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## Case Report

# Caudal Regression Syndrome/neurogenic bladder presented as recurrent urinary tract infection



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## 1. Introduction

Caudal Regression Syndrome (CRS) is also known as 'Sacral Agenesis' which represents vertebral anomaly and imperfections in the caudal region. It is a congenital syndrome; therefore, abnormalities in the fetal development are serious outcomes of this condition. Impaired development in the caudal region will affect the general health status of the patients.<sup>1</sup> This syndrome usually occurs in combination with morphologic dysfunction of the feet and spinal cord malformations. It can be said that CRS is a rare and serious medical condition, which should be addressed properly.<sup>2</sup> Vertebral column bone malformations, bones of feet and legs, the pelvic bone, absent genitalia, blocked opening of the anus, and ureters fused are some of the symptoms of CRS.<sup>1</sup>

Urinary tract infection is a very common medical condition, which mostly occurs in hospitals or clinical settings 'nosocomial infection'.<sup>3</sup> Difficulty in urination and impaired functioning of the bladder are two extremely common symptoms of urinary tract infection. A proper treatment approach is required by the professionals to eliminate the condition of UTI (Urinary Tract Infection) effectively.<sup>4</sup>

Neurogenic bladder is another very common condition, in which an individual lacks the control of bladder because of deformities within the spinal cord, brain, or nervous supply. A number of nerves and muscles mostly work together for the attainment of specified function. A very common example regarding the bladder is, urinary incontinence. In this condition, the brain is unable to control the functions of bladder, which results in neurogenic bladder.<sup>5</sup> These three medical conditions have similar signs, symptoms, and nature, which frequently result in poor diagnosis.

## 2. Methodology

### 2.1. Study design

This research has used case study design for deriving out the specified outcomes, which is very commonly used and have an

association with rare medical condition. In case of very small sample size, the approach of case study is used for the identification of hidden factors. The incidence rate of CRS is extremely rare condition, which occurs in 1 child among the population of 25,000 individuals<sup>6</sup>; therefore, it would become very hard for the investigators to make a healthy sample size.<sup>7</sup> For this purpose, case study approach has been used for this research project.

The findings obtained from the case study strategy can be applied on similar cases of the selected medical condition. Additionally, the approach of case study will derive out effective outcomes by various means. A number of relative literatures are mostly used in the research project for making positive relevance to the existing knowledge.<sup>8</sup>

### 2.2. Case presentation

The case study, which was selected for this research project, is related to a 2 years old girl, a citizen of Saudi Arabia. She got admitted in at Alnoor specialist hospital, department of pediatrics, with the complaints of fever, diarrhea, and vomiting. The parents of the patient clearly indicated that she had these three symptoms for 3 days. With further history taking, they mentioned that vomiting was a frequent symptom; and the patient used to vomit (non-bilious) for about 5–6 times per day.

Additionally, the parents further added that diarrhea was also frequent; occurring 4–5 times a day, the nature of diarrhea was not watery. The urination process was also described as painful with intense frequency and urgency. Offensive smell of the urine was also observed during investigation. The patient was also facing suprapubic pain during admission. The oral intake of the patient was decreased along with the activities of the patient.

The past history of the patient evidently mentioned that the patient has been admitted in different hospitals for three times. The 1st admission in the hospital was due to urinary tract infection. The second was regarding right feet abscess. However, bacterial meningitis was the third reason for hospital admission at the age of 2. The mother of the patient was suffering from Diabetes Mellitus during pregnancy. The mother has normal antenatal and postnatal history. The child and mother were vaccinated as per

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recommended Saudi vaccination schedule. Family history of the patient revealed that the parents are third degree relatives.

The physical examination of the patient also revealed various factors in relation with the possible condition of Caudal Regression Syndrome. The physical examination showed that the patient was febrile and lethargic. The patient had urosepsis which suggests abnormal bladder function which can be possibly present especially with infant of diabetic mother. The temperature of the patient was 40 °C, which was affecting her general health status. The pulse rate was 129 per minute, respiratory rate was 40 per minute, and blood pressure was 120/80 mmHg. The neurological examination of the patient did not show any abnormality.

### 2.3. Approach used for findings

Different types of approaches have been used for the proper configuration of the findings. Blood tests, urine tests, radiologic evaluations, renal nuclear study, cystoscopy, urodynamics, and magnetic resonance imaging were used for investigating the health status of the patient.

## 3. Results

### 3.1. Investigation of patient

A proper investigation was carried out with the help of different tools to derive effective outcomes.

Complete blood count was done as seen in Table 1. The urine culture and sensitivity test has shown the presence of klebsiella pneumonia. The presence of blood was not found in the urine after using culture and sensitivity (C&S) test. Negative HIV Elisa and normal level of immunoglobulin serum was identified in immunology evaluation test.

