Alder Hey Children's NHS
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Neonates with acute kidney injury requiring peritoneal dialysis continue to be at risk of iatrogenic iodine toxicity and hypothyroidism with attendant risk to the developing brain

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Background

There are published recommendations to avoid exposure of neonates to iodine. Iodine is avidly trapped by the thyroid gland from the blood stream and used for the synthesis of thyroid hormones. Any excess is excreted almost entirely in the urine. Acute kidney injury, especially anuria places the infant at risk of toxicity due to a high plasma iodine concentration and paradoxical hypothyroidism due to the Wolff-Chaikoff effect[1]. Congenital hypothyroidism of sufficient severity to seriously put the brain at risk has been reported in this setting[2]. The paediatric nephrology community have taken appropriate precautions and this stimulated an alert by Medicines and Healthcare products Regulatory Agency (MHRA) in the UK in 2006. However, we describe a case where this has occurred again.

Wolff-Chaikoff Effect

Wolff and Chaikoff reported in 1948, that organic binding of iodine in the thyroid, decreased when plasma inorganic iodine levels were increased[1]. This effect is usually temporary and within a few days, hormone synthesis returns to normal through the so-called 'escape' phenomenon. This escape does not occur in a few susceptible individuals[2].

Case Report

A male infant born at 38 weeks with autosomal recessive polycystic kidney disease required bilateral nephrectomies and continuous peritoneal dialysis on day 7 of life. The newborn screening test for congenital hypothyroidism (CH) revealed a blood spot TSH of 7.5 mu/l which would have been accepted by many screening programs as normal. It was repeated, as our centre has a cut-off point of 5 mu/l for further attention. Plasma Free T4, 6 pmol/l (ref 10-25) and TSH 312 mu/l (ref 0.3-3.8) confirmed CH. Ultrasound demonstrated a normally sited, normal looking thyroid. Plasma iodine concentration was 3.1 µmol/l (ref 0.32-0.62), lower than a paired peritoneal dialysate fluid iodine concentration of 13.3 µmol/l. The dialysis catheter cap was found to contain an iodine impregnated swab (see figures 1 & 2). He was commenced on treatment with thyroxine and is currently stable on dialysis, on 50µg thyroxine daily. He now has normal thyroid function.

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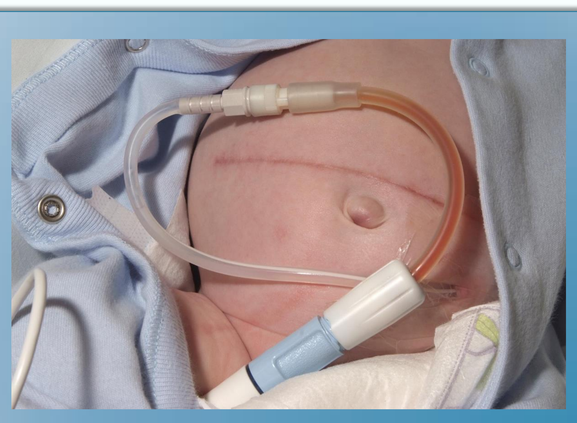

Figure 1. Photograph demonstrating dialysis fluid stained with iodine distal to the peritoneal dialysis cap, shortly after the cap was connected

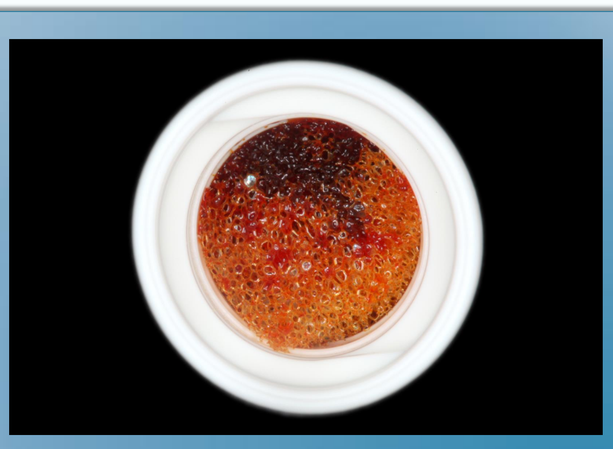

Figure 2. Photograph of the opened peritoneal dialysis cap showing the iodine soaked swab within the cap

Discussion

The plasma TSH of 312 mu/l with plasma FT4 of 6 pmol/l represents CH universally accepted as a serious risk to the developing brain in a newborn. The physiology of iodine handling depends on excess iodine being excreted by the kidneys. This presents a special risk in infants with acute kidney injury or anuria, if the patient is exposed to iodine. The resultant high plasma iodine level presents a toxic environment to the thyroid of a newborn infant and in turn, the developing brain. The literature suggests that the Wolff-Chaikoff effect is a transient problem with an escape phenomenon. We speculate that the repeated reports of hypothyroidism associated with exposure to iodine in the neonatal period may be due to immaturity of the enzyme systems governing thyroid hormone production during this period, and the effect of iodine on these immature enzyme systems leading to a prolonged effect on thyroid hormone production.

Our units have previously reported this problem in neonates having peritoneal dialysis[2] and action by the MHRA followed. This has clearly not removed the risk. Iodine impregnated swabs continue to be used in peritoneal dialysis circuits. If such swabs are considered vital on grounds of antisepsis, paediatric nephrologists must ensure that all neonates who have peritoneal dialysis must have a mandatory assessment of thyroid function 1 week **and** 2 weeks after commencement of dialysis to ensure that the developing brain is not put at increased risk. Prompt commencement of treatment with thyroxine removes this added risk to the developing brain.

Conclusion

All infants having peritoneal dialysis must have a biochemical assessment of thyroid function undertaken after commencement of dialysis.

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