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COMPLICATIONS OF CHICKEN-POX

BY

CHAVA E. ROTEM, M.D., M.R.C.P., M.R.C.P.Ed.

Formerly Senior Medical Registrar, Leicester Isolation Hospital and Chest Unit*

Varicella is a highly infectious disease of children, usually mild in nature, without complications or sequelae. Occasionally, however, the virus of varicella may give rise to a number of complications of varying severity which may occur singly or in association, affecting (in descending order of frequency) the respiratory system, the nervous system, the urinary system, and the skin. Cases of visceral chicken-pox have been reported by Johnson (1940), Nicolaides (1957), and McLachlan (1957). Haemorrhagic chicken-pox is usually associated with other complications and is of grave prognosis; two such cases were seen at the Leicester Isolation Hospital; another had been described by Cohen and Bansmer (1947).

Mostly single cases or complications affecting one system only are described in the literature. This paper describes all the complications of varicella seen in this hospital over a ten-year period.

Survey of Material

Twelve patients with complications of varicella were admitted to this hospital during 1950-9. The hospital admits infectious cases from an area including Leicester City and County, and Rutland, with a total population of about 1,000,000.

*Present address: EMMS Hospital, Nazareth, Israel.

Table I shows the distribution of cases by age and sex, and the fatalities that occurred.

Table II shows the various complications encountered in order of descending frequency. No cases of nephritis or nephrosis were seen. Five patients had symptomless albuminuria and mild pyuria for a short time.

TABLE I

No. of Cases	Age Groups	Sex		Fatalities	
		M	F	M	F
5	1-10	2	3	1	1
1	11-20	1			
2	31-40	2		1	
2	41-50	2			
2	61-85	1	1		
Total 12		8	4	2	1

TABLE II

Complications	No. of Cases		Total	Fatal	Remarks
	M	F			
Disseminated pneumonia	4	2	6	—	Two cases associated with profuse rash, 1 with zoster, 1 with varicella gangrenosa, 1 with meningo-encephalitis, 1 with haemorrhagic varicella and visceral lesions
Encephalitic symptoms	3	2	5	1	Fatal case had haemorrhagic chicken-pox
Albuminuria and leucocytes in urine	4	1	5	—	None had any symptoms referable to genito-urinary system. All urine abnormalities cleared spontaneously
Localized skin complications	2	1	3	—	One had varicella gangrenosa. Two had superinfection with <i>Staph. aureus</i> . All were mild
Herpes zoster	1	1	2	—	One had superinfection with <i>Staph. aureus</i> and pulmonary infarcts. The other had disseminated pneumonia
Pulmonary infarcts	2	—	2	1	Fatal case had thrombosis of pelvic veins
Visceral lesions	—	1	1	1	Varicella haemorrhagica

Pulmonary Complications

Pulmonary complications were the most common. Four of the six cases of disseminated pneumonia were admitted for other complications. None had any symptoms referable to the chest and the diagnosis was made radiologically. The case reports of the other two cases are given below.

FIG. 1.—Case 3 on May 21, 1950.

Case 3. — Man aged 44; probable source of infection — own child with uncomplicated varicella two weeks prior to illness. May 14, 1950: onset with malaise. May 15: first spots, with rapid increase in spread and density. May 16: upper abdominal pain aggravated by deep breathing; no vomiting, but loss of appetite, normal stools. May 20: admission to hospital. On examination — profuse rash

(Fig. 1), ulcers on gums, palate, and uvula. The rash involved the axillae; there was no adenitis and each lesion was characteristic of chicken-pox. Pain was that of diaphragmatic pleurisy though cough was not marked. There were a few rales in the chest. May 22: rash pustular. May 23: patient lethargic. May 24: scabbing of skin lesions. May 25: patient well enough to be x-rayed; widespread disseminated pneumonia (Fig. 2). May 30: thrombosis in right calf, anticoagulant therapy (heparin) started. May 31: pleuritic pain in right chest, pleural friction rub audible; pulmonary infarction diagnosed. June 10: clearing of lesions but thickening of right pleura evident. June 12: discharged. August 10: Follow-up,

FIG. 2.—Case 3. Radiograph on May 26, 1950. Note size and distribution of opacities.

x-ray film clear except for increased bronchovascular markings. Symptom-free. Albuminuria + to ++, and leucocytes were found on several occasions. Total duration of illness was 30 days.