### 3.2. Radiology evaluation

Another very important approach, which was used for investigation, is radiology evaluation. It is mentioned above that CRS is the abnormal development or absence of the vertebrae or caudal bone in the lower region of back. For proper investigation, the use of radiology approaches will certainly result in the identification of unseen factors.

For constructive movement of the study, ultrasound of the kidney was done after B.'s parents consent. Figs. 1–3 clearly indicate the major and minor findings of ultrasound. The ultrasound of the right kidney demonstrated that the size of the kidney was normal and average. The right kidney had thin parenchyma with marked hydronephrosis and a dilated ureter has been identified by the ultrasound. Additionally, ultrasound of left kidney is showing certain enlargement in the structure. The parenchyma of left kidney is 1.5 cm; however, moderate hydronephrosis and dilated

ureter have been observed. The ultrasound has further presented partially filled urinary bladder. All of the findings clearly demonstrated abnormalities in the structures and functions of the renal system.

Voiding cysto-urethro-gram was another approach used for the investigation, as seen in Figs. 4 and 5. The comprehensive findings of VCUg have shown drastic outcomes. Decreased capacity of the bladder with serrated and irregular outline has been observed. The V-U reflux of right side is of grade IV; however, reflux of left side is of grade I. Trabeculated bladder wall with bilateral V-U reflux was identified. Also, the possibility of a neurogenic bladder.

### 3.3. Renal nuclear study

The renal nuclear study was another approach; Fig. 6 is representing the findings of renal nuclear study with the help of DTPA. The findings have shown non-functioning right kidney; however, the functions of left kidney were moderate with delayed and slow excretion.

### 3.4. Cystoscopy

The approach of cystoscopy was used after treating pyelonephritis. The report has shown patent both vesicoureteric with bilateral vesicoureteric reflux. Moreover, obstructive secondary PUJ has been observed in the report. The cystoscopy report is illustrated in Fig. 7.

### 3.5. Urodynamics

Bladder functions were assessed by urodynamics, as seen in Fig. 8. Increased intra-vesicle pressure was observed with the bladder volume of 83 ml. This condition is responsible for causing increased intra-vesicle and detrusor pressure. The pressure of intra-vesicle and detrusor are 64 and 58 mmH<sub>2</sub>O respectively.

### 3.6. Magnetic resonance imaging (MRI)

Fig. 9 demonstrates the MRI report of the lumbar spine; MRI have shown partial sacral agenesis; however, only S1 and S2 sacral bones are present. Furthermore, abrupt termination of Conus Medullaris has been identified at the level of L1. These findings are clearly indicating the presence of Caudal Regression Syndrome.

### 3.7. Repeated urodynamics

After two months urodynamics were re-assessed again after the use of Oxybutynin and the treatment of pyelonephritis and prophyllaxis. The treatment was covered with the help of anticholinergics and antibiotics. The results showed improvement in bladder capacity, as illustrated in Fig. 10.

## 4. Discussion

Two years old B., had recurrent admissions secondary to recurrent sepsis. The most common possibility of the sepsis is urosepsis. The findings clearly indicate the presence of neurogenic bladder secondary to sacral agenesis and CRS. Both conditions have a relationship with the diabetic mother.

Caudal Regression Syndrome refers to the impaired development or absence of caudal bone. The presentation of this condition usually varies from absence of coccygeal segments to agenesis of lumbosacral region. This is a rare medical condition, which occurs in 1 child among the population of 25,000 individuals.<sup>6</sup> The risk of mortality is extremely low. Different evidence based literatures

**Table 1**  
CBC results.

CBC results			
WBC	30.4 (4.5–11.0 × 10 <sup>9</sup> )	Glucose level	94 mg/dL
Hemoglobin	9.2 g/dL	Blood urea	79 mg%
Hematocrit	27%	Serum Creatinine	1.3 mg%
MCV	71 fL	Calcium	9.7 mg%
MCH	24 pg/cell	Sodium	130 mg%
Platelet	398 × 10 <sup>9</sup> /L	Potassium	4.1 mg%
Erythrocyte	72 mm/1 h	Albumin	3.1 mg/dL
Sedimentation Rate		Urine Puss Cells	50–60/HPF

