystitis present; ureters catheterized showed urine containing a large number of pus cells coming from both kidneys.

Bacterial examination showed in each case a bacillus with all the cultural characteristics of a colon bacillus.

Pelvis of each kidney irrigated with 25 per cent solution of argyrol, and one dram left in the pelvis. Daily bladder irrigations and silver nitrate installations in the bladder were given, as well as a continuous Murphy proctoclysis. Urotropin administered in 15 frain doses, t.i.d. For a few days temperature ranged lower, but patient's general condition was decidedly worse and vomiting was occurring at intervals during the day.

October 19, 1908, patients condition became so serious that it was decided to empty the uterus.

October 22, 1908, after the introduction of bougies, which were in place for two days, the temperature reached 105, and shortly thereafter the foetus was expelled. Following this the patient made an uninterrupted recovery, and was discharged from the hospital November 4, 1908, with no symptoms of infection referable to the kidney.

Case two. Mrs. Urdang, aged 26.

Primipara; last period six-and-a-half months ago. Twelve days ago patient was awakened in the morning with a sharpe stabbing pain in the left lumbar region, bowels constipated; involuntary urination; urine loaded with pus; no casts. Temperature from 100.6 to 96.6; leucocytes 10,000; polymorphonuclears 70 percent; pain in the left lumbar region continued and she was admitted to the hospital.

October 20, 1908, cystoscopic examination; moderated degree of cystitis; left ureter opening slightly in flamed; urine collected from left kidney showed a few hualine casts, epithelium from the pelvis of the kidney, many pus cells and polymorphonuclear leucocytes. In a single field, under the microscope, using 7-A objective and a No. 2 eye-piece, there were sixty pus cells in the field. Urine from right ki kidney showed a few leucocytes, and a number of red bbood cells probably of traumatic origin, also a few hyaline casts; the pelvis of each kidney was washed with a 25 per cent solution of argyrol.

Bacteriological examination: Urine from both kidneys sterile

Patient was put in the elevated head and trunk position, urotropin was given and the bladder was irrigated with 25 percent solution of argyrol twice a week. Temperature remained practically normal.

October, 27, 1908, a second examination was made and the pelvis of the left kidney again irrigated with argyrol

Urine from this kidney at second examination showed very fewpus cells present, and all the signs of inflammation had subsided; next day patient was allowed out of bed.

November 4, 1908, patient was discharged from the hospital entirely cured.

Remarks. This case presents the typical picture of an acute catarrahal pyelitis of pregnancy, probably due to pressure of the enlargeing uterus; no infecting bacilli were found, but they were probably present. As in the first acse, an examination of the urine after a week, taken from the diseased kidney, showed a very marked dminution in the absolute number of pus cells present.

Case three. Mrs. Diamond, aged 19. Patient at full term. November 30, 1908, patient had a sudden, sharp pain in the right lumbar region, which did not radiate in any direction; high fever but no vomiting; bowels had been regular; no examination of the urine was made

December 4, 1908, patient had a normal delivery.

December 6, 1908, had a chill, and later a high fever with great prostration and pain referred to the left lumbar region; no urinary symptoms; she was markedly prostrated and suffered considerably.

December 7, 1908, temperature 104, pulse 120, respirations 40; urine was acid; specific gravity 1.020; contained pus casts and many pus cells, granular casts, and renal epithelium.

Blood examination: 32,000 leucocytes; 84 percent polymorphnuclears. Temperature was septic in type.

December 9, 1908, cystopic examination revealed a general cystitis of the bladder; urine from left kidney showed pus cells and flocculi; right ureter not catheterized; pelvis of the kidney irrigated with argyrol. Patient placed in elevated haed and trunk position; urotropin administered; bladder irrigated; for next three days temperature was slightly irregular, but on the fourth day it became normal; on the sixth day patient was allowed out of bed and made an uneventful recovery

December 16, 1908, patient was discharged.

Remarks The case just detailed is an example of an acute pyelitis occurring at term; it is an example of a condition which may cause a severe septic state a few days after delivery, and in all cases of septic conditions following delivery a thorough examination of the urine may help to clear up the diagnosis

Case four. Mrs. Silbert, aged 21

Primipara in the sixth month of her preganancy. Patient's condition was normal until five days ago when she was seized with a severe, sharp, stabbing pain over the right lower quadrant of the abdomen; this condition was increased at the beginning, during, and after urination, and the patient noticed that her urine was cloudy and high-colored; pain and rigidity over the right renal region; had frequent desire to urinate but it caused great pain; slight edema of the feet had severe chills in the morning and evening followed by fever and headache; now complains also of pain in the left lower quadrant of the abdomen; vomiting of stomach contents.

Patient was put to bed in the elevated head and trunk position; fluid diet; large amount of water. Blladder was irrigated twice during the day and argyrol injected. Catheterized urine from the bladder was alkaline; there was considerable albumin; loaded with pus; the day following admission to hospital termperature fell to normal, and pusle to 90. The urine was loaded with pus. Improvement was lamost immediate, and at no time was the temperature again high; amount of pus in urine gradually decreased, and in thirteen days renal cells began to appear in the urine, but not in sufficient number to in dicate any degeneration; the tenderness and rigidity in the renal regions gradually diminished and the patient was discharged at the end of three weeks entirely relieved. The bladder irrigations were given

twice daily, using argyrol and silver nitrate, to clear up the cystitis

Remarks. In this case it was not deemed necessary to catheterize the ureters, inasmuch as the signs and symptoms were quite positive as to the origin of the pus, and the marked improvement in the patient's condition did not demand irrigation of the pelvis.

