Findings that shed new light on the possible pathogenesis of a disease or an adverse effect

Subaponeurotic or subgaleal fluid collections in infancy: an unusual but distinct cause of scalp swelling in infancy

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Summary

Subaponeurotic or subgaleal fluid collection is a rare but important cause of scalp swelling in young infants. Fluid in the subaponeurotic or subgaleal space presents as soft, ill-defined, fluctuant, highly mobile scalp swelling and is not limited by suture lines, which makes it clinically very distinct from other scalp swellings. However, the aetiology of such swelling still remains uncertain but may be related to traumatic labour that manifests after the first few weeks of life. There is no indication for imaging if the condition is diagnosed clinically with confidence. The late subaponeurotic or subgaleal fluid collection resolves spontaneously without any intervention, hence conservative management is the treatment of choice.

BACKGROUND

This topic will be of interest to general paediatricians as well as neonatologists as subaponeurotic fluid collection in infancy is poorly described in the literature. Scalp swelling in infants secondary to subaponeurotic or subgaleal fluid collection usually manifests beyond the neonatal period; the aetiology of such swelling remains uncertain but may be related to traumatic delivery. It is important for paediatricians to know that delayed subaponeurotic or subgaleal fluid collection in infancy is a benign condition with a tendency for spontaneous resolution in a few weeks and that investigations are usually not needed unless there is a diagnostic dilemma.

CASE PRESENTATION

Case 1

A male infant aged 8 weeks presented with a 1-day history of asymptomatic scalp swelling. He was born by emergency caesarean section at 41 weeks' gestation due to abnormal cardiotocograph (CTG) trace and failure to progress. He weighed 2.7 kg and no bruising, swelling or cephalhaematoma was noted in the immediate newborn period. At presentation there was a soft, non-tender, fluctuant swelling predominantly in the occipital region. This swelling was mobile and not limited by suture lines, and a fluid wave was felt on movement of the head.

The infant underwent skull x-ray, cranial ultrasound and MRI to ascertain the nature of the swelling (figures 1–3). The swelling resolved spontaneously over the next few weeks.

Case 2

A female infant presented at 4 weeks of age with an ill-defined scalp swelling. She was born by emergency caesarean section at term due to failure to progress. There was

no history of forceps or ventouse application prior to delivery. No scalp swelling or bruising was seen at the time of birth or in the immediate postnatal period.

At 2 weeks of age the parents noted a mobile, fluctuant scalp swelling of increasing size. On presentation to the hospital this swelling was soft, non-tender and fluctuant and a fluid shift was noted on head movement that was not limited by suture lines. There was no abnormality on palpation of the scalp and there were no signs of bruising or trauma. A clinical diagnosis of subaponeurotic or subgaleal fluid collection was made and no investigations were performed. There was spontaneous resolution of the swelling by 7 weeks of age.

Case 3

A male infant presented at 14 weeks of age with a 1-day history of ill-defined scalp swelling in the absence of any history of trauma or injury. He was noted to have a soft, fluctuant, non-tender mobile swelling that felt 'like bag of water' under the scalp which shifted with head movement and clearly crossed suture lines. Physical examination was otherwise normal. He was delivered by emergency caesarean section for failure to progress with face presentation at 36 weeks' gestation and weighed 2.55 kg. There was evidence of bruising over his face and the fronto-parietal area of the scalp at the time of birth that settled within the next few days.

His skull x-ray revealed a soft tissue swelling and there was no evidence of fracture. On MRI the fluid collection was identified as subaponeurotic or subgaleal that was overlying the vertex and parietal region. The brain and extra-axial spaces were unremarkable.

The lesion resolved spontaneously without intervention by 17 weeks.

Figure 1 Skull x-ray showing soft tissue swelling extending from the supraorbital ridge to the nape of the neck (fluid collection in the subaponeurotic plane).

Figure 2 Ultrasound of the cranium showing fluid collection external to the calvarium, confirming the subaponeurotic plane of fluid collection.

Case 4

A male infant presented at 4 weeks of age with scalp swelling. He was born by emergency caesarean section at 39 weeks for failed forceps and ventouse attempt. No evidence of scalp bruising or swelling was seen at the time of birth or during newborn examination. At 4 weeks he

was noted to have an ill-defined fluctuant swelling over the occipital area that was clearly mobile and non-tender. A clinical diagnosis of subaponeurotic or subgaleal fluid collection was made and no cranial imaging was performed. The lesion resolved gradually without intervention over the next 8 weeks.