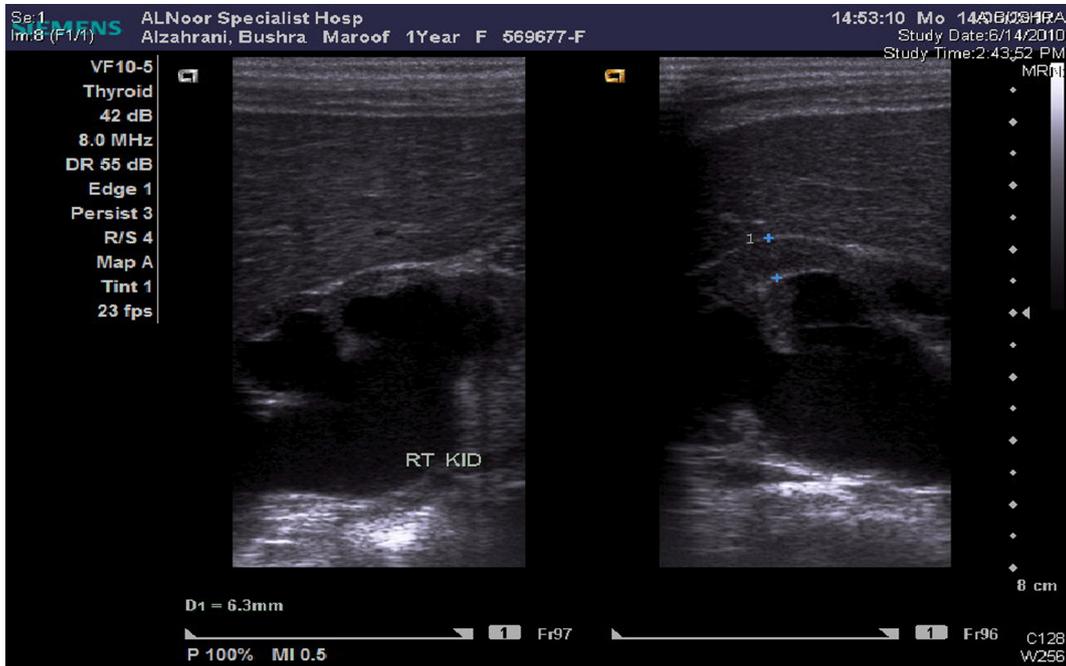


Fig. 1. Ultrasound of the kidney - 1.

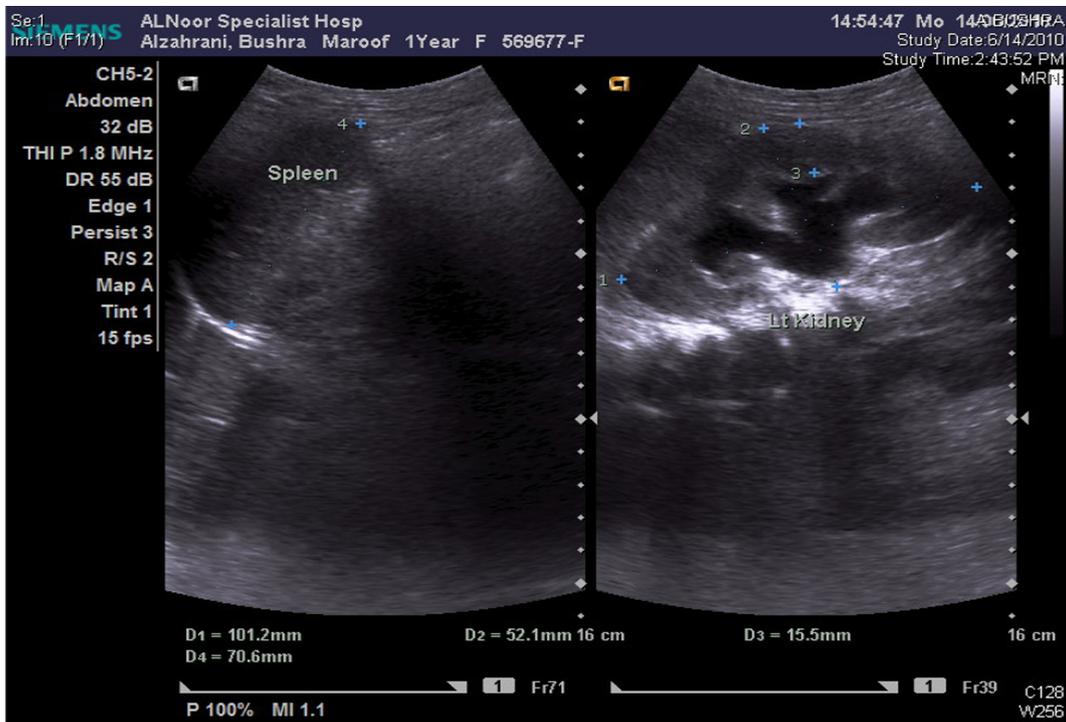


Fig. 2. Ultrasound of kidney - 2.

have shown that most of the patients are at the risk of various comorbidities after getting indulged with this syndrome. Various bladder-related disorders can be developed in an individual, coping with the condition of Caudal Regression Syndrome.<sup>9</sup> The male to female ratio of CRS is 2.7:1.<sup>10</sup>

Third degree familial marriages refers to the distribution of gene and genetic materials, which are shared by two blood family members. One eighth of the genes have been shared by third degree relatives. Prior studies show that a number of acute, chronic, and

serious medical conditions can occur as a result of marriage between third degree relatives.<sup>11</sup> The mother of the patient is 20 years old, and she was on insulin treatment at the time of pregnancy. The father of the patient was 29 years old, who suffers from bronchial asthma. B. is the only child in the family. There was no history of miscarriage or still birth regarding this family.