Other cases of disseminated pneumonia were not quite as striking.

Case 8.—Man aged 37; contact of his three children, all suffering from chicken-pox. August 26, 1958: appearance of rash and cough. Progressively worse; admitted on August 31. X-ray examination showed "miliary" mottling of both lung fields. Scanty mucoid sputum, no pathogens isolated on culture. On 12th day of illness developed thrombophlebitis of left calf and had a two-weeks course of anticoagulants (phenindione). September 30: x-ray examination at follow-up showed generalized increase in lung markings.

In Case 5 disseminated pneumonia was associated with visceral chicken-pox, in case 7 with meningo-encephalitis, in Case 9 with varicella gangrenosa, and in Case 12 with herpes zoster.

Neurological Complications

Neurological complications may precede, accompany, or follow the development of the rash up to 21 days. In the five cases in the present series, onset of encephalitic symptoms occurred one, three, six, and seven days after the rash and preceded the rash by three days in one

case. The case report of the child who died was as follows:

Case 10.—Boy aged 6, admitted June 3, 1959, seven days after onset of varicella. Vomiting had started two days prior to admission. Drowsy for one day when admitted. On examination: semicomatose, restless, dehydrated. Skin: sparse lesions which were haemorrhagic. Chest clear on auscultation, no cardiac murmurs. Blood-pressure 105/50. C.N.S.: pupils dilated, reaction to light doubtful, marked photophobia; no neck rigidity. Negative Kernig and Brudzinski's signs. Normal reflexes. Sensorium could not be tested. C.S.F. pressure 80 mm., clear, no increase in cells or protein. Blood urea and electrolytes within normal limits. White blood count, 16,300/c.mm. (73% polymorphs, 23% lymphocytes, 4% monocytes). Prophylactic treatment with penicillin started. 2½ pints (1.3 litres) dextrose 5% to combat dehydration administered, but steady deterioration continued. Tracheostomy performed when left lung apparently collapsed owing to aspiration of vomit. Temperature rose to 103° F. (39.5° C.); died less than 24 hours after admission. At necropsy: brain swollen, vessels engorged, parenchyma bulging. Microscopically: widespread swelling of capillary endothelium, but no haemorrhages. Lungs congested, with areas of collapse. The air passages contained mucus and slightly blood-stained oedema fluid; scattered petechial haemorrhages on pleurae. Congestion of alimentary tract. No other abnormality. Cause of death: cardio-respiratory failure secondary to encephalitis following chicken-pox.

The next case report illustrates the seriousness of neurological complications in an adult.

Case 7.—Man aged 46; admission July 22, 1957, as case of meningitis with two days' history of pyrexia, headache, and vomiting of sudden onset. On examination—rather ill, lethargic, a few macules on trunk. C.N.S.: signs of meningitis. C.S.F.: cells 133 (polymorphs 22, lymphocytes 111); protein, 36 mg./100 ml.; chlorides, 550 mg./100 ml.; sugar, 68 mg./100 ml. Phenoxymethylpenicillin injections started. July 23: varicella rash. Photophobia and meningism marked. No cough, chest x-ray film showed mild disseminated pneumonia; semiconscious. July 25: nearly comatose; reacts only to painful stimuli; has to be fed by Ryle's tube. C.S.F.: cells 1,500 (polymorphs 1%, lymphocytes 75%, monocytes 24%); protein 750 mg./100 ml.; chlorides and sugar normal. July 26: recovered consciousness with complete amnesia of previous three days. Slow uneventful recovery. C.S.F. normal on October 30.

All other cases in this group had less severe symptoms with only slight pleocytosis and/or raised protein in the C.S.F., but the following case was of some interest.