Case Five.

Mrs. Feinberg, aged 30.

Multipara. Patient in ninth month of her pregnancy; previous pregnancies normal.

December 21, 1908, patient was seized with a sudden sharpe chill and pain in the right side; had repeated chilly sensations followed by high fever; marked frequency of urination and pain upon urinationl

Blood examination; Leucocytes , 20,500; polymorphonuclears 90 per cent; urine acid; specific gravity 1.016; moderate amount of albumin; no sugar; loaded with pus cells and pus casts; few renal cells; no other evidences of nephritis. Temperature ranged from 99 to 102 every day; pulse from 125 to 90.

January 6, 1909, cystoscopic examination; bladder showed a moderate cystitis; ureter catherized; right kidney pelvis contained four and one-half ounces of residual urrine and pus; the first test-tube contained only a small amount of pus, the second a little more, the third still more, and the fourth contained urine loaded with pus; urine from the left kidney was normal in every way. On account of the large amount of residual urine in the pelvis of the right kidney, the catheter was left in place after the injection of the pelvis with 25 per cent solution of argyrol; the catheter remained in the ureter for five hours, and at the end of that time the pelvis of the kidney was again irri-

gated with 25 percent argyrol solution. Patient was turned on the left side, was postured with head and trunk raised, pelvis lowered, urotropin given and daily irrigations of the bladder introduced. The following day the temperature became normal and remained so.

Bacterial examination revealed a grampositive and gram negative bacillu and diplococcus, varying in size, spore bearing and fermenting sugar. Patient made an uneventful recovery and left the hospital before the birth of her child.

Remarks. The patient was treated expectantly for two weeks with the hope that she would not need to have her kidney irrigated; her course was rapid toward improvement after renal lavage. It is the first case in which the author found such a large amount of residual urine in the pelvis of the kidney; it is also the first case in which. so far as he knowes, a permanent catheter has been left for so long a time; when removed, the catheter, which had become molded to correspond to the curves of the ureter, showed the direction of the ureter to have been changed so that it was pushed over further to the right, the extra curve being midway between the pelvic brim and the kidney.

Case six. Mrs. Herman, aged 20.

November 3, 1908, patient was admitted to the hospital; temperature 102.6, pulse 125; a history of sudden, sharp pain in the right and left inguinal region accompanied by chills and fever; painful urination; she had suffered from slight attacks of pain in this region for the last five years; at present she is in the seventh month of pregnancy; gives a history of slight bleeding from the uterus two months ago.

Urine examination did not reveal the presence of any pus cells; leucocytes 20,000; polymorphonuclear leucocytes 84 per cent. An operation was done by Dr. Duffield and an acutely congested appendix removed, the seat of an acute catarrhal inflammation; during the next five days the patient had a stormy course, temperature ranging from 100 to 105, patient showing marked symptoms of general sepsis; at this time patient was referred to department of cystoscopy. Blood examination showed 15,000 leucocytes with 80 per cent polymorphonuclear cells.

Urine examination showed acid urine containing many pus cells, a few pus casts and hyaline casts; on that day she aborted, being delivered of a seven months' foetus that died in twelve hours.

Cystoscopic examination was made and the bladder was found to be the seat of a general cystitis; ureters were catheter-

ized and pus was found in the urine from bothkidneys; the pelvis of each kidney was irrigated with 25 per cent solution of argyrol; her temperature became normal on the fourth day a after delivery, and she made an uneventful recovery.

Remarks In this case we have a condition of double puelitis of pregnancy, complicated by an acute catarrhal inflammation of the appendiz; it is probably a fact that the original condition was a pyelitis, and if that had been controlled it might not have been necessary to have done the appendectomy nad the child might have been saved. At the time of the first examination of the urine no pus was found, and it is probable that at that time the ureter was occluded and no secretion was being expelled from the right side. I believe it is occassionally the case that a diagnosis of appendicitis is made where pyelitis is the real cause of the trouble; in this case there was no question about the existence of an acutely inflamed appendix, but at the same time, the condition of the appendix was not such as to account for the severity of the septic condition.

CONCLUSIONS.

I do believe that the etiology has not as yet been definitely discovered. It seems that most authors disagree as to what factors produce urinary stasis. They are agreed that obstruction and atony are present but as to what causes this obstruction and atony they are still undecided.

Three factors figure most importantly in the etiology of the pyelitis of pregnancy. They ar (1) stasis of urine, (2) presence of infection, and (3) lowering of resistance.

In spite of evidence contrary, the route of infection is in most cases by way of the blood stream.

Diagnosis of the disease should be made early.

Medical treatment instituted early and if no progress is made, urologic treatment should follow at once. Urologic treatment should be in the hands of a competemt urologist.

Early diagnosis, proper and careful treatment should prevent surgical or obstetrical intereference and thus lower fetal mortality and morbity as well as maternal morbidity. Except in cases where othere complications effect the mother, maternal mortality should be zero.

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