The etiology of CRS has indicated that the diabetic state of the mother will increase the risk of this syndrome. Moreover, premature pregnancy and ischemic events will also enhance the risk of



Fig. 3. Ultrasound of kidney - 3.



Fig. 4. Voiding Cysto-Urethro-Gram (VCUG) - 1.

CRS. Presence of infection or substance toxicity of mother during pregnancy will also make a negative impact over the health of fetus.<sup>12</sup>

It is extremely important to know about the relationship between diabetes mellitus and Caudal Regression Syndrome. It has been evaluated that the condition of hyperglycemia will make a negative impact over DNA function & structure.<sup>13</sup> Furthermore, increased blood glucose level will also increase the level of oxidative stress and also lead to hyperketonemia. All increased values can increase the risks of defects and malformations of the fetus.<sup>14</sup>

All the defects are strongly associated with the lower half of the human body and Similarly, will also affect the structures and

processes of genitourinary system. Studies have observed dysmorphogenesis in relation with embryonic metanephrosis. This finding is also dependent upon the increased levels & concentrations of the glucose in blood.<sup>15</sup>

Proper understanding of the pathogenesis is of importance for making a proper diagnosis. It has been evaluated by various studies that disruption in the maturation of caudal region will lead an individual towards neurologic impairment. The condition of neurologic impairment will directly affect the genitourinary system; neurological loss such as incontinence of urine is a common symptom of neurological impairment.<sup>16</sup> Various and different medical conditions of musculoskeletal system, central nervous system,

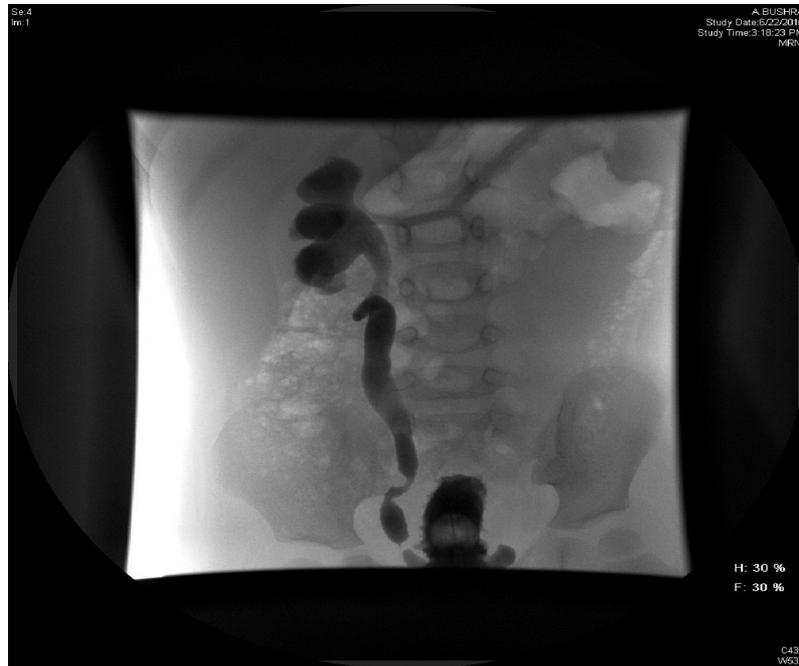


Fig. 5. Voiding Cysto-Urethro-Gram (VCUG) – 2.