Figure 3 MRI (coronal FLAIR sequence). The scalp swelling is seen over the posterior parietal region centrally and extending slightly towards the left. FLAIR sequence was specifically performed to suppress the signal return of CSF and confirmed the collection was of the same signal intensity as the CSF (compared to the fluid in the left ventricle).

In all four cases there was no excessive increase in the head circumference at presentation due to the mobile and fluctuant nature of the swelling (table 2).

INVESTIGATIONS

1. Full blood count – to assess haemoglobin, haematocrit and platelet count
2. Clotting profile – to look for significant coagulopathy leading to subaponeurotic haemorrhage as seen in haemophilia which can be associated with intra- and extracerebral haemorrhage
3. Imaging
 - A. x-ray – to rule out fracture
 - B. ultrasound of the head – will confirm the diagnosis of subaponeurotic or subgaleal collection but will not give any information about the nature of the fluid
 - C. MRI – superior to CT as it does not involve radiation and is easier to perform in this age group (feed and wrap technique); will also give information about the nature of the fluid.

DIFFERENTIAL DIAGNOSIS

1. Non-accidental or accidental head injury leading to subaponeurotic or subgaleal haemorrhage – there may be evident history of trauma or other clues supporting child abuse
2. Coagulation disorders such as haemophilia
3. Subaponeurotic haemorrhage due to traumatic labour – early onset and often associated with vacuum extraction/forceps delivery or failure to progress
4. Neonatal extracerebral fluid collections such as caput succedaneum and cephalhaematoma.

OUTCOME AND FOLLOW-UP

There was spontaneous resolution of the swelling in all four cases a few weeks after the onset of scalp swelling.

DISCUSSION

Scalp swellings are common in infants and have recently been reviewed by Williams *et al.*¹ The most common scalp swellings are caput succedaneum and cephalhaematoma and both are more commonly associated with instrumental delivery or difficult labour.

The subaponeurotic or subgaleal space is the area between the scalp aponeurosis and peri-cranium extending from the supraorbital ridge to the nape of the neck from anteriorly to posteriorly and laterally to the ears. The subaponeurotic layer is made up of multiple sheets of vascularised connective tissue that are able to glide over each other. The highly vascular nature of this tissue increases the risk of bleeding which may be significant, and subgaleal or subaponeurotic haemorrhage occurs due to the rupture of emissary veins which are connections between dural sinuses and scalp veins. Haemorrhage can occur into this large space during delivery causing hypovolaemic shock early in the perinatal period. Subaponeurotic or subgaleal haemorrhage is most often associated with vacuum extraction or forceps delivery, but it can occur spontaneously.^{2,3}

Subaponeurotic or subgaleal fluid collections are thought to be rare and present later. These four cases all presented within a 6-month period in a mid-sized district hospital with a birth rate of 3400 per year. These scalp fluid collections were clinically distinct with features typical for fluid in the subaponeurotic or subgaleal space, that is, mobile, compressible fluid collection with often a prominent fluid

Table 1 Details of 15 cases of subaponeurotic fluid collections

Age at presentation at York District Hospital (weeks)	Gestation (weeks)	Delivery	Neonatal scalp appearance	Presentation	Imaging	Treatment	Age at resolution (weeks)
8	41	EmLSCS	Normal	Cephalic	USS, skull x-ray, MRI	Conservative	11
4	40	EmLSCS	Normal	Cephalic		Conservative	7
14	36	EmLSCS	Face+scalp bruising	Face	Skull x-ray, MRI	Conservative	17
4	39	EmLSCS, failed forceps/ventouse	Normal	Cephalic		Conservative	12
<i>Hopkins et al⁴</i>							
18	40	Ventouse	Cephalhaematoma, resolved at 2 weeks	Cephalic	USS, skull x-ray	Conservative	42
13	40	Ventouse, 3 failed forceps, EmLSCS	Large caput resolved at 4 weeks	Cephalic	USS, skull x-ray	Aspiration×2	26
3	41	Ventouse	Normal	Cephalic	USS, skull x-ray	Conservative	7
3	39	NVD	Normal	Cephalic	USS, skull x-ray	Conservative	6
8	38	NVD	Normal	Cephalic	USS, skull x-ray	Conservative	10
6	40	Failed ventouse, low forceps	Normal	Cephalic	USS, skull x-ray	Conservative	15
<i>Schoberer et al⁶</i>							
7		Ventouse		Cephalic	USS, MRI, CT	Aspiration×2	
8		EmLSCS, failed external cephalic version		Breech	USS	Aspiration	
8		Ventouse		Cephalic	USS, CT	Aspiration	
8		Ventouse		Cephalic	USS, CT	Conservative	
8		Ventouse		Cephalic	USS	Conservative	

Mean age presentation (n=15): 7.5 weeks; mean age at resolution: 10 weeks. Presentation: cephalic 14, breech 1.