Case 1.—A girl aged 5 developed an asymmetrical spastic paraplegia in March, 1950, seven days after appearance of varicella rash. She also had generalized hyperreflexia, marked clonus, and profuse vomiting. C.S.F. was under increased pressure but contained only 57 cells (all lymphocytes) and protein 35 mg./100 ml. Discharged after one month, walking normally, but some ankle clonus still present.

Varicella Gangrenosa

One patient developed varicella gangrenosa.

Case 9.—A 9-year-old boy admitted on December 16, 1958, had four deep necrotic ulcers each about 1–1½ in. (2.5–3.8 cm.) in diameter—two on buttocks, one on abdomen, and one on thigh. No pathogens isolated from the lesions; general condition remarkably good. Lesions healed slowly by granulation, leaving deep scars.

Herpes Zoster

Herpes zoster is occasionally associated with chicken-pox. It may arise as a subsequent complication or precede varicella as in the following patient who had never had varicella or zoster.

Case 11.—A man aged 85, admitted on June 10, 1959, afebrile, yet extremely ill with severe herpes zoster affecting all three trigeminal branches on the left. There was corneal ulceration and chemosis. Herpes lesions were superinfected with *Staph. aureus* and *Proteus sp.* Typical varicella rash with lesions on buccal mucosa and fauces had developed three days after onset of zoster. Fifteen days after admission, while improving, he developed a large pulmonary infarct. Anticoagulant therapy (phenindione) was given for one month with satisfactory clearing of pulmonary lesion.

Pulmonary Infarction

The following case of multiple bilateral pulmonary infarcts proved fatal.

Case 4.—Man aged 34 developed mild varicella on January 6, 1954. Haemoptysis two weeks later, followed by polyuria and macroscopic haematuria. February 9: pains in chest and dyspnoea, rapidly increasing in severity. On admission, February 16, found to be very ill, dyspnoeic, febrile (101.2° F. 38.4° C.). Recently healed chicken-pox lesions on body. Blood-pressure 130/90, gallop rhythm. X-ray examination confirmed bilateral pleural effusions, which on aspiration were found to be heavily blood-stained. After aspiration x-ray film showed opacities suggestive of multiple pulmonary infarcts. Blood count and blood urea normal. R.B.C. in urine. After initial slight improvement patient died suddenly on February 22. Necropsy: Ulcerated varicella lesions underneath left scrotum, which appeared bruised; from these, thrombosis of spermatic veins, iliac veins, and inferior vena cava, giving rise to bilateral pulmonary emboli and pulmonary infarction. Cause of death: cardio-respiratory failure due to multiple pulmonary infarcts.

Visceral Involvement

To end this series of case histories, a case of extensive haemorrhagic chicken-pox with visceral involvement is described. The extent of the lesions as well as their microscopical appearance would justify the term "visceral chicken-pox." This case closely resembled that of visceral herpes zoster described by Wyburn-Mason (1957).

Case 5.—Baby girl aged 1, admitted July 10, 1957, from a poor home in neglected condition. On admission, widespread haemorrhagic gangrenous varicella rash. Temperature 101.8° F. (38.8° C.); haemoglobin, 57%; white blood count, 7,100 (polymorphs 52%, lymphocytes 48%). In spite of high dosage of penicillin, and later addition of chloramphenicol, temperature rose gradually to 104° F. (40° C.) on July 17 and she died. Necropsy: Respiratory system: varicella lesions covering the pharynx, epiglottis, vocal cords, and trachea down to the third ring. Trachea and main bronchi contained mucus and aspirated vomit. Right upper lobe somewhat collapsed, both lungs congested and oedematous. Alimentary system: mouth, tongue, and pharynx showed ulcerated vesicles not extending into stomach. Small and large bowel appeared normal. Skull and its contents were, unfortunately, not examined. Microscopically the tongue, epiglottis, larynx, and lungs showed scattered necrotic and ulcerated lesions on their epithelial surfaces. Oedema of lungs and bronchopneumonic changes. One large pulmonary vessel contained an ante-mortem thrombus. Cause of death: varicella haemorrhagica and aspirative pneumonia.

