

Case report

Clinically Significant Anti-M Antibodies in a 15-year-old Girl with Pituitary Adenoma

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Abstract

This article presents a rare clinical case that highlights a serious problem of transfusion preparation in neurosurgical patients. A 15-year-old girl with pituitary adenoma was found to have clinically significant anti-M antibodies with IgG activity, capable of causing hemolysis. The uniqueness of the case lies in the absence of a transfusion history and the need for surgery in the presence of anemia with a high risk of massive bleeding. The main difficulty was the shortage of compatible M-negative donor components in the blood bank, which required advanced immunohematological testing and individualized selection of red blood cell units. Despite these challenges, transfusion readiness was achieved, and the surgery was completed without complications. This case emphasizes the necessity of routine antibody screening, establishing registries of rare donors, and applying a “readiness without transfusion” strategy when facing unpredictable immunohematological findings.

Keywords: anti-erythrocyte antibodies, anti-M, immunohematology, transfusion, antibody screening, pituitary adenoma, individualized selection.

1. Introduction

Antibodies against the M antigen (anti-M) of the MNS blood group system are relatively rare and, in most cases, represent naturally occurring or cold-reactive antibodies that do not cause clinically significant hemolysis of red blood cells. Typically, such antibodies are active at low temperatures, around 4 °C, and have minimal impact on the body at the normal core temperature of 37 °C [1].

However, in some cases anti-M antibodies may acquire clinical significance, particularly when an IgG component is present and active at 37°C. In such situations, they can cause acute or delayed hemolytic transfusion reactions and may also be responsible for hemolytic disease of the newborn (HDN) [2,3]. Despite

reports of individual cases, there is very little published data on clinically significant anti-M antibodies in children, particularly in patients with central nervous system tumors, which creates a knowledge gap and complicates transfusion practice.

The aim of the present work is to describe a rare clinical case of detecting clinically significant anti-M antibodies in a 15-year-old neurosurgical patient without transfusion history and to emphasize the importance of preoperative antibody screening and individualized transfusion preparation.

2. Clinical Case Description

A blood sample from a 15-year-old girl diagnosed with a pituitary adenoma was submitted to the Immunohematology Laboratory of the Transfusion Department, JSC “National Center for Neurosurgery” for routine ABO and Rh typing, as well as antibody screening. All immunohematological studies were performed using the microcolumn gel agglutination

method, which ensures high sensitivity and specificity [4].

Figure 1 shows agglutination in the microcolumn with anti-A and anti-D, as well as with standard B red cells, confirming the blood group A RhD+. An additional immunological finding was the presence of anti-A1 agglutinin (arrow).

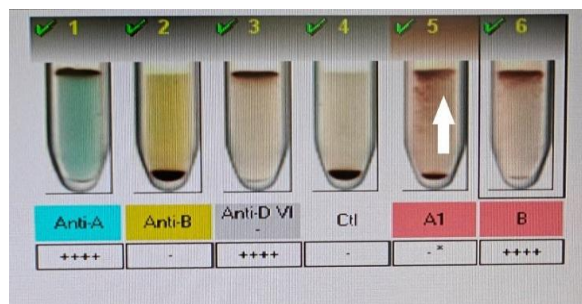


Figure 1 – ABO and RhD blood group determination (agglutination with standard A1 red cells)

According to the literature, anti-A1 antibodies occur in 1–8% of individuals with blood group A, more often in subgroup A2 carriers (up to 20%) and A2B (up to 35%) [5]. In most cases, these are naturally occurring cold IgM antibodies with no clinical significance. However, if active at 37°C or containing an IgG

component, anti-A1 antibodies may cause transfusion incompatibility and hemolytic complications, requiring careful interpretation during pretransfusion testing. Antibody screening in the indirect antiglobulin test (IAT) using a three-cell panel was positive (Figure 2).

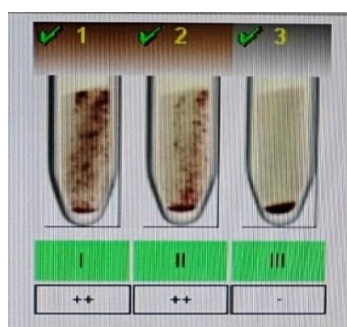


Figure 2 – Antibody screening (indirect antiglobulin test)

The antibodies were reactive at 37°C, making them clinically significant and increasing the risk of hemolysis if incompatible blood were transfused.

Autocontrol and the direct antiglobulin test (DAT) were negative (Figure 3), excluding autoantibodies.

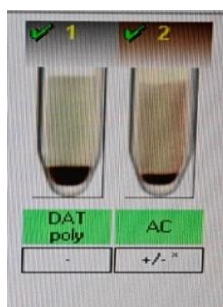


Figure 3 – Direct antiglobulin test and autocontrol

To verify the results, a fresh blood sample was requested, and the patient’s history and planned surgical volume were clarified. The medical history confirmed no prior transfusions, excluding post-transfusion sensitization. To eliminate preanalytical or technical errors, all studies were repeated on the new sample,

yielding identical results. This confirmed the presence of true irregular red cell antibodies requiring further identification and clinical evaluation.

