Allogeneic cartilage used for skull base
plasty in children with primary intranasal
telencephalomeningocele associated
with cerebrospinal fluid rhinorrhea

Abstract Three children with primary
intranasal encephalomeningocele
associated with cerebrospinal fluid
rhinorrhea were operated on at
the Department of Neurosurgery,
Hradec Králové. In two children,
aged 4 and 9.5 years, freeze-dried al-
logeneic costal cartilage was glued
into the skull base defect. This plug-
ing was covered up with deep-
frozen allogeneic fascia lata. In the
third child, an only 1-year-old boy,
after transection of the neck of the
encephalomeningocele freeze-dried
allogeneic dura mater was glued on
extradurally and deep-frozen alloge-
neic fascia lata applied intradurally.
The cerebrospinal fluid rhinorrhea ceased immediately after surgery.
Spontaneous atrophy of the intrana-
sal portion of the encephalomeningo-
cele was demonstrated respectively
11, 1, and 7 years postoperatively on
computed tomography. To evaluate
cartilage healing histologically, the
extracted allogeneic cartilage used
for orbital roof plasty after 4 months
was examined. The extent of spotty
regressions represented about 7% of
the tissue volume. It is stressed that,
once diagnosed, intranasal encepha-
lonemengocele associated with cere-
brospinal fluid rhinorrhea should be
operated on for prevention of menin-
gitis as soon as possible.

Key words Skull base plasty
Allogeneic costal cartilage
Allogeneic dura mater
Allogeneic fascia lata
Intranasal encephalomeningocele
Cerebrospinal fluid rhinorrhea

Introduction

Primary intranasal encephalomeningocele (PIEMC) is
considered a developmental anomaly which may be diag-
nosed clinically at any age [4, 16]. It passes through the
lamina cribrosa into the nasal cavity and presents as a gray-
blue polypoid mass of varying size between the middle tur-
binate bone and the nasal septum [6, 24].

Clinically, PIEMC may be diagnosed on the basis of (1)
widening of the bridge of the nose [9, 25]; (2) cerebrospi-
nal fluid (CSF) rhinorrhea [4, 20]; (3) repeated episodes of
meningitis [3, 4, 8, 9, 18]; (4) rhinoscopy [19]; and (5)
Fürstenberg’s sign, i.e., when compression of the jugular
veins produces swelling and pulsation of the mass instead
of nasal polyp [12, 18].

Laboratory proof of CSF in rhinorrhea associated with
PIEMC can be obtained (1) biochemically, by showing in-
creased glucose levels, or (2) immunologically, by demonstrating the presence of an extra band of transferrin, β2-transferrin, which is pathognomonic of CSF [7].

Radiographically, PIEMC is demonstrated especially by isotope cisternography [3, 5, 9, 18], computed tomography (CT) [3, 9, 18, 20], CT cisternography [2, 18], digital subtraction cisternography, and, lastly, magnetic resonance imaging (MRI) [22, 24].

In the differential diagnosis, the most common entity to be taken into account is nasal polyp [2, 3, 25]. However, nasal polyps are rare before the age of 5 years, so CT of the skull should be always performed before a planned polypectomy [20]. With the exception of polyps originating in the posterior ethmoid cells, all ordinary nasal polyps are located lateral to the middle turbinate bone. Almost all PIEMC are situated medial to the middle turbinate bone [12]. Congenital nasal masses, such as gliomas or dermoids (which may have intracranial extension) [2, 8], angiomas, hemangiomas, and/or teratomas may also be seen at the site of the lesion [16]. Mucoceles characterize extend medially into the nasal cavity and the paranasal sinuses, whereas PIEMC more commonly show no lateral wall attachment [24].

In surgery of PIEMC, various materials have been used for plugging of the bony defect in the anterior skull base. These include:

1. Autogeneic grafts: temporal muscle or fascia [4, 9, 13, 19], pericranium, either on one side [5, 6, 13] or on both sides of the dura mater (dura sandwich) [1], fascia lata reinforced by split skin grafts (Symon, cit. [1]), vascularized musculocutaneous flap (Jones, cit. [1]), bone chips collected from the opening of the cranium to seal the bony defect [5], and split calvarial bone graft [24].

2. Allogeneic grafts: freeze-dried dura mater [9, 17, 23, our case], deep-frozen fascia lata (our cases), and costal cartilage (our cases).

3. Synthetic materials: Teflon sheet [4], tantalum mesh [6, 19], and cement (polymethylmethacrylate) [8, 13, 16, 19, 20]. Gelfoam [6] and biological glue were used in some cases [1, 9, our cases].

We present three cases in which a PIEMC associated with CSF rhinorrhea was operated on in children. To obtain an extensive pericranial autograft for double-decked anterior skull base plasty was impossible in a child. Neither a rigid cortical bone graft nor synthetic material was suitable for the situation. To secure a barrier against intracranial infection we also considered the use of allogeneic fascia lata [14] or dura mater [15]. Finally we decided on a soft but solid biological material, allogeneic costal cartilage, glued into the skull base defect and covered up with deep-frozen allogeneic fascia lata.

Fig. 1 Freeze-dried allogeneic cartilage packed in double plastic transparent bags and sterilized by ethylene oxide gas

Materials and methods
Preparation and packaging of cartilage
The costal cartilage was harvested from dead donors aged 18–35 years. The tissue was collected within 18 h of death. Aseptic postmortem tissue excisions were performed in the operating room of the tissue bank after washing and disinfection of the skin and draping with sterile sheets. The cartilage was removed, mechanically processed in laminar flow equipment (removal of muscles, perichondrium, and calcifications), decontaminated by cold shock [10], placed in a sterile glass jar, and stored in the frozen state at a temperature of ~70°C (Mechanical freezer NZ 350/75, Frigera Kolín, Czechoslovakia) or ~80°C (Mechanical freezer REVCO ULT 1786, Rheem Scientific, USA). Given negative serology of the donor (HIV, HBsAg, syphilis), absence of contraindications (clinical history of the donor verified by autopsy), and negative bacteriology of the processed tissue, the grafts were delivered for clinical use.

Another way of harvesting of the cartilage was removal of the sternum with the costal part of the ribs in the autopsy room on opening the thorax cavity. The cartilage was processed mechanically in the same way as aseptically harvested cartilage, decontaminated, and bacteriological swabs taken. Given negative serology and bacteriology, the grafts were freeze-dried (Equipment LZ 9, Frigera Kolín, Czechoslovakia) and either (1) packed in double transparent plastic bags and sterilized by ethylene oxide gas, or (2) placed in a sterile glass jar and sterilized by gamma radiation at a dose of 25 KGY (Radiation Sterilization Center Bioster, Veverská Bítýška, Czech Republic). The freeze-dried grafts were stored at room temperature until clinical use (Fig. 1).

Preoperative and peroperative preparation of cartilage
The freeze-dried graft was rehydrated in sterile physiological saline solution 12 h before surgery. The cartilage thus became soft and could be shaped with a scalpel or rongeur to fit the bone defect. The deep-frozen graft could be shaped after about 30 min at room temperature.

Case reports
Case 1
In a 3-year-old girl, hypertrophy of the right middle turbinate bone without any polyp was diagnosed by nasal inspection. Adenotomy for pollinosis was performed. At 4 years of age the patient struck her