Discussion

Though adults seldom suffer from chicken-pox, it appears that complications are more common and more severe than in children (Davidson, 1956). In the present series, 6 out of 12 patients were adults. Boucher (1953), Saslaw *et al.* (1953), Lander (1955), Tan *et al.* (1956), and McLachlan (1957) have reported similar findings.

Disseminated pneumonia caused by the virus of varicella has been previously described (Saslaw

et al., 1953; McLachlan, 1953; Tan *et al.*, 1956; Southard, 1956; *British Medical Journal*, 1957). It is a diffuse pneumonia with very characteristic radiological appearances. Widespread nodular shadows are seen, similar to, but larger than, those of miliary tuberculosis, superimposed on increased bronchovascular markings. There is usually no segmental consolidation or collapse. Resolution starts 10 to 14 days after onset and is progressive. In most of our cases, however, increased bronchovascular markings were still visible up to two months afterwards. Chicken-pox pneumonia usually develops in adults only. Occasionally disseminated pneumonia is diagnosed on radiological grounds only, as clinical symptoms such as cough and sputum are often mild or absent.

A point of interest is the frequent association of a profuse skin rash with disseminated pneumonia, while symptoms of encephalitis seem to occur more often in patients with a sparse rash. In the present series there were no fatal cases due to disseminated pneumonia. Corticosteroids appear to enhance the action of varicella virus, and it is in cases receiving corticosteroids that the only fatalities from disseminated pneumonia had been recorded (Cheatham *et al.*, 1956; *Lancet*, 1957; *British Medical Journal*, 1957; Harrison, 1957; McLachlan, 1957; Stokes, 1959a, 1959b). It therefore appears that corticosteroids should be discontinued in patients developing chicken-pox and adequate antibiotic cover given.

The most serious complication of chicken-pox is encephalitis. The incidence has been estimated at about 1 in 1,000 (Miller *et al.*, 1956). Mortality varies between 10 and 50%. The patients who recover do so usually without sequelae and within two to three weeks. The encephalitis of chicken-pox is non-specific and indistinguishable from that following measles or rubella: the theory has been postulated that it is an allergic reaction in the central nervous system (Russell, 1955).

Encephalitis presents clinically either as (1) meningo-encephalitis or (2) encephalomyelitis, and histologically as either haemorrhagic leucoencephalitis or acute disseminated encephalomyelitis. The two forms are probably only variants of one pathological process (Russell, 1955).

The onset of encephalitis may precede the rash by up to four days as in Case 7, or follow it by up to 21 days. Among all the reported cases surveyed, encephalitis developed an average of six days after the appearance of the rash. The onset is gradual, with headache and meningeal signs, focal neurological signs being usually absent. Drowsiness and stupor are present in about half the cases. When the onset is sudden, with convulsions and coma, the prognosis is bad. Such a case was encountered in the present series, a boy of 6 who died within three days (Case 10). The C.S.F. is usually clear but under increased pressure: it can be either completely normal or show a lymphocytic pleocytosis with or without increase in protein content.

Histologically, in acute disseminated encephalomyelitis, there is widespread perivenous inflammatory cell infiltration and demyelination with general survival of nerve cells even within the inflamed area (*Lancet*, 1957), which might explain the recovery without sequelae. In haemorrhagic leucoencephalitis there are macroscopical widespread petechial haemorrhages throughout the white matter and microscopical swelling of capillary

endothelium in grey and white matter. Some necrosis of vessel walls occurs with proliferation of microglia and occasional formation of glial nodules. Perivascular demyelination and round-cell cuffing are demonstrable (Miller *et al.*, 1956).