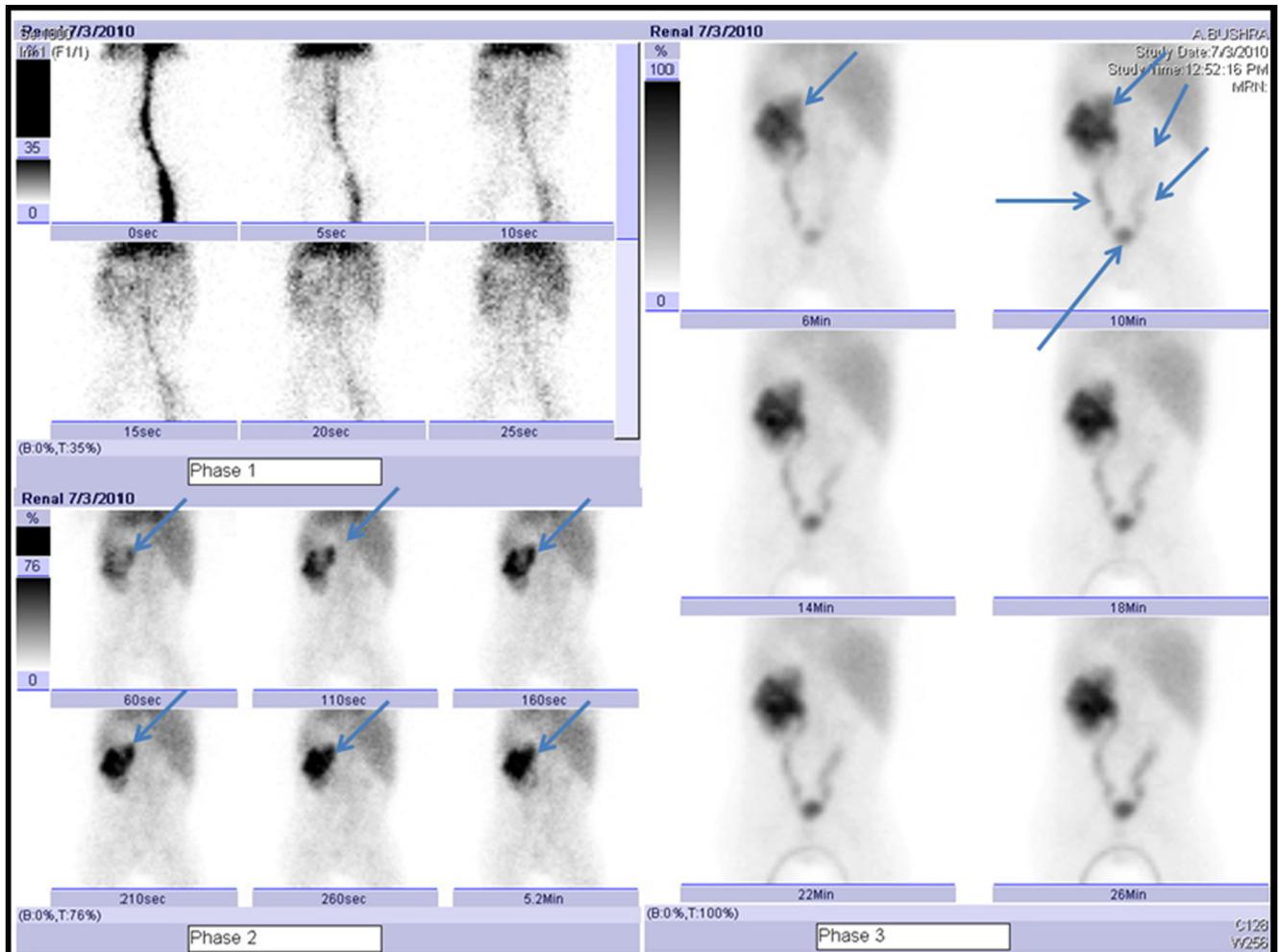


Fig. 6. Renal nuclear study – DTPA.

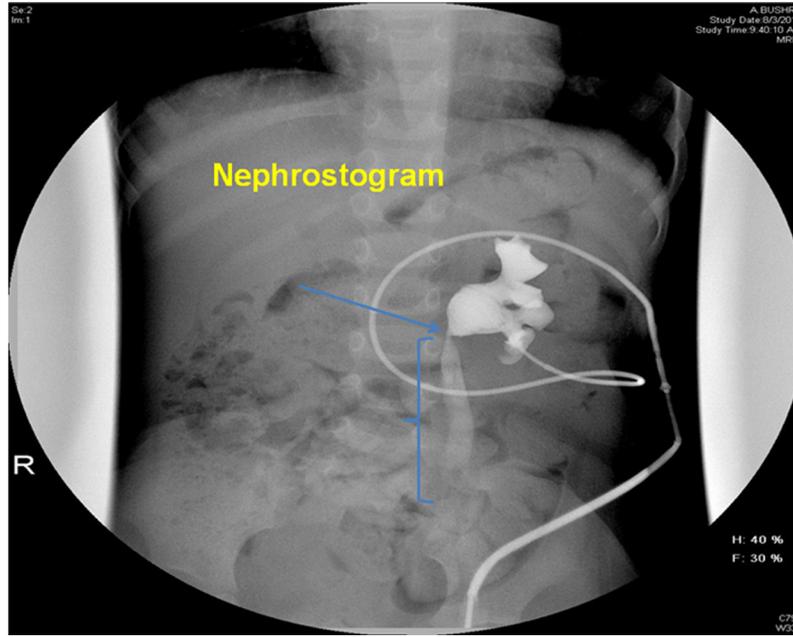


Fig. 7. Cystoscopy.