The detected antibodies showed reactivity at 37 °C and produced positive results in compatibility testing by IAT (Figure 4).



Figure 4 – Crossmatch testing (positive agglutination with donor red cells)

To ensure transfusion readiness, samples were sent to the reference laboratory of the Scientific Production Center for Transfusiology (SPCT). Extended red cell phenotyping, antibody identification, and individualized donor unit selection were performed. This approach is consistent with international recommendations [6], which require advanced immunohematological analysis and confirmation in specialized laboratories when clinically significant irregular antibodies are identified.

Phenotyping and compatibility testing results are presented in Table 1 and Figures 5–8. The findings confirmed clinically significant anti-M antibodies in a patient without transfusion history. According to the literature, anti-M antibodies may arise naturally without transfusions, though they rarely show activity at 37°C [7–9]. Thus, phenotyping established specificity to the M antigen of the MNS system and guided the selection of safe donor components.

Table 1 – Results from the SPCT Laboratory

Parameter	Results
Patient	15-year-old girl
Diagnosis	Pituitary adenoma (transnasal approach, planned surgery)
Hemoglobin at admission	90 g/L
Blood group	A RhD+; extraagglutinin present – agglutination with A1 red cells intensity 3+
Indirect antiglobulin test	Positive, intensity 3+, specificity to M antigen of MNS system established
Phenotype	CcDEe, Kell negative, antigens present: K, Kp(b), Jk(a), Jk(b), N, s, Fu(a), Fu(b); M antigen absent
Anticipated transfusion needs	Expected Hb drop during/after surgery, predicted need for 2 units of red cell concentrate

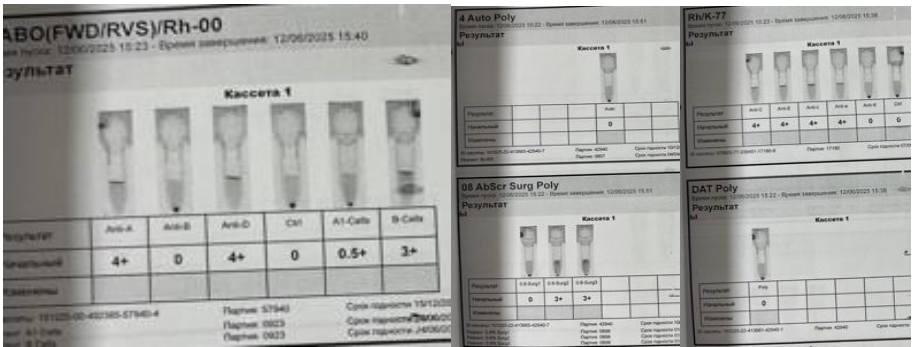


Figure 5 – Phenotyping and compatibility testing results: A) ABO and Rh blood group typing; B) Rh antigens and direct antiglobulin test; C) Autocontrol and indirect antiglobulin test

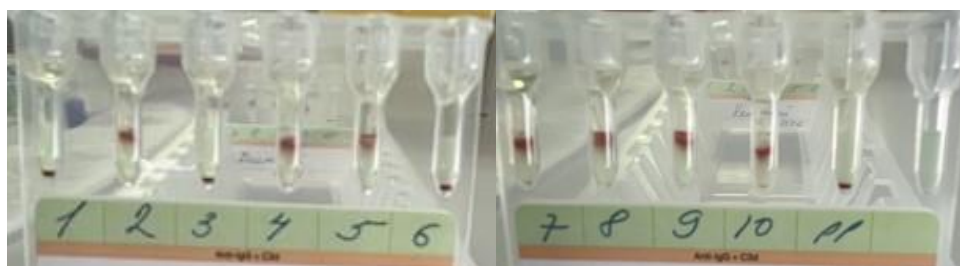


Figure 6 – Identification of irregular red cell antibodies – specificity to M antigen of the MNS system established



Figure 7 – Rare antigen profile



Figure 8 – Crossmatch testing

3. Discussion

Among the 47 blood group systems officially recognized by the International Society of Blood Transfusion (ISBT), ABO and Rh are of key importance in daily transfusion practice [10]. However, non-routine systems such as MNS may play a significant role in selecting red cell components and ensuring transfusion safety [6].

The MNS system comprises 46 antigens, with M, N, S, and s being the most relevant. While most antibodies of this system are clinically insignificant, anti-M antibodies can sometimes pose a risk of transfusion complications, particularly when containing an IgG component [11,12].

According to published data, the frequency of spontaneous anti-M antibodies among donors varies from 1:2500 to 1:5000, depending on antigen phenotype (more frequent in M+N- cells). Anti-M antibodies are

often found in individuals without prior transfusion or pregnancy [13]. Typically, they are naturally occurring cold IgM agglutinins active below 37°C and not complement-binding. Such antibodies are not detected under standard 37°C incubation and do not hinder transfusions. However, if active at body temperature and/or reactive in the antiglobulin test, they should be considered potentially clinically significant [14].