A fatal case of acute haemorrhagic leucoencephalitis has been described by Lander (1955). Bergman and Magnusson reported 10 cases with neurological complications occurring in the decade 1927 to 1938 at Stockholm. In England and Wales nine cases were reported in 1950, one of which was fatal (quoted from Miller *et al.*, 1956). The present survey adds five cases with neurological complications. Four of these were in children aged 4–15 years; one terminated fatally. These findings are similar to those described by Brain (1955). Lesions suggestive of cerebellar involvement, as described by Walsh (1957), were not seen.

The occasional association between chicken-pox and shingles has been widely discussed. The identity of the viruses of varicella and zoster has now been established by antigenic analysis and by antibody evidence (Hope Simpson, 1954; *Lancet*, 1954; Downie, 1955; Stokes, 1959a, 1959b).

It is not clear which factors determine whether one or the other disease appears after exposure to the virus or, if both appear, which one arises first. Stokes (1959) has discussed the theories that varicella virus possesses neurotropic properties, and that varicella can be regarded as the early general infection while zoster is a late localized manifestation in the immune or partially immune person at a later age. These theories would not explain the development of the chicken-pox rash three and seven days respectively after the onset of zoster in two of our elderly patients, and in two cases of Knyvett *et al.* (1957).

Severe visceral involvement will occasionally occur and is usually fatal (one case reported by Johnson (1940), three cases by Nicolaides (1957), one case in the present series). In all cases there was extensive involvement of the oesophageal mucosa down to the cardia and of the laryngeal mucosa down into the main bronchi, as well as on the pleurae. Macroscopically, there are vasodilatation and oedema, haemorrhages, and inflammatory changes which predispose to vascular thrombosis. Microscopically, cells of the epithelial types are mainly affected, preceded by involvement of the endothelial cells. Case 5 in this series presented these findings.

A rare complication of chicken-pox is varicella haemorrhagica, the aetiology of which is ill understood. A case has been described by Cohen and Bansmer (1947) of a boy of 11 who developed varicella haemorrhagica and purpura and recovered after 30 days in hospital. Treatment included transfusions and analeptics. The case was seen in the acute stage by Dr. William Dameshek, who found it to be indistinguishable from idiopathic thrombocytopenic purpura, and perhaps patients with varicella haemorrhagica develop this abnormality temporarily. The incidence of this complication is low and only single cases have been reported. The mortality is high—only three out of nine cases have recovered. In no case was there a previous history of bleeding or haemorrhagic diathesis. In our two cases of varicella haemorrhagica (Cases 5 and 10), one was a baby from whom no blood was taken for extensive haematological studies, and the other was a boy of 6 who died within 24 hours of admission.

Ocular involvement occasionally occurs in chicken-pox. Conjunctivitis, and punctate and interstitial

keratitis have been described (Walsh, 1957). The ocular complications are usually mild and the recovery rate is high. Walsh also describes the case of a 5-year-old girl in whom a bilateral optic neuritis with practically total loss of vision developed a week before the appearance of the varicella rash. He also describes other cases in which transient blindness occurred shortly after an attack of chicken-pox. Similarly, Hatch (1949) reported another case of bilateral optic neuritis which followed varicella, and cases of varicella of the cornea have been described (Pickard, 1936). No ocular involvement occurred in our series except in Case 11, who had ulceration of the cornea due to zoster of the ophthalmic branch of the trigeminus.

Summary

Twelve patients with complications of varicella were admitted to the Leicester Isolation Hospital over the decade 1950 to 1959. The age of the patients ranged from 1 to 85 years. The commonest complications were disseminated pneumonia, which presented a characteristic radiological appearance, and encephalitis. The rarest was varicella haemorrhagica. There were three fatal cases.

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"Dr. Janet Travell is not after all the first woman to be the White House physician. That distinction belongs to Dr. Susan Ann Edson, who attended President Garfield from the time when he was shot on July 2, 1881, until he died on September 19. Dr. Edson was Garfield's family doctor, and she was known at the White House as the 'head nurse.' Her devoted service during Garfield's last days undermined her own health, and she was given a special grant of \$3,000 by Congress." (*Daily Telegraph*, March 2.)