Mode of delivery: EmLSCS 6 (three with attempted instrumental delivery), ventouse 6 (attempted ventouse 9), forceps 1 (attempted forceps 2), normal delivery 2;

EmLSCS+instrumental 13, instrumental total 10.

EmLSCS, emergency lower segment caesarean section; NVD, normal vaginal delivery; USS, ultrasound scan.

Table 2 Obstetric details of four cases born at York District Hospital

Initials	Case 1	Case 2	Case 3	Case 4
Parity	0	1 (previous CS)	0	0
Date of birth	12.12.08	23.5.09	13.2.09	10.6.09
FH/PMH	Nil of note	Nil of note	Nil of note	Nil of note
Gestation	41+0	40+2	36+2	38+2
Onset of labour	Spontaneous	Spontaneous	Induced (SRM at 36+1)	Spontaneous
Augmented	No	No	Yes	No
FBS during labour	Twice	No	No	No
FSE	Yes	No	No	No
Dilatation at delivery	5 cm	Fully	Fully	Fully
Mode	Emergency CS	Emergency CS	Emergency CS	Emergency CS
Reason	Abnormal CTG	Failure to progress	Brow presentation	Failed forceps
Instrumental	No	No	No	Kiellands
Complications during caesarean section	No	No	Disimpaction needed vaginally	High BMI
Birthweight (g)	2700	3755	2550	3270
Apgars (1 min, 5 min)	8, 10	9, 10	8, 10	9, 10
Cord gases (ven, art)	7.21, 7.18	7.33, 7.32	7.30, 7.29	7.26, 7.21
Clotting screen	Normal	Normal	Normal	Normal

BMI, body mass index; CS, caesarean section; CTG, cardiotocograph; FBS, fetal blood sampling; FSE, fetal scalp electrode; FH/PMH, family history/past medical history; SRM, spontaneous rupture of membranes.

thrill. The fluid moved with the position of the head and clearly crossed suture lines. They were clinically very distinct from other scalp swellings in infancy. Although all cases in our series were born by emergency caesarean section and one of the four experienced a failed forceps delivery, but there were no unusual features in these cases that could be considered to be specifically relevant to the aetiology of subaponeurotic or subgaleal collection presenting after the first 2–3 weeks of life.

Hopkins *et al*⁴ reported a series of seven cases (six were infants and one a 7-year-old child) that presented over a 4-year period with subaponeurotic fluid collections. Mean

age at presentation was 9 weeks. Of the six cases that presented in infancy, four were born via ventouse delivery while the remaining two were spontaneous vaginal deliveries. All six had skull x-rays and there was no evidence of fractures. Ultrasound of the head confirmed scalp fluid swellings with no intracranial extension or haemorrhage. The fluid was seen to cross the sutures and could be chased over the vault. They postulated that the cause of the swellings were small subaponeurotic bleeds at delivery which were masked by soft tissue swelling which may have gradually liquefied with further fluid accumulation due to exudation resulting in increase in size and later presentation.

They also postulated that there could have been a disruption in lymphatic drainage with resultant accumulation of fluid over several weeks. They aspirated fluid from the lesion in one case and identified clear fluid. All resolved spontaneously between 2 and 24 weeks.

Schoberer *et al*⁵ reported a series of five cases of subaponeurotic fluid collection, four of which were large in size, presenting at 7–8 weeks after birth. Four of the infants were delivered by ventouse extraction and one was delivered by caesarean section after failed external cephalic version. In all cases ultrasound showed a compressible lesion of low echogenicity with no cyst wall and no flow signals on colour-coded duplex sonography. One patient underwent MRI, three had CT scan and all had normal intracranial findings, with no extra-cranial connections, skull fractures or abnormal vascular markings. In this case series fluid was aspirated in three cases (twice in one case) and it was interesting to note that the fluid re-accumulated after aspiration on all three occasions. The fluid was serosanguinous in appearance and negative for microbiological studies. Further analysis of the fluid showed a high concentration of β -trace protein, and β 2-transferrin was present in all aspirates within the normal range for CSF. They concluded that the fluid collections, as in the series by Hopkins *et al*,⁴ appeared to be related to traumatic labour, which was also supported by the serosanguinous nature of the fluid aspirates, and that the β 2-transferrin and β -trace protein indicated the presence of CSF in all aspirates. They postulated that the origin of the CSF may have been due to microfractures undetectable by neuroimaging or disruption of emissary or diploic veins that connect intracranial venous sinuses with superficial veins of the scalp.