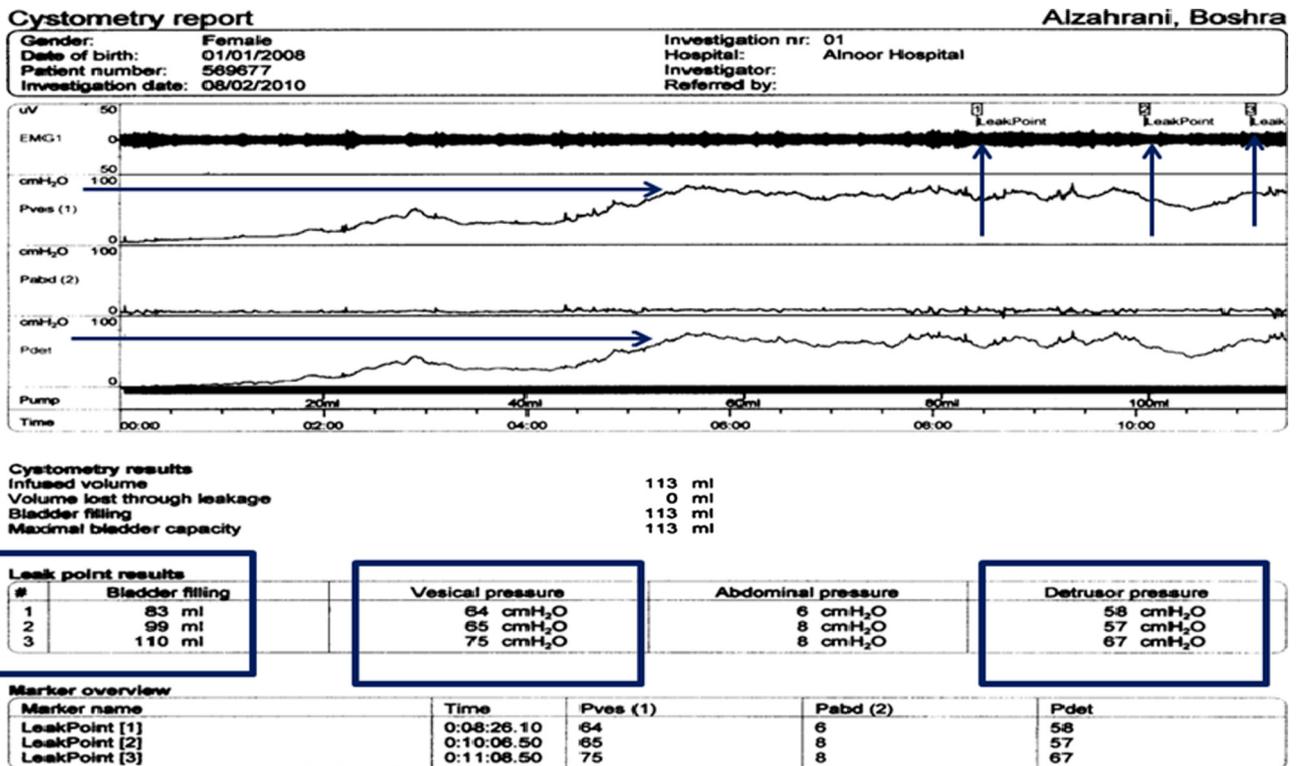


Fig. 8. Uroynamics.

cardiac systems, gastrointestinal system, respiratory system, and genito-urinary system are directly associated with CRS. Co-morbidities have a serious impact over the general physical and mental health status of the patients.<sup>17</sup>

There are certain disorders, problems and issues which are strongly connected with CRS. Absence of tail bone partially is the leading problem, and is strongly connected with the condition of CRS. It is a fact that impaired development of the spinal cord

may result in the partial absence of the tail bone and relative regions. At the same time, extreme malformations are usually observed at the level of pelvis, vertebrae, and spine. Malformations will affect the general functioning of the systems and organs of the human body. It is also seen that in some cases the symptoms are not fully present to show the minor problems, hence the patient comes with no complaint.<sup>18</sup> Birth defects, neurological impairment and urine incontinence are very common problems and directly

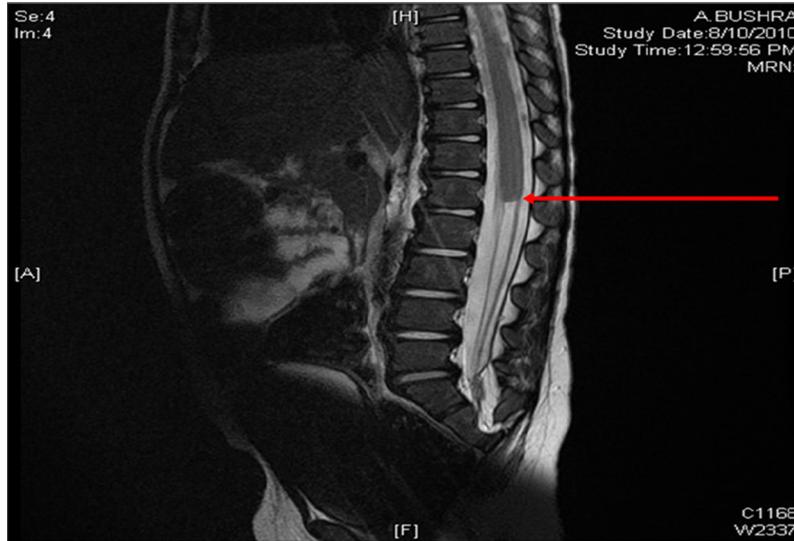


Fig. 9. MRI lumbar spine.