Anti-M antibodies have been detected in both children and adults, with some authors linking their emergence to prior bacterial infections [7,8]. They have also been identified in pregnant women whose children were later found to lack the M antigen [3,15]. In hematology patients receiving multiple transfusions, anti-M may coexist with antibodies of other systems (Rh, Kell, Kidd, Duffy) [16]. Reports of anti-M antibodies in pediatric oncology patients are rare,

highlighting their unpredictability [9]. Our case parallels these findings, describing anti-M in a child with a tumor, also without prior transfusions.

In this case, the absence of transfusion history ruled out sensitization through prior exposure. Since the antibodies were reactive at 37 °C in the antiglobulin test, we concluded that the detected anti-M antibodies were naturally occurring with an IgG component, making them clinically significant. A prior infection may have triggered their development.

Given the patient's preoperative anemia, transfusion readiness with individualized donor selection was ensured. Two phenotypically matched M-

negative red cell units, compatible by IAT, were reserved.

Although most descriptions of anti-M antibodies relate to neonatal hemolytic disease or transfusion events, clinically significant anti-M in neurosurgical patients are extremely rare. Our case is likely the first description of anti-M antibodies with an IgG component in a child with anemia and risk of intraoperative bleeding. This underscores the need for careful preoperative antibody screening and special attention in planning transfusion therapy for neurosurgical patients. In our case, surgery proceeded without hemorrhage and no transfusion was required.

4. Conclusions

Pediatric patients with clinically significant antibodies such as anti-M require particularly thorough transfusion preparation and individualized blood component selection. This case demonstrates a rare detection of anti-M antibodies with an IgG component in a child without transfusion history, highlighting the necessity of universal antibody screening regardless of patient age or clinical profile.

Our experience emphasizes the importance of establishing local and national registries of phenotyped donors with rare antigen profiles [17], which would facilitate rapid transfusion readiness. Practical measures also include advance reservation of compatible units and close collaboration with reference laboratories and blood centers.

The "readiness without transfusion" strategy implemented in this case proved effective and may serve as a model for managing patients with rare antibodies, particularly when facing high intraoperative bleeding risk.

Ethical Approval. This work complies with the Declaration of Helsinki. Informed consent was obtained from the patient's legal guardians. No personal data are disclosed.

Conflict of Interest. The authors declare no conflict of interest.

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Гипофиз аденомасы бар 15 жастағы қыздағы клиникалық маңызды анти-M антиденелер

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Түйіндеме

Бұл мақалада нейрохирургиялық науқастарда трансфузиялық дайындықтың күрделі мәселесін айқындайтын сирек клиникалық жағдай баяндалады. Гипофиз аденомасы бар 15 жастағы қызда гемолизге әкелуі мүмкін IgG-белсенділігі бар клиникалық маңызды анти-M антиденелер анықталды. Жағдайдың бірегейлігі – науқаста трансфузиялық анамнездің болмауы, бірақ анемия аясында жоспарлы ота және массивті қан кету қаупінің болуы. Негізгі қиындық – қан банкіндегі сәйкес келетін анти-M донор компоненттерінің тапшылығы. Бұл терең иммуногематологиялық зерттеулер мен эритроцитарлы компоненттерді жеке таңдауды талап етті. Қиындықтарға қарамастан, трансфузиялық дайындық қамтамасыз етіліп, ота асқынусыз өтті. Аталмыш жағдай иммуногематологиялық күтпеген табылымдар жағдайында антиденелерге рутинді

скрининг жүргізудің, сирек донорлардың регистрлерін қалыптастырудың және «трансфузиясыз дайындық» стратегиясын қолданудың маңыздылығын айқындайды.

Түйін сөздер: антиэритроцитарлық антиденелер, анти-М, иммуногематология, трансфузия, антиденелерді скринингтеу, гипофиз аденомасы, жеке іріктеу.

Клинически значимые анти-М антитела у девочки 15 лет с аденомой гипофиза

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Резюме

В статье представлен редкий клинический случай, подчеркивающий актуальную проблему трансфузионной подготовки у нейрохирургических пациентов. У 15-летней девочки с аденомой гипофиза были выявлены клинически значимые анти-М антитела с IgG-активностью, потенциально способные вызвать гемолиз. Особенностью случая заключается в отсутствии трансфузий в анамнезе и необходимости операции на фоне анемии с высоким риском массивного кровотечения. Основная трудность заключалась в дефиците совместимых М-негативных донорских компонентов в банке крови, что потребовало углубленных иммуногематологических исследований и индивидуального подбора эритроносодержащих сред. Благодаря предпринятым мерам удалось обеспечить адекватную трансфузионную готовность, и операция прошла без осложнений. Данный случай акцентирует необходимость рутинного скрининга антител, формирования регистров редких доноров и применения стратегии «готовность без трансфузии» в условиях непредсказуемых иммуногематологических находок.

Ключевые слова: антиэритроцитарные антитела, анти-М, иммуногематология, трансфузия, скрининг антител, аденома гипофиза, индивидуальный подбор.