When considering the data available on all 15 cases that presented in infancy (excluding the 7-year-old boy of the Hopkin *et al* study) (table 1), the common clinical finding at presentation was of a distinct, highly characteristic scalp swelling of short duration, detectable at a mean age of 7 weeks that resolves spontaneously on average 3–4 weeks later. There is a strong association with cephalic presentation and instrumental delivery with only 2/15 (13%) cases having normal delivery, 9/15 (60%) having ventouse or attempted ventouse delivery, 2/15 (13%) having forceps delivery and 6/15 (40%) being born via caesarean section. There is no history of significant scalp injury or swelling recorded on newborn examination. There is no associated skull fracture or intracranial haemorrhage and the prognosis is good with spontaneous resolution in all cases. This swelling is not associated with excessive increase in the head circumference as the swelling is very mobile, fluctuant and shifts with the position of the head. The fluid is serosanguinous in nature with some indication that it may originate from CSF, although the exact aetiology of the collection is not clear. It would appear that aspiration of the fluid is not helpful therapeutically or diagnostically and risks introducing infection. If the condition is diagnosed clinically with confidence there is no specific indication for imaging studies or therapeutic intervention.

Non-accidental head injury should always be considered in the differential diagnosis of children with spontaneous

scalp swellings as this can commonly occur in the absence of any supporting history or physical examination. Subgaleal or subaponeurotic haemorrhage has been described in the pattern of injury associated with shaken baby syndrome and other non-accidental head injuries, but such infants are usually unwell in contrast to children with subaponeurotic fluid collections.

If imaging is to be considered in infants with subaponeurotic or subgaleal fluid collections when there are concerns regarding abusive head injury, then a skull x-ray should be performed as an initial investigation to rule out any evident fracture. Ultrasound is then a useful and simple investigation that will confirm the diagnosis of subaponeurotic or subgaleal collection but will not give any information regarding the nature of the fluid. MRI is then a better option to confirm the nature of the fluid as compared to CT because it does not involve radiation and is easier to perform in this age group (feed and wrap technique).

Learning points

- ▶ Subaponeurotic fluid or subgaleal collection is a rare but important cause of scalp swelling in infants.
- ▶ It is different from subgaleal haemorrhage in newborns, which is a life threatening condition; subaponeurotic fluid collection also presents later in infancy and such children are very well at presentation.
- ▶ The aetiology remains uncertain but may be related to traumatic delivery, but it is unclear why it presents later.
- ▶ It is clinically very distinct from other scalp swellings and the fluid in the subaponeurotic or subgaleal space is very characteristic – it is ill defined, mobile, fluctuant and is not limited by sutures.
- ▶ It can be diagnosed clinically without the need for radiological investigations due to the characteristic nature of the swelling, but appropriate imaging studies should be carried out if there are any concerns regarding the nature of the swelling.
- ▶ As the swelling resolves spontaneously without any intervention, no treatment is needed.

Competing interests None.

Patient consent Obtained.

REFERENCES

1. Williams H. Lumps, bumps and funny shaped heads. *Arch Dis Child Educ Pract Ed* 2008;**93**:120–8.
2. Plauché WC. Subgaleal hematoma. A complication of instrumental delivery. *JAMA* 1980;**244**:1597–8.
3. Vacca A. Birth by vacuum extraction: neonatal outcome. *J Paediatr Child Health* 1996;**32**:204–6.
4. Hopkins RE, Inward C, Chambers T, *et al*. Sub-aponeurotic fluid collections in infancy. *Clin Radiol* 2002;**57**:114–16.
5. Schoberer A, Yagmur E, Boltshauser E, *et al*. Sub-aponeurotic fluid collections: a delayed-onset self-limiting cerebrospinal fluid fistula in young infants. *Eur J Paediatr Neurol* 2008;**12**:401–3.

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