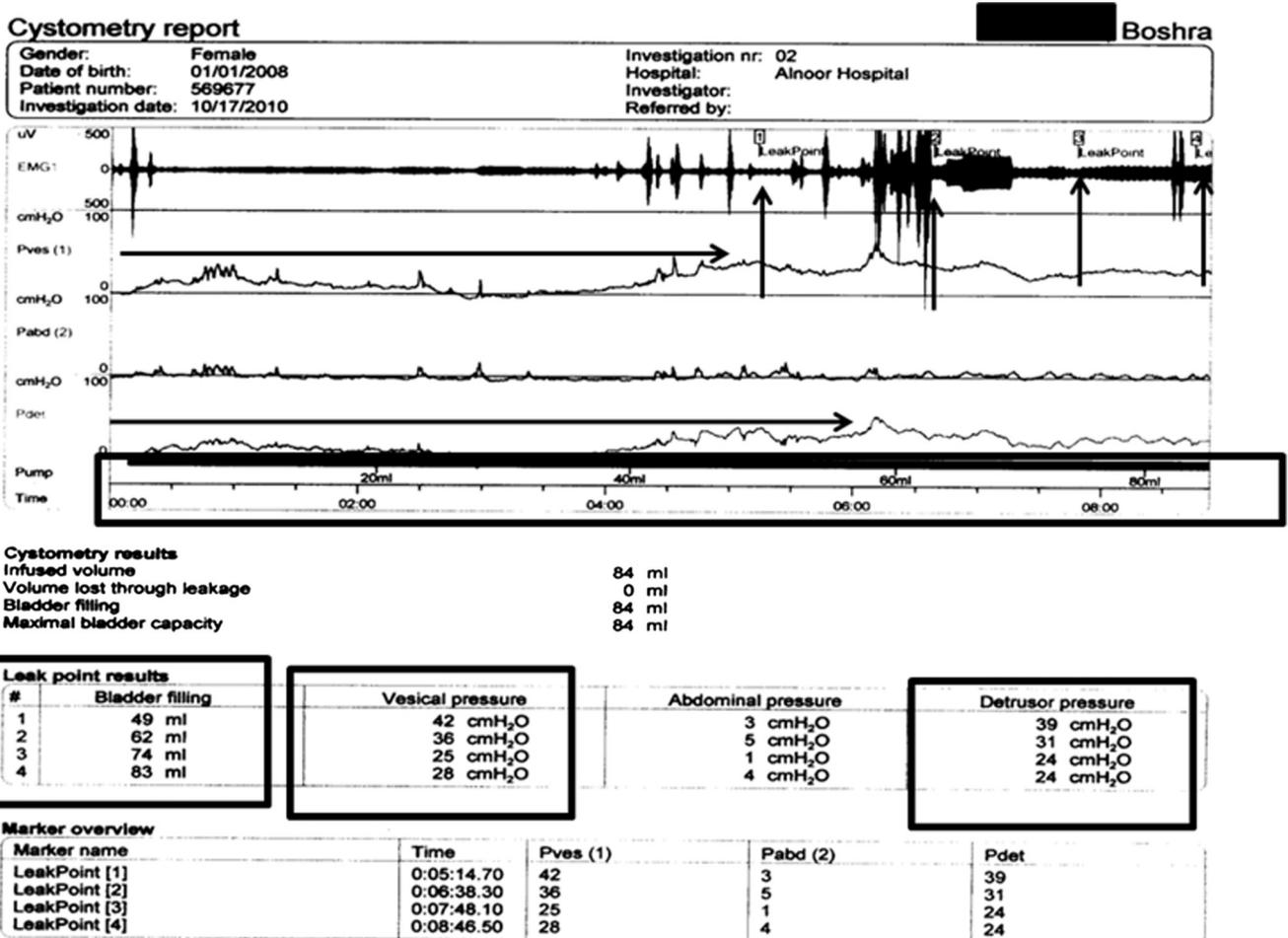


Fig. 10. Repeated urodynamics.

associated with the condition of CRS. Studies have also shown that flaccid paralysis of the lower extremities may also occur as a result of Caudal Regression Syndrome.<sup>19</sup>

Presence of the associated problems independently will also increase the risk of CRS. Urinary tract infection is considered as a

serious medical condition, which has the capability to increase the risk of CRS. The urine test of the patient showed the presence of klebsiella pneumonia; a pathogen that has the capability to cause urinary tract infection. It has been evaluated that the factor of urinary tract infection will increase the risk of neurogenic

bladder.<sup>20</sup> Neurogenic bladder is a serious medical problem, in which an individual lacks the control of bladder. This medical issue will affect the normal functioning of genito-urinary system. Bladder voiding and painful urination are common symptoms of neurogenic bladder.<sup>21</sup>

The condition of neurogenic bladder is a very common symptom of CRS. Therefore, urinary tract infection is a very general differential diagnosis of Caudal Regression Syndrome. The health care professionals and clinicians should give excessive concentration to evaluate the correct medical conditions with the help of different tools. Therefore, it is said that neurogenic bladder and CRS will cause similar symptoms and conditions.<sup>22</sup>

A study was conducted by Moritoki et al. (2013), has shown that CRS has the ability to cause neuropathic bladder without producing any neurogenic symptoms. It has been evaluated by the study that CRS is a vertebral anomaly, which will affect the morphologic dysfunction and malformations of the lower region of spinal cord. The study mentioned that this syndrome will result in the renal dysfunction because of its symptoms. The patient will become extremely prominent to the symptoms of impaired renal functions, impaired bladder functioning, and painful urination. By the time, the patient will also lose control of the bladder in relation with the urination.<sup>23</sup> Therefore, the condition of neurogenic bladder will occur.

The study has mentioned that the condition of CRS usually do not produce any major or minor symptoms in the patient, therefore, the diagnosis is discovered after a while. To avoid this condition, it is extremely necessary for the health care professionals to use radiological approaches. It is a fact that neurological manifestations usually correspond with the vertebral agenesis. Therefore, the patient will not suffer from any neurological defect. Urodynamics testing is the leading diagnostic approach, which has shown that the impaired urinary tract function is directly associated with CRS. Therefore, the study clearly mentioned that Caudal Regression Syndrome, urinary tract infection, and neuropathic bladder are closely attached with each other.<sup>23</sup>

Another study was conducted by Semba and Ki (2013), which was focused on the different causes of CRS. The study has shown that Caudal Regression Syndrome is a rare medical condition, which will affect the caudal region of the fetus during development. The study has mentioned that increased glucose level of the mother will affect the normal development of the fetus. Our study has also shown that the state of hyperglycemia is the leading reason for the occurrence of CRS.<sup>24</sup>

Although it was priorly mentioned that increase blood glucose has a negative impact on DNA. However, our study showed diabetes mellitus is not the main cause of CRS. Presence of infection is another very common cause of this medical condition. The urine test has shown presence of *Klebsiella pneumoniae* in the patient.<sup>24</sup> Soria et al. (2011) has also supported the influence of infection and toxicity over the CRS. The study further mentioned that partial or complete absence of tail bone will emerge various complications in an individual. The findings of this study and the outcomes of past studies are similar and authentic. It is a fact that the patient has been hospitalized due to the condition of UTI. The presence of urinary tract infection directly affected the normal functioning of bladder and genito-urinary system.<sup>25</sup> It has now become clear that the patient is suffering from the condition of CRS and neurogenic bladder presented by urinary tract infection.

Sacral agenesis is another very common differential diagnosis, which refers to the complete or partial absence of the tail bone. A study has shown that the condition of diabetes mellitus and genetic deformity will increase the risk of sacral agenesis. The study mentioned that genetic factors will play a hazardous role in the development of caudal region.<sup>26</sup> Another study has shown that mutation in HLXB9, a homeodomain gene, will increase the

risk of sacral agenesis.<sup>27</sup> Similarly, another study has also supported this statement that mutation of the HLXB9 is responsible for the occurrence of sacral agenesis.<sup>28</sup> A study has also shown that urinary continence can be easily attained with the help of long term treatment approaches.<sup>29</sup>

## 5. Conclusion

Caudal Regression Syndrome is a rare congenital medical condition, in which an individual suffers from impaired development of the tail bone in the caudal region. Urinary tract infection is a very common type of nosocomial infection, which affects the urinary tract. Neurogenic bladder is another very common problem, in which an individual lacks the control of his bladder. It is seen that CRS, neurogenic bladder and UTI infections have analogous signs and symptoms, which usually results in the poor or confused diagnosis. Clinical history, physical examination, blood tests, urine tests, radiologic evaluations, renal nuclear study, cystoscopy, urodynamics, and magnetic resonance imaging are common approach, which can be used for effective diagnosis. Diabetic mother will increase the chances of CRS. Therefore, it can be said that caudal regression syndrome and neurogenic bladder can be presented as urinary tract infection.

## Conflict of interest

No conflict of interest and contending financial benefits have been declared by the research workers in regards with